

University of Maryland Language Science NRT Program

INTERNAL EVALUATION, FOURTH YEAR REPORT

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UNIVERSITY OF MARYLAND | COLLEGE OF EDUCATION

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Overview of Internal Evaluation Activities

Funded by the National Science Foundation, the University of Maryland's Language Science National Research Traineeship (NRT) Program was designed to transform interdisciplinary STEM graduate education by training and educating graduate students to become engaged and adaptable leaders in language science (UMD Language Science Center, n.d.). Housed in the UMD Language Science Center (LSC), the NRT program provides funding (stipends, travel/research assistance) to graduate students ("NRT students" or "NRT fellows") in multiple language science fields of study. NRT students are expected to participate in a range of professional, research, outreach, and leadership activities designed to promote their development as interdisciplinary scholars. We provide an overview of UMD's NRT Program goals below.

Program Goals

Student Goals

(1) To enhance doctoral student agency as interdisciplinary researchers

- a) to enhance student research skills
- b) to enhance student confidence and ability to pursue research independently
- c) to enhance student confidence and ability to collaborate on research with others and be an effective member of a research team
- d) to increase the likelihood that students will take risks and work in areas outside their comfort zone
- e) to increase student ownership and contributions to their interdisciplinary program

(2) To change the nature of student professional networks

- a) to be more diverse (include more colleagues in other disciplines and people using different methods or approaches)
- b) to be larger (more people in them)
- c) to increase the value of the information, feedback and ideas networks provide

(3) To enhance student understanding of particular research problems and the relationship between research problems and contexts

- a) to have improved understanding of the relationship between the particular research problem they are studying and macro issues (zoom in/out)
- b) to have improved understanding of how the particular research problems they are studying relate to knowledge and research in other fields and disciplines
- c) to have improved understanding of how the particular research problems they are studying relate to real world applications and problems (such as in industry, policy, clinical or educational practice)

(4) To enhance student ability to communicate about research problems and their contexts, and adjust their communication according to the audience, channel, and goals

- a) to be better able to communicate the details of a research problem and its relationship to macro issues, knowledge and research in other fields and disciplines, and real world applications and problems
- b) to be better able to adjust their communication for different audiences (e.g. scientists, government officials, high school students, etc.)

- c) to be better able to adjust their communication for different goals (e.g. informing, entertaining, persuading)
- d) to be better able to communicate through different channels (e.g. journal articles, conference presentations, websites, blog posts, various informal interactions)

(5) To enhance student ability to choose and successfully pursue a career within or outside academia

- a) to have improved understanding of their personal interests, skills, and values, and how they fit potential careers.
- b) to have improved understanding of the career options available
- c) to be better able to communicate how their knowledge and skills are applicable to their career of choice.

Graduate Education Goal

(6) To share, and help other graduate programs adopt, best practices in interdisciplinary graduate education that emerge from the NRT project

Institutional Change Goal

(7) To reduce organizational constraints to, and facilitate, faculty collaboration on interdisciplinary research

Questions and Methods

This document is a fourth-year, internal evaluation of the University of Maryland's Language Science NRT Program. We provide an assessment of NRT progress to date. We use case study methods (Merriam, 1998; Yin, 2009) to evaluate the NRT program's progress towards its seven goals. Specifically, our evaluation is guided by the following questions:

- To what extent has the NRT program achieved its seven stated goals?
- Which elements of the program were most influential in accomplishing these goals?
- Are there challenges or context constraining the NRT program, or LSC more generally, from achieving its goals?

Case study approaches emphasize the value of multiple data sources to enhance the reliability and validity of findings (Yin, 2009). Our evaluation draws primarily from qualitative data sources, including: interviews with UMD NRT students, focus groups with NRT students and faculty involved in teaching, mentoring, or advising NRT students, and observations of LSC/NRT-related programs and activities. In Table 1, we provide a description of the data sources we drew from to evaluate UMD's NRT program between Fall 2015 and Spring 2019. University of Maryland's IRB office approved the protocols for our observations, interviews, and focus groups. Faculty and students who took part in focus groups and/or interviews completed a consent form prior to participating. Members of the internal evaluation team transcribed each interview and focus groups recordings.

At the time of writing, we have completed six focus groups, interviewed 18 NRT fellows, conducted exit interviews with nine graduating fellows, and observed approximately 50 hours of NRT programs and activities. We have conducted six institutional informant interviews with key UMD administrators, faculty involved in the NRT program, and UMD graduate school staff. We have additionally reviewed the application materials and progress reports submitted by each NRT fellow. We have completed two waves of an IRB-approved survey that compared the curricular and out-of-classroom experiences of UMD's NRT fellows to language science students

at three peer institutions (University of Connecticut, The Ohio State University, and University of Wisconsin). This survey was also distributed with permission to the students in the NRT program in CMNS, which is named COMBINE. Thus, in reporting the survey results, we also include the COMBINE students' results, where applicable¹.

In addition to these research questions, our team's overall objective is to contribute to the social science research on graduate education practices that facilitate the development of graduate students as interdisciplinary scholars, such as the development of scholarly identity as interdisciplinary scientists, fostering creative collisions between graduate students and faculty from different disciplinary backgrounds, and facilitating graduate student agency. See Appendix B for an overview of the research papers currently under development by the research team.

Internal Evaluation Team Members

Our internal evaluation team consists of researchers in higher education with expertise and interest in graduate education.

- KerryAnn O'Meara (Lead Evaluator): Associate Dean for Graduate Studies and Faculty Affairs, UMD College of Education; Professor, Higher Education; Director, University of Maryland ADVANCE Program
- Dawn Culpepper (Researcher): Doctoral Student, Higher Education, University of Maryland (On team from Summer 2017 – Present)

Former Members:

- Stephanie Hall (Researcher): Doctoral Student, International Education Policy, University of Maryland (On team from Spring 2015-Summer 2017)
- Gudrun Nyunt (Researcher): Doctoral Candidate, Student Affairs, University of Maryland (On team from Summer 2017 – Spring 2018)

¹ Findings from the UMD COMBINE program have been published:

Marbach-Ad, G., & Marr, J. (2018). Enhancing graduate students' ability to conduct and communicate research through an interdisciplinary lens. *Journal of Microbiology & Biology Education*, 19(3).

Findings

UMD's Language Science NRT Program was designed to achieve seven goals organized into three categories. The program aims to provide a transformative experience for graduate students individually and collectively, to innovate within graduate education more broadly, and encourage change at UMD and in the field. We organize our findings in these three categories. In this fourth-year report², we draw primarily from surveys and interviews. In particular, we discuss data primarily drawn from:

1) Survey Results: We present the 2018 and 2019 survey results on the extent to which students had access to opportunities in their doctoral program that could allowed them to develop in the five NRT goal areas. In each goal, we compare UMD students in Wave 1 (2018) to UMD students in Wave 2 (2019). We then compare UMD students to non-UMD students and COMBINE students (when applicable) across survey waves. Because of the small sample size and selection bias in who took the survey, we report mean scores for comparison and benchmarking purposes only. Appendix C includes demographic information on the participants who took the survey in 2018 and 2019 and tables of the mean scores and standard deviations for UMD students, non-UMD students, and COMBINE students (where applicable).

2) Exit Interviews: We conducted 6 interviews with graduating NRT students in Spring 2018, and 3 interviews with graduating NRT students in Spring 2019. These interviews will continue in 2019 and 2020.

3) Institutional Informant Interviews: We conducted 6 interviews with key institutional informants, which included faculty involved in the NRT program and UMD administrators involved in graduate education and interdisciplinary research. These interviews will continue in 2019 and 2020.

Graduate Student Development

(1) To enhance doctoral student agency as interdisciplinary researchers

a) There is some evidence participating in the NRT program has changed the nature of student research interests or enhanced the methodological skills they bring to bear on their research. Most students indicated that their dissertation research had, in some way, been influenced by participating in the LSC's interdisciplinary community. For some, the impact was more concrete, in that their topics focused explicitly on problems that crossed two or more disciplines. For example, one student said:

The LSC for me was extremely instrumental for setting me on this path and making it possible for me to initiate a research program that was this interdisciplinary in these specific ways...In particular, I was not a computational linguist coming in and at the time one of the big parts of the LS program was the external rotation, which was supposed to be a semester doing something outside of your area of core expertise. After some mulling over what would be optimal for me, I ended up doing a computational rotation and getting totally hooked on that computational methodology and the types of questions being

² In our third-year report, we presented findings from data collected from 2015-2018 and drew primarily from qualitative data sources including student interviews and focus groups.

asked and that sort of community. So, I ended up building this research program around the fact that I was originally a linguistic and a cognitive scientist interested in meaning and human language processing, but now, I had these computational interests and so my research program became this effort to bridge those different areas.

Other students discussed how the direction or nature of their experiments were influenced by a theory or discussion they had with a faculty member or student from a different department. One student highlighted this finding when he said:

Most of my research that I've actually done has been within the linguistics department, and I think even without the LSC, I probably would have done a lot of that. But I have done this [method] that no one in my department had really done. So I had to go to the broader language science community, to [Faculty Member A] and [Faculty Member B] who helped me figure out how to set it up, and having connections with other students who had done similar stuff outside of the linguistics department, they were able to help me set it up and figure out how to analyze the data.

Another student said:

The entire first part of that project [her dissertation]...came out of a seminar that I took, which was led by [Faculty Member], in the Hearing and Speech Department...And in terms of the skills and breadth of knowledge that that opened up for me, it's not a massive departure from what I already was doing within my department. And yet, the vast majority of the work I've done is with people in my department, but the initial starting point was generated from that seminar with [Faculty Member], and it's based on a lot of her work.

b) There are some NRT/LSC practices that institutional informants identified as being particularly useful or influential in the NRT/LSC's success in achieving graduate training goals.

a) Multiple Advisors. Several institutional informants mentioned that the practice of having multiple advisors was an innovative strategy for facilitating interdisciplinary training for graduate students. One informant summarized the benefits of having two advisors when he said:

Maybe people shouldn't just have one advisor. I think that that when it works, it works remarkably well. It also gives you an insurance policy against not being able to work with your advisor. I think that this idea that one of the ways to change graduate education is to make more than one person responsible for the student's success...Now, it doesn't mean that there aren't tensions that can develop, because you could have two advisors and they could disagree on what the person should do. But I actually think having an overt discussion of that stuff, if it's possible to have one without it breaking down, that discussion itself is useful.

b) Ownership. Ownership is one of the keys ways in which the LSC facilitates students' agency as interdisciplinary researchers. Several institutional informants suggested that the LSC's emphasis on students identifying their goals and selecting the activities that would help achieve said goals was a unique feature

of the program. The following two quotes from informants help to illustrate this point:

We're saying, "Look, you're responsible for getting the education that you want to get," and so if you're unsure as to what it is you want to do, that can be pretty frightening. But ultimately, they are responsible. Ultimately, it's their career, not my career. – Faculty Member

One is the notion of the program being defined by the students rather than defined by the faculty. So, the activities that are part of the Language Science Center, the talks that are given, the outreach at events, all of this is really driven by what the students want to do rather than by what the faculty think is the best thing for them to do. It's very different from a typical university department where the faculty develop a program of study, and put it through the powers that be...and get it approved and then the students come to it and they take this thing. – Faculty Member

2) We note some areas in which institutional informants indicated there had been less success. One specific activity that the NRT grant proposed included was the creation of interdisciplinary research teams, which according to institutional informants, has not produced the expected results. This finding was mirrored in the feedback received when our team presented preliminary findings at a Language Science Lunch Talk in February 2019, as well as findings from interviews with students. One institutional informant summarized challenges associated with the interdisciplinary research teams in the following quote:

The group research activities really have not taken off...[For] a variety of reasons. Partially it was a lack of foresight on our part as to what it really entailed. We had this notion that we could have summer research topics, it ends up being a lot more complicated partially because every student is on the NRT for only one year or 15 months. But, if there were different research projects every year, the one that that student might be interested in, it might not match them. And, students have a lot already on their plates to then take a solid month, multiple summers, to do something like this. So, there were a lot of mechanistic problems with it that hadn't quite come to the forefront until we started trying to think about how we'd instantiate it and realized it wasn't quite as simple as we thought.

As we noted during the LSLT, while it may be true that the interdisciplinary research teams never "took off" in terms of actual producing research, many of the NRT students noted that process of coming together with an interdisciplinary group of colleagues in and of itself was beneficial. Several participants noted during exit interviews that they had gained significant insight into how interdisciplinary research works. For example, one NRT student said:

The biggest challenge was coming up with a question that would be useful to both sides. We were trying to get a single project that would simultaneously benefit both parties and we realized that would either be really hard or not plausible and so we decided that it would be more useful to try to answer a question from one side of either computation or cognition, but then bring the skills and knowledge that both groups have to bear on that question. I think our biggest challenge was coming up with a question that would be interesting to everyone. We knew we wanted to collaborate on something and build this interdisciplinary team, but it was hard to figure out what the project would be. Once we realized it would be better to focus on one side at a time, it became a little

easier. But it was still hard to come up with a way to tackle these questions using all the skills that everyone had.

Another student expressed a similar experience when she said:

[The interdisciplinary research group] ended up falling apart this year because we all got too busy. That was challenging because you had to communicate your ideas to someone who has a completely different background than you and you're not even sure what the background is. Figuring out what's common ground and what you can assume, the vocab you use. I might call this an entailment, but to someone else, an entailment in linguistics is different than in computer science. It's challenging, but it also makes you understand your work better.

3) Turning to the survey results, there is evidence that UMD NRT students: 1) have access to opportunities that develop their agency as interdisciplinary researchers; 2) Have growing confidence in their abilities as interdisciplinary researchers, and 3) Believe that they are making valuable contributions to their fields and departments. Likewise, nearly all NRT students reported that they participated in activities that contribute to their interdisciplinary research skills such as research talks by faculty and students, meetings with collaborators and research teams, or lab meetings within the last year (See Appendix C, Figures 1-7).

a) Comparing UMD Wave 1 to UMD Wave 2

- Our results suggest that student access to training activities that develop their agency as interdisciplinary researchers remained relatively consistent from last year to this year (Figure 1). For instance, in 2019, UMD students reported only slightly fewer opportunities to take courses in other departments and research problems that were different than the ones they previously studied compared to 2018.
- Figure 2 reports the results on student confidence in their agency as interdisciplinary researchers. UMD students reported slightly greater confidence in their ability to collaborate with a range of professionals compared to 2018. There was a slight drop in UMD students' confidence on their ability to work on research requiring new skills.
- Figure 3 summarizes student perspectives on their agency as interdisciplinary researchers. UMD students in both 2018 and 2019 had positive views of their contributions to their intellectual community and research field and agreed that they had the skills needed to contribute to meaningful research in their field of study.

b) Comparing UMD Students to Other Institutions and Programs

- When comparing UMD NRT students to non-UMD students and COMBINE students, survey results revealed that the UMD NRT program provides more activities intended to foster student agency as interdisciplinary researchers, and there are some differences between UMD NRT students, non-UMD students, and COMBINE students.
- UMD students, non-UMD students, and COMBINE students had about the same access to examples of what interdisciplinary problem solving looks like, role models of interdisciplinary researchers and projects, and encouragement by faculty to collaborate with students and faculty from other departments or programs. UMD students, non-UMD students, and COMBINE students all reported relatively lower levels of confidence in their ability to collaborate with a range of other professionals.

- There were greater differences between UMD students in 2018 and 2019 and COMBINE students in 2017 on two items: opportunities to research problems that are different from what they previously read about and opportunities to work in fields that were previously unknown to them, with UMD NRT students reporting greater access on both items.
- UMD students appeared to have greater access to ownership opportunities over their program compared to non-UMD students in both years, with UMD students in both 2018 and 2019 reporting that they had strong opportunities and encouragement to contribute to the development of their programs by leading and designing events.

Figure 1. Presence of activities in doctoral program that enhance student agency as interdisciplinary researchers

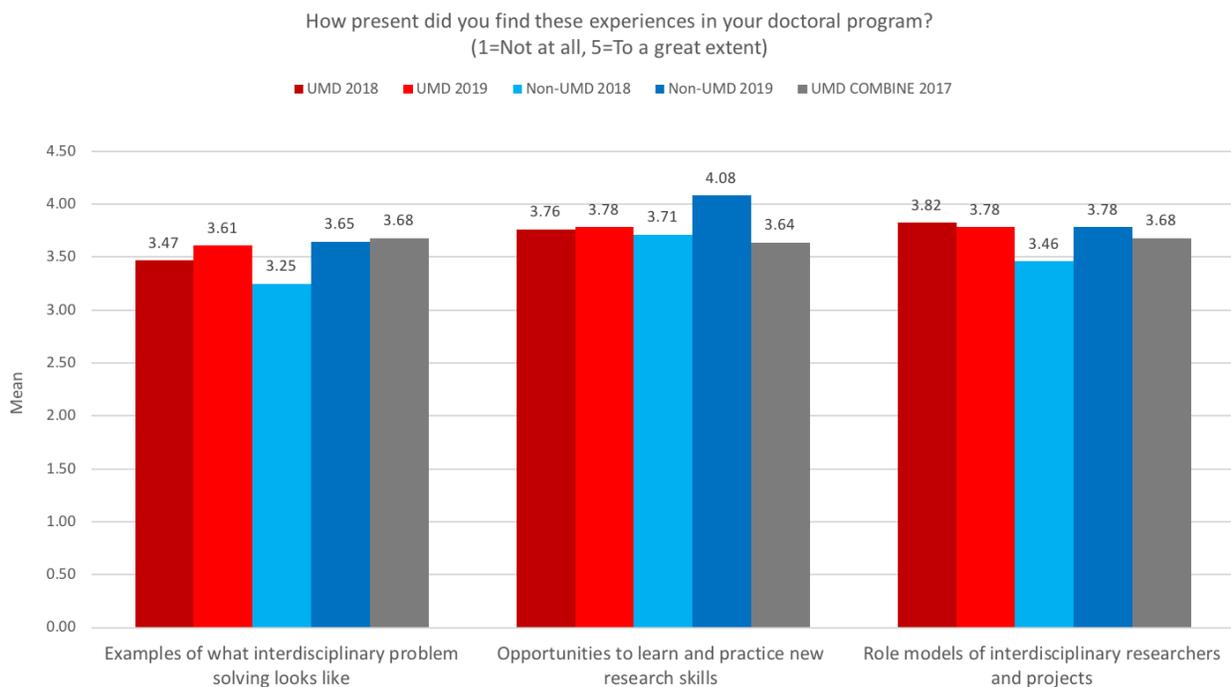


Figure 1 (cont.). Presence of activities in doctoral program that enhance student agency as interdisciplinary researchers

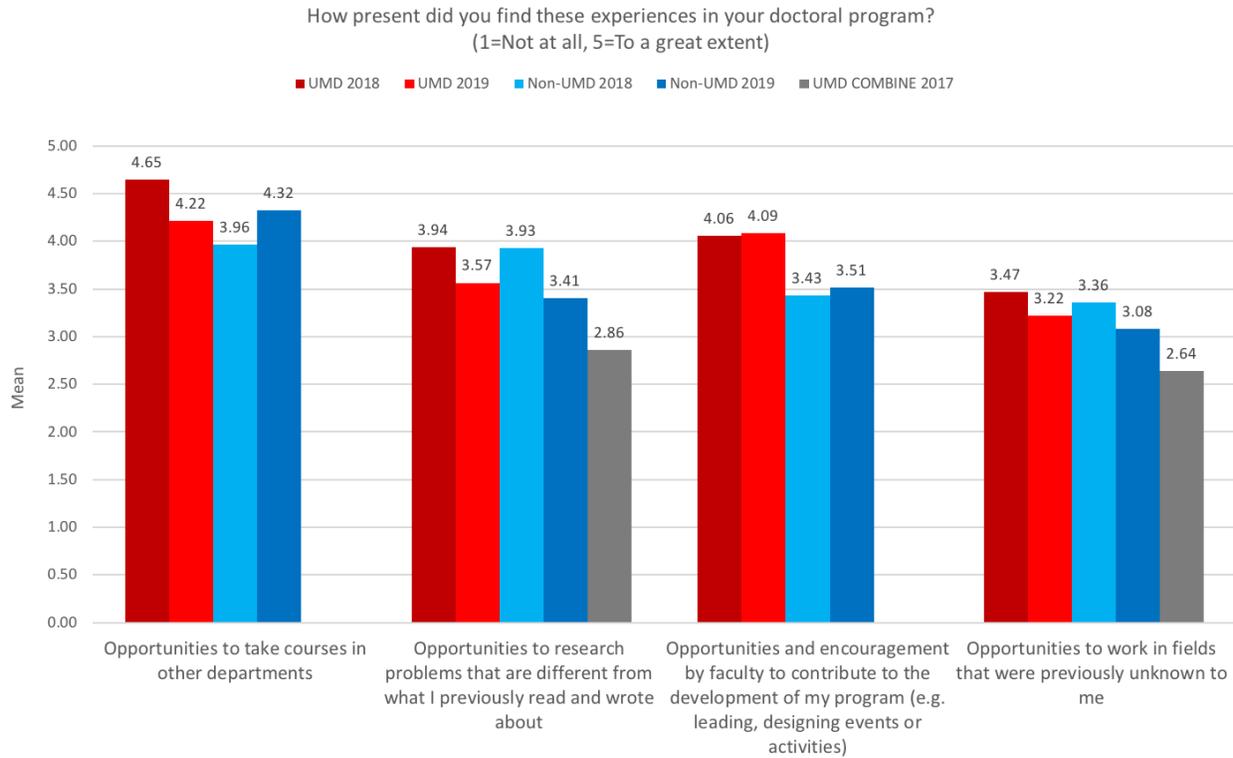


Figure 2. Student confidence in agency as interdisciplinary researchers

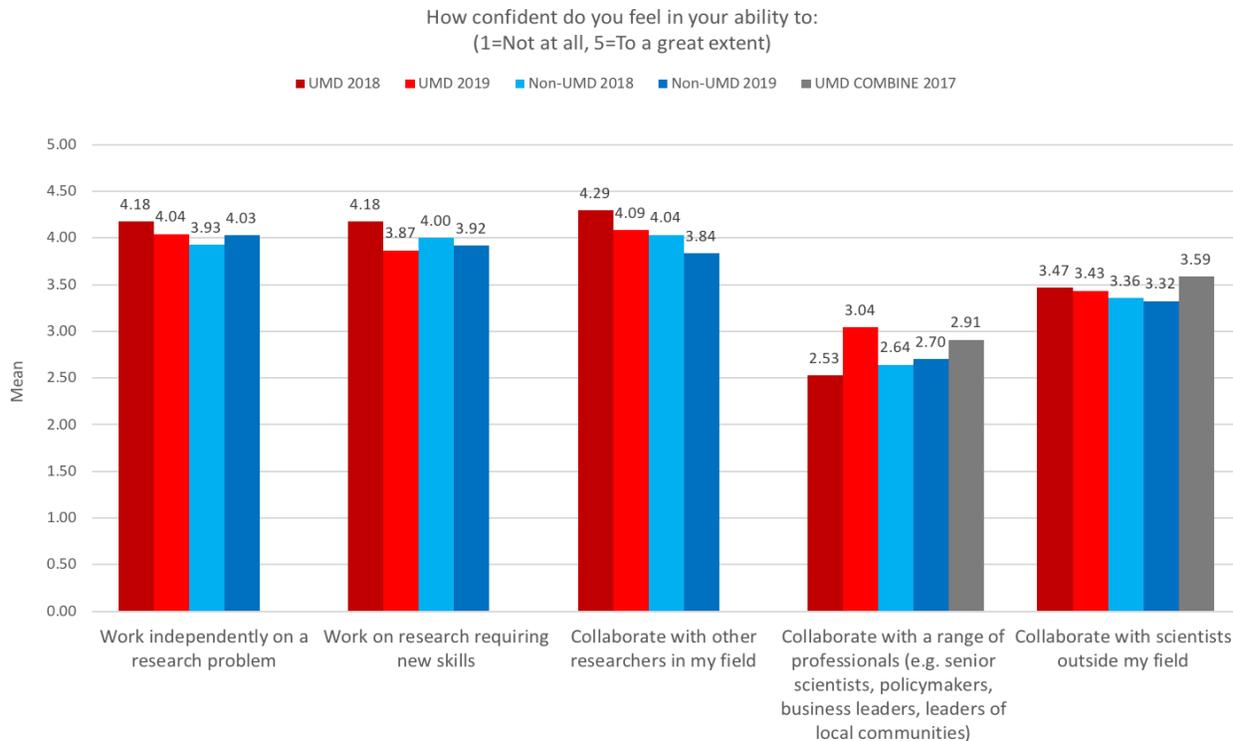
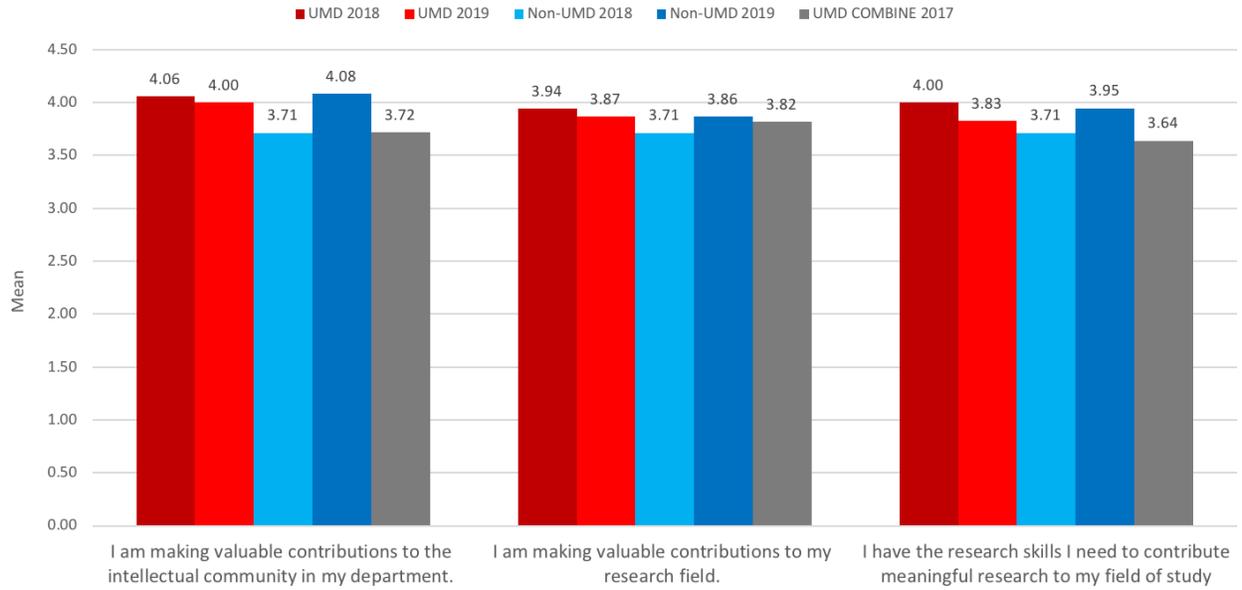


Figure 3. Student perspectives on agency as interdisciplinary researchers

Indicate the extent to which you agree or disagree with the following statements about your own experiences in the last 12 months:
(1=Strongly disagree, 5=Strongly agree)



(2) To change the nature of student professional networks

1) To understand the nature of student professional networks, we analyzed survey responses to the question “Please name the people you have talked about research with in the last year and indicate how frequently you talk with them.” Participants input up to 12 individuals who they considered to be influential contributors to their discussion network. Participants also indicated how frequently they interacted with their network connections and indicated the field of expertise for each network connection (Wave 2 only).

In Table 1, we compare the average participant responses to each question by institution. Overall, we find that the networks of UMD students and peer institutions are relatively similar. Students reported that faculty or postdocs made up the greater number of individuals in their network and most students identified several individuals who use different research methods than their own as members of their network. Relatively few students indicated that their networks were composed of individuals affiliated with other universities or individuals who work outside of academia. Students varied in the amount that they interacted with their network, though appeared to have contacts with whom they interacted with on a daily, weekly, monthly, or annual basis.

In Wave 2, we also asked respondents to indicate which field their network connections were in. Perhaps unsurprisingly, we found the strong presence of disciplinary homophily, wherein most students reported that the members of their discussion network were in the same field as their own (e.g., Linguistics students reported more connections to other linguists, Psychology students reported more network connections with other psychologists). That being said, of the 21 UMD students who completed this section of the survey, 86% indicated that they had at least one member of their discussion network who was outside of their home discipline, compared to 50% of WISC students, 74% of UCONN students, and 79% of OSU students. Thus, we find some evidence that UMD NRT students may have networks with less homophily.

Table 1. Language Science Student Networks

On average, the networks of language science students are composed of:	Individuals who use research methods different than those I typically use		Individuals who are outside my academic program		Individuals affiliated with another university		Individuals who works outside of academia		Students		Faculty or Postdocs	
	<u>2018</u>	<u>2019</u>	<u>2018</u>	<u>2019</u>	<u>2018</u>	<u>2019</u>	<u>2018</u>	<u>2019</u>	<u>2018</u>	<u>2019</u>	<u>2018</u>	<u>2019</u>
	UMD	2	4	1	2	1	2	1	0	2	3	4
UCONN	2	3	1	2	1	1	0	0	2	3	3	4
WISC	2	4	1	2	1	0	1	2	2	3	2	5
OSU	3	3	2	3	0	1	1	0	2	3	3	4

Table 1 (cont.). Language Science Student Networks

On average, students interact with members of their discussion network:	About daily		About weekly		About monthly		A few times a year	
	<u>2018</u>	<u>2019</u>	<u>2018</u>	<u>2019</u>	<u>2018</u>	<u>2019</u>	<u>2018</u>	<u>2019</u>
	UMD	1	1	3	3	1	2	2
UCONN	2	1	2	3	1	2	1	2
WISC	0	1	1	3	2	3	1	3
OSU	1	1	3	3	1	3	1	3

2) Additional survey results overall point to evidence that UMD NRT students have access to strong networks and receive beneficial feedback and resources from their networks.

a) Comparing UMD Wave 1 to UMD Wave 2

- Responses on the networks of UMD NRT students remained mostly stable from Wave 1 to Wave 2. UMD students in 2019 reported slightly greater encouragement by faculty to collaborate with students and faculty from other departments compared to 2018 (Figure 4).
- Students were less likely to report that they had access to team-teaching by faculty from different departments and/or disciplines from 2018 to 2019 (Figure 4).
- Although the UMD students' responses from 2018 to 2019 did not substantially drop, UMD students were less likely to report that individuals in their network let them know of professional opportunities, provide affirmation and moral support, provide helpful feedback on research, expand their knowledge base into other disciplines, and assisted them in finding a job from 2018 to 2019 (Figure 5).

b) Comparing UMD Students to Other Institutions and Programs

- UMD students reported greater access to opportunities that would change their networks when compared to non-UMD and COMBINE students in both waves of the survey on the following items (Figure 4): team-teaching by faculty from different departments, encouragement by faculty to collaborate with students and faculty from other departments and programs, and opportunities for students to share their research with one another.
- UMD and non-UMD reported about the same average scores for opportunities to get feedback from peers, which were higher than the scores reported from COMBINE students (Figure 4).
- UMD and non-UMD students generally agreed that the individuals in their network were helpful to their professional success (Figure 5). One area where networks seemed to be less useful for both UMD and non-UMD students was in assistance with finding a job.

Figure 4. Presence of activities in doctoral program that change the nature of student networks

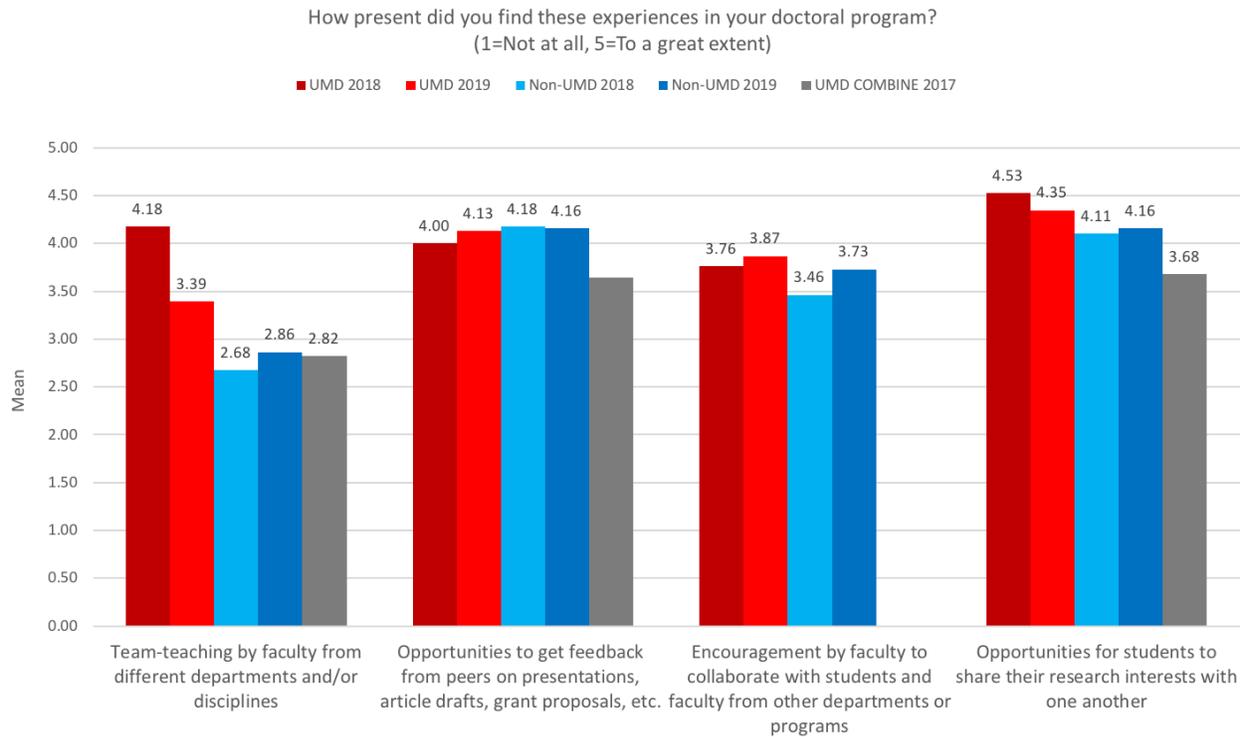
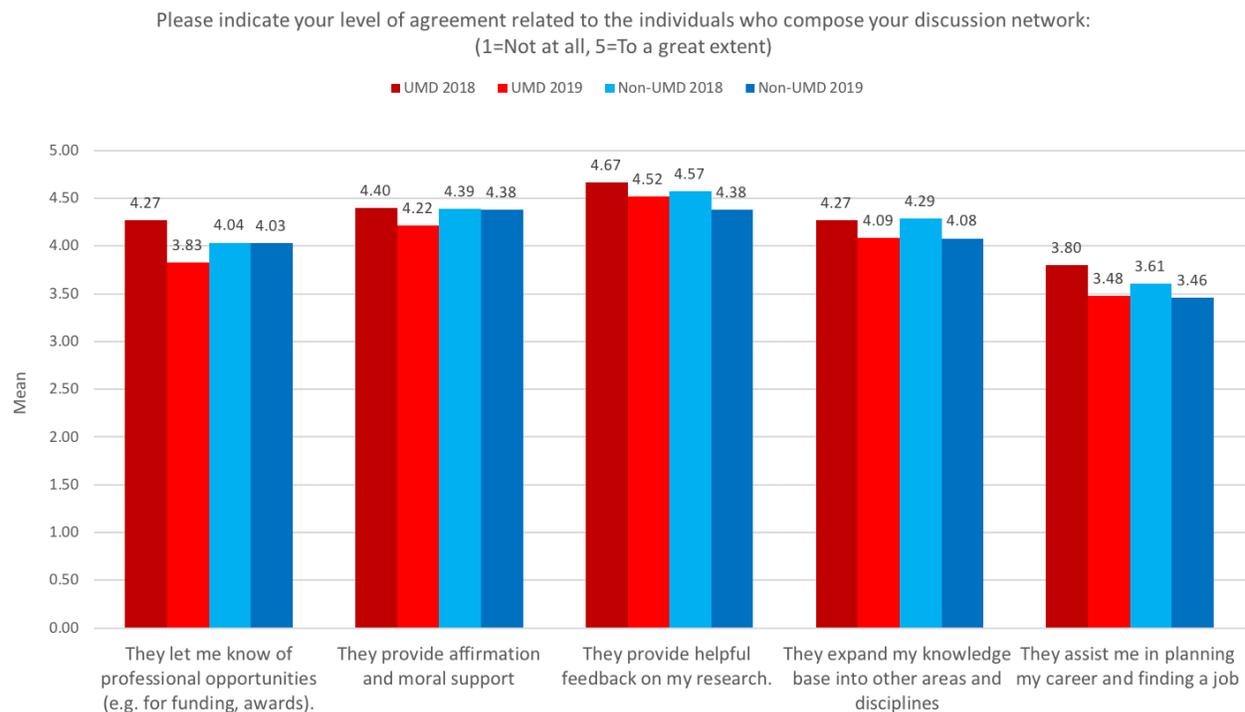


Figure 5. Individuals who compose student discussion networks



(3) To enhance student understanding of particular research problems and the relationship between research problems and contexts, and (4) To enhance student ability to communicate about research problems and their contexts, and adjust their communication according to the audience, channel, and goals

1) Survey results indicated that UMD students have some access to opportunities to learn about the relationship between research problems and context and opportunities to develop their communication skills. COMBINE students did not complete any of the survey items related to these goals.

a) Comparing UMD Wave 1 to UMD Wave 2

- UMD students reported slightly less access to opportunities that facilitated their development in these two goal areas from 2018 to 2019. UMD students reported slightly fewer opportunities to learn about the impact of research in their field on clinical applications, industry, or public policy; opportunities to learn and practice strategies for communicating with diverse audiences; and opportunities to communicate about their research field to nonacademics (Figure 6 below).
- On the other hand, student confidence in their ability to connect their research to applications and communicate to diverse audiences remained relatively stable from year to year. Students continue to report lower average scores on their confidence to connect their research with specific applications and high confidence in their ability to explain their research to peers (Figure 7 below).

b) Comparing UMD Students to Other Institutions and Programs

- UMD students in both years reported greater access to opportunities that allow them to learn about research problems and context and communication compared to non-UMD students (Figure 6 below).
- UMD students reported that they had more opportunities to learn about the impact of their research on applications, opportunities to learn and practice strategies for communicating with diverse audiences, and opportunities to communicate about their research field to nonacademics compared to non-UMD students (Figure 6 below).
- UMD and non-UMD students reported about the same levels of confidence in their communication skills across survey items (Figure 7 below).
- Non-UMD students were slightly more likely to indicate that they felt confident in their ability to connect their research to specific applications compared to UMD students in 2019 (Figure 7 below).

Figure 6. Presence of activities in doctoral program that help students learn about research problems and contexts or communicate to diverse audiences

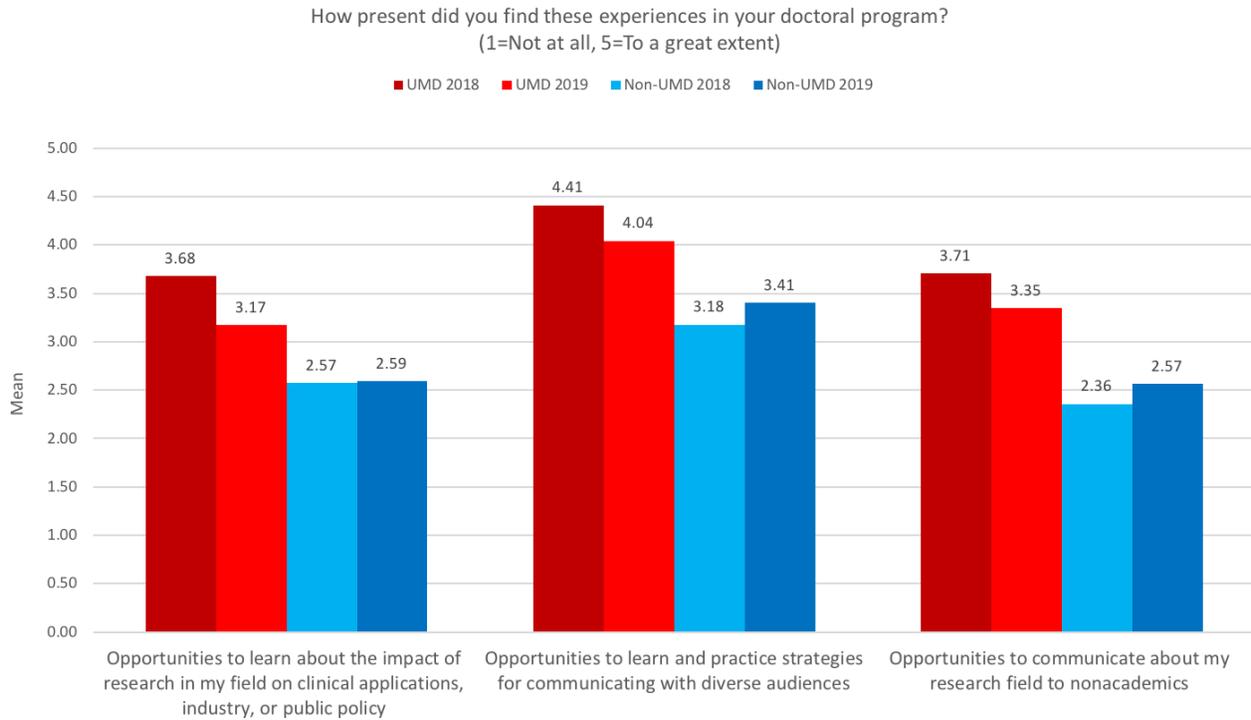
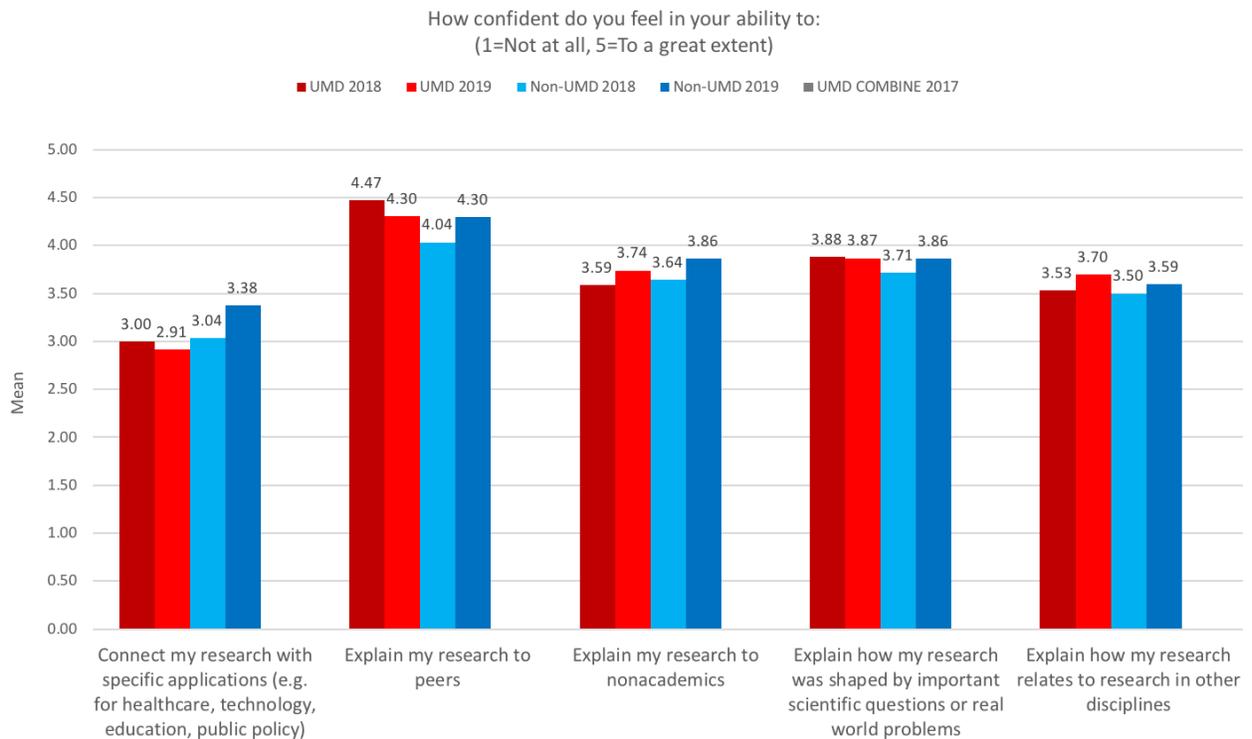


Figure 7. Student confidence in ability to connect research problems to contexts and to communicate to diverse audiences



(5) To enhance student ability to choose and successfully pursue a career within or outside academia

1) Exit interviews suggest that although most graduating NRT students intended to pursue careers in academia, the NRT program had opened up the possibilities for pursuing non-academic careers for other students. The following quotes illustrate this finding:

It's opened me to the idea that if I don't get an academic position, I could enjoy non-academic positions. It's helped me get an idea of what other options might be available or at least what other options there might be to figure it out. That's something that I definitely wouldn't have gotten through the department alone, that it's only been through the LSC that I've had even ideas of what I could do outside of academia.

When they said policy internship, I was like I really don't want to do that. But it was nice to see that I can do something that is "policy-ish" in an area that I do think is interesting. It's also been helpful because I applied to a job yesterday it's had more to do with second language stuff and I've been able to say, "Hey, I've done this internship, I do care about it," it's not just that I am saying that I like it on paper. So that maybe will be helpful.

For students that did not want to pursue a career in academia, the NRT emphasis on non-academic careers was particularly useful. One student said:

I knew for a while, maybe halfway through the program, that I didn't want to stay in academia. I don't like to teach, I don't like the idea of having to find my own funding, and I'd like more geographical freedom than an academic career gives you. So data science is a good forefront of the field area, but it is people who really love to learn and pick up new techniques. Sort of similar to the academic culture in that way, but more focused on the analysis side as opposed to the writing side.

With those new career goals mind, the student continued by saying:

They [The LSC] have done a lot to help me figure out what I wanted to do. A lot of the professional development, doing the informational interviews or doing the IDP [individual development plan], where it forces you to think about what skills do I have, what skills do I want, and what do I actually like doing has been incredibly helpful.

2) On the other hand, some graduating NRT students indicated that although they had gained some new skills that could have been marketable, they felt as though they had not achieved the level of competence they needed to get a position in a particular area.

As I'm applying for jobs, I see that there are a lot of jobs in computational linguistics, but despite having done this NRT rotation in it, I am nowhere near competent enough for most of those jobs. I feel really comfortable enough that I could collaborate with people, but I don't think I'm going to get a job working for Amazon as an NLP person. And I think that looking back, if I were to choose an outside area again, I would tell myself to look more at what jobs are available that I think that I could actually gain skills enough to do. So like there are tons of jobs for people doing TSOL, or people doing SLA, something more applied. I don't know if that really fits the goals of what were started to us of the NRT. But I think that something like that would have been more useful for me to apply to a lot of jobs. It would have been more of a direct benefit to my career at least right now.

3) Turning to the survey results, to determine differences in opportunities to learn about academic and non-academic careers, we made some changes to the survey in Wave 2 by removing the question about whether students had opportunities to learning about academic and non-academic careers and separating this item into two questions. COMBINE students did not respond to survey questions related to career development.

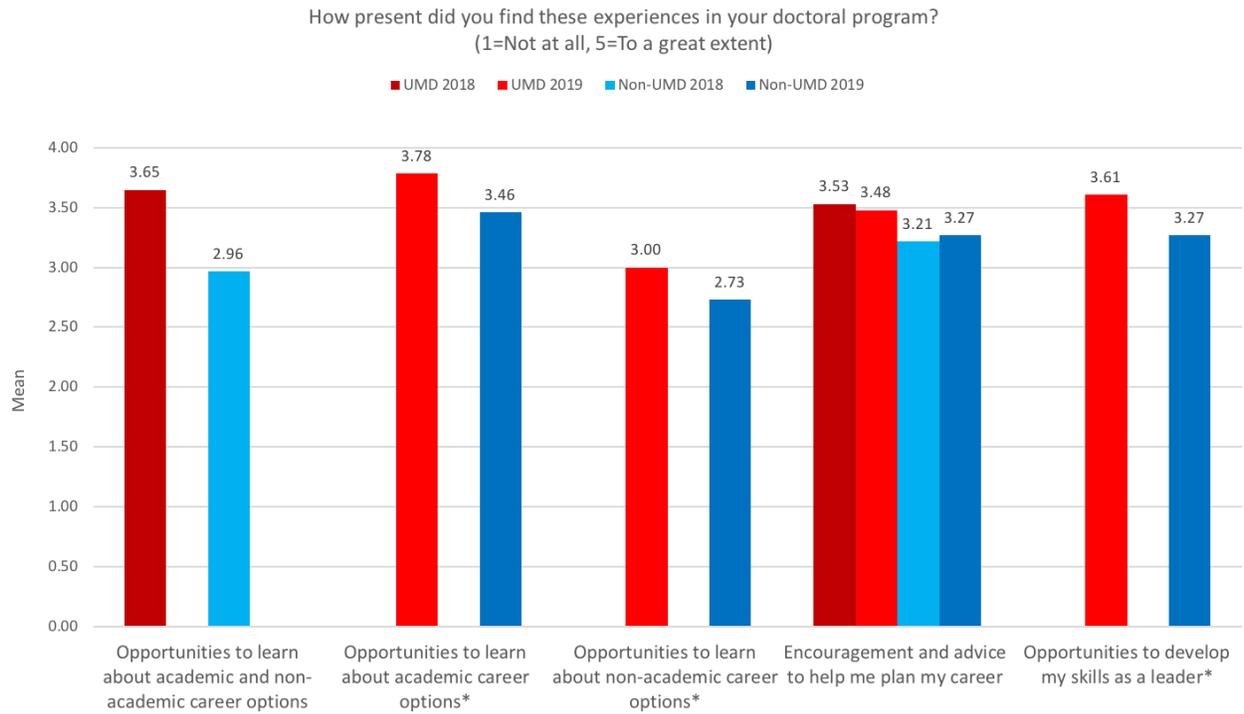
a) Comparing UMD Wave 1 to UMD Wave 2

- UMD students reported consistent access to opportunities that helped them prepare for careers from wave 1 to wave 2 and reported about the same confidence in their ability to identify, apply to, and interview for jobs.
- Fewer UMD students reported participating in professional skills trainings and career planning regularly throughout the year in Wave 2 compared to Wave 1 (Appendix C, Figures 7-11), and more UMD students reported participating in an internship.

b) Comparing UMD Students to Other Institutions and Programs

- UMD students reported more opportunities to learn about academic career options and non-academic career options compared to non-UMD students (Figure 8).
- UMD students also reported slightly greater access to encouragement and advice to plan their careers and opportunities to develop themselves as leaders compared to non-UMD students. UMD students also had slightly greater confidence in their ability to identify, apply to, and interview for jobs after graduation in both survey waves compared to non-UMD students (Figure 9).
- UMD and non-UMD students were about equally as likely to agree to that they understood how their interests, skills, and values related to post-graduation career outcomes.

Figure 8. Presence of activities in doctoral program that help students learn about academic and non-academic careers



*denotes questions introduced on second wave of survey.

Figure 9. Student Confidence in ability to pursue academic and non-academic careers

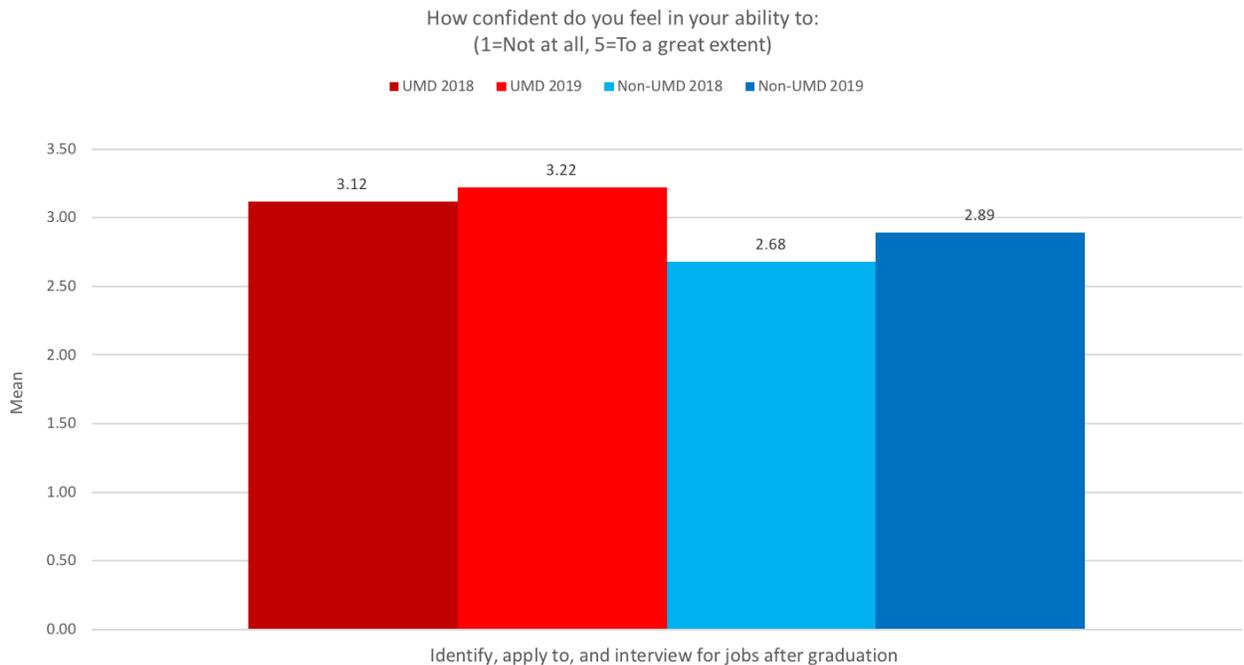
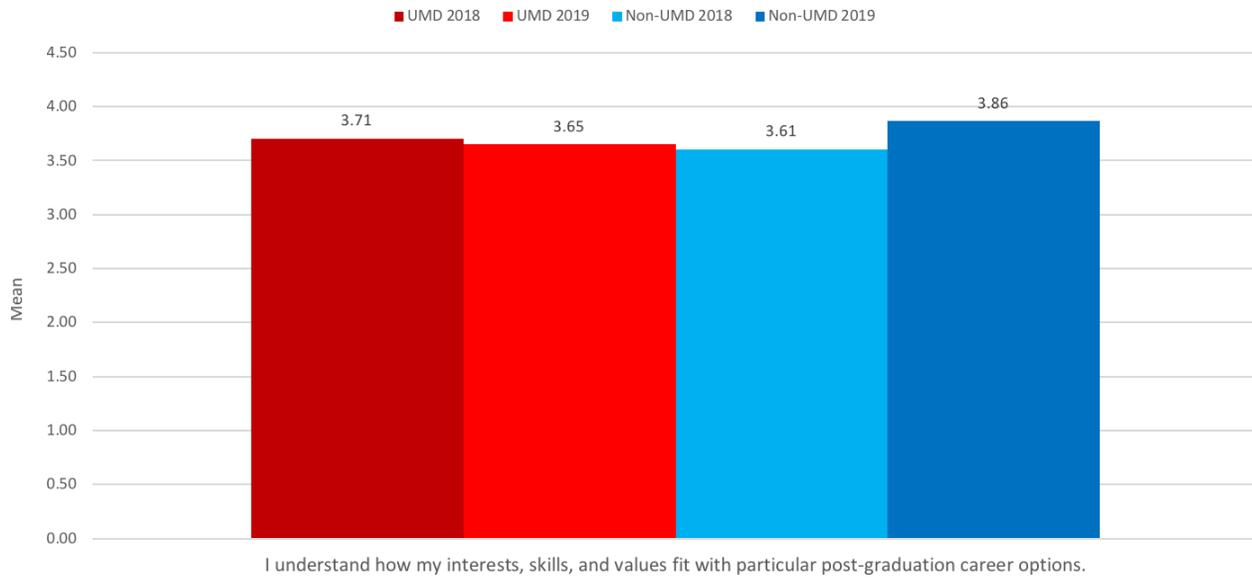


Figure 10. Student perspectives on ability to pursue career post-graduation

Indicate the extent to which you agree or disagree with the following statements about your own experiences in the last 12 months:

(1=Strongly disagree, 5=Strongly agree)



(6) To share and help other graduate programs adopt best practices in interdisciplinary graduate education that emerge from the NRT project.

1) There is some evidence that the LSC is a model for interdisciplinary graduate training and graduate student professional development on UMD's campus. Multiple participants indicated the LSC's NRT grant had facilitated other UMD units receiving subsequent NRT awards. The following quotes illustrate this theme:

Colin's success has enabled us to get the two or three other NRTs because he's been able to provide the mentorship for those. He stepped up the game in terms of professional development, which we have tried to coordinate with.

I think they [the other NRT grants] made a huge difference in us being able to obtain this grant because we were already learning from the opportunities and challenges that the existing grant presented.

Other NRT programs directly replicate or emulate aspects of the LSC's NRT activities. For example, UMD Global STEWARDS is planning to hold a Winter Boost workshop in the winter term that focuses explicitly on graduate student professional development. Students in the program will also complete an internship in a non-academic setting. NRT program leaders also want to replicate some of the values that guide the LSC NRT program, namely, student ownership. For example, one institutional informant said:

We're going to be relying on our students to help us frame and mold the program and also run the program throughout because it's a wonderful way for our trainees to practice their leadership skills as well, taking something and running with it.

2) There is also some evidence that the LSC is viewed as a national model for interdisciplinary graduate training. For instance, LSC program leaders are invited to serve on campus and national committees, such as the CIRTL committee, to discuss how to better incorporate professional development into graduate student training. One institutional informant summarized the ways in which the LSC is viewed as a model when he said, "It [the LSC] has been recognized nationally. The NIH and NSF see it as a positive working model. Three years ago, they did that national NRT conference here and that was driven by Colin."

Likewise, exit interviews with students on the faculty job market indicated that other institutions were interested in learning about what training activities UMD used to promote interdisciplinary skill development. One student said that she had been asked frequently about the kinds of lessons or practices she would consider bringing over from the LSC to a prospective institution as a faculty member. She said, "I've been asked questions like this a lot. I think the LSC is a really great example of a successful program. In terms of specifics, in general, the focus on having an interdisciplinary community and the focus on bringing people together from different perspectives [is something I've learned from UMD]." She went to say, "I heard from multiple places that they had their eye on what Maryland has done and thought it was great. I don't think anywhere has the same level of community established."

(7) To reduce organizational constraints to, and facilitate, faculty collaboration on interdisciplinary research.

1) At a campus-level, most institutional informants indicated that the movement towards interdisciplinary research has been funding-driven rather than responsive to an actual change in institutional culture. We observe evidence of this finding in two ways:

a) There is a lack of centralized, institutional support or resources that supports interdisciplinary graduate training. Institutional informants suggested that a lack of formal structures and incentives for participation in interdisciplinary graduate education and interdisciplinary research more generally often undermined efforts to change culture, as illustrated by the following quotes:

We don't have a structure on campus to support interdisciplinary [work] in the way that it needs to be supported...We don't have a means, as a campus, where a normal graduate school would provide the central source for funding, recruitment, faculty support, and all that. Our graduate school, that was never the mindset... The closest we have come is doing some of these graduate certificates and graduate professional masters, which are graduate school degrees. The problem is that we need someone here, so it's not any one college.

You've got to figure out how to build in that funding stream, so it continues a lot, which we have never been successful in doing. So a lot of centers end up with one person in it with nothing else going on. The name remains, but there is no funding behind it. You've got to figure out how to support these things.

I think the larger issue, which maybe we can try to help move forward, is that my general view of how the campus overall can move forward with interdisciplinary projects is if the campus puts resources towards this and tells us as faculty members that this is valuable to the campus because it takes a whole lot of energy from individual faculty members to begin these big programs. But, if it's valuable to the campus, then we need to have some campus support.

If the campus thinks this is a good idea for us to be trying to train our students in an interdisciplinary fashion, I think in order for faculty to be excited about that, perhaps if there is a way to in the future somehow make allowances in the promotion process that support this type of activity. For example, one thing that we need to figure out is everybody has their existing teaching loads and how do we shift that, how do certain team taught courses still count for their teaching load, these types of things.

b) There is a real concern from many institutional leaders on campus that once grants like the NRT come to an end, centers like the LSC will also lose their ability to provide quality programs. For example, institutional informants said the following:

Without an umbrella organization or something like that, it's going to be out of sight, out of mind. And I think then we lose these opportunities. I think that when this was first started, I think it was generally not obvious to people how many people there were working across the campus, working on language science in some form or another. And so, I think that this has made people much more aware of that. I think that that's been very, very positive.

I think that if we think that this has been a successful endeavor, and we certainly do, then there would need to be some permanent resources devoted to this from the university. I don't think it amounts to an enormous amount of resources, but it's not obvious who that's supposed to come from.

2) However, within the broad language sciences at UMD, we found evidence that the LSC has been able to tap into an existing network of campus units that were already interested in doing interdisciplinary work. As one participant summarized, the LSC is not “trying to connect things that didn’t want to be connected.”

a) Several participants indicated that the NRT/LSC leaders had been strategic, in that they leveraged the support of certain departments that have a pre-existing inclination towards interdisciplinary collaboration. Many of the key departments who supported the LSC’s creation and who serve as the main feeders into the NRT program have long traditions of interdisciplinary collaboration among their faculty (e.g. LING’s tradition of two mentors and highly flexible program plans, HESP’s orientation towards applied research). This inclination makes the LSC uniquely positioned to bring together faculty and students from multiple departments who value interdisciplinary collaboration and who believe strongly that graduate students should acquire the skills necessary to participate in it. The following quotes from institutional informants highlight this theme:

We [the department] are definitely of the belief that having interdisciplinary experiences are crucial to transcending the structures or the mindset of your own field. So, we think that that people do better work when they work with other people and when those people have a diverse set of experiences. So I think that bringing up something like speech pathology concerns, things that people have never thought of, in their own work, I think that that can really be informative...it really enriches their experience.

Many people don't know their neighbor next door, in the same building, but we [University of Maryland] somehow seem to attract researchers who want to do interdisciplinary, want to get outside their office, they want to get outside their lab or open their lab to other people.

[The LSC] is about learning how to make connections outside of the typical ones, about how to communicate to people who don't have the same background as you do about how to see broader pictures, and to go in and out forest to trees and trees to forest and, and not stay at one level and that's hard, but that's the kind of thing that these types of programs train. It is the real goal or should be the real goal of NSF to create those types of people rather than just the content experts, and it should be the real goal of a university and what should lead to university recognition eventually, to create those kinds of scientists. And that's a different set of goals than are sometimes fostered by traditional departmental silos.

There are other pockets of long-lasting interdisciplinary collaboration on campus (NIH training grants, the Brain and Behavior Institute, NACS) that likewise suggest there is a precedent for cross-departmental initiatives on campus. Some participants suggested that UMD has experienced some success in attracting faculty who are more inclined towards interdisciplinary collaboration, which in turn makes interdisciplinary initiatives

such as the LSC more likely to be successful. For example, one institutional informant said:

If you look at some of the largest interdisciplinary [centers]...there's Language Science Center, there's the CBH, there's the neuroscience program, there's ISR. If you look at the core people in those...they have some other interaction besides where they are, you know, so there's BBI. So, everybody who's in NACS is considered a BBI member. ISR, if you look at who they have in there, there's engineers, there's biologists, there's psychologists, there's language people. So we have these six or seven programs around campus that all interact with one another in some way.

b) The NRT/LSC has strengthened some of these pre-existing connections and collaborations and brings visibility to the units doing interdisciplinary work on campus.

Some informants suggested the unique position of the LSC, within ARHU, but working on important language science questions, had facilitated success. For example, one institutional informant said:

It's advantageous that Colin has more of a scientific approach to Linguistics...that allows him to be able to talk to a lot of the other STEM disciplines. Being based in ARHU gives him the label of being on the humanities side of the campus, but he can talk. When we were talking about postdocs, if you talk about trainees, it shuts the humanities side off. He was able to transcend some of those bounds. He works well with [colleague in CMNS]. He's been able to show how it works.

Other informants indicated that the NRT/LSC activities had brought together faculty from different disciplines who may not have otherwise collaborated. Informants said:

There was some communication between Linguistics and Hearing and Speech, but the Language Science Center, it's like night and day, there's just been way more of it. How much of it is due to the Language Science Center? I would say an awful lot. I mean, there are the things you can point to like [Faculty Member] and I, before this existed, we co-taught a NACS course together. So, it's certainly true that NACS has also been a facilitator for communications between Linguistics and NACS, but I really think that the bulk of that success can be definitely due to the Language Science Center. But, they did have something to build on.

I think the Language Science Lunch Talks have been very successful at bringing together a consistent...there's been consistently pretty good attendance at it, and then, you're likely to see people that you wouldn't see otherwise at these things. And so it's an opportunity to find out what they're doing, and I think that that's been very effective.

c) There is some evidence that the NRT/LSC has been able to maneuver some of the barriers that typically hinder interdisciplinary graduate education. For example, one institutional informant discussed the ways in which regular LSC programs had broken down disciplinary silos. She said:

The notion that the students were going to be expected to cross boundaries and work in another lab, that was planned. I think I thought was that what would happen was the student would be in this lab, they would maybe go and spend a

semester doing a rotation over here and that would allow them to bridge areas and maybe help create some combinatorial projects. The notion of it entirely breaking down some of the boundaries, such that the students don't even necessarily know which department each other is in, I think that was something that more developed.

Another participant indicated that one of the key features of the NRT/LSC that made it successful is the centralized staff who provide dedicated support to programs. She said:

The administrative support matters. If there wasn't Shevaun, if there wasn't Tess and Caitlin, this wouldn't be sustainable. The activities give the students a whole new set of soft skills that really can benefit them, but the activities also require administrative support and that has to come time wise from someone and someone has to have the time to give it. And the only way there are people who have time to give it is if there are people who are in essence paid as salaried to provide that.

This point was echoed by other institutional informants, who suggested that having administrators who have training in the discipline of the program is also critical. One informant said:

[Administrators in interdisciplinary programs] gives a different track for some of our PhD students, and at other universities where I've seen this occur, they're almost always homegrown, they're PhD students who just decided that they thought they would like that more...So the idea of taking PhDs and allowing us to use our degrees to help foster research, I think it's huge for the campus.

3) On the other hand, as we noted in our previous report, there are some persistent barriers that continue to hinder interdisciplinary graduate training and interdisciplinary research. One informant discussed the ways in which programs like the NRT/LSC can impact faculty service loads:

On the one hand, faculty benefit [from participation] on the research side, but also to some degree, [participation] can hurt faculty in terms of service. You don't get limited to just doing service or being asked to do service within your own unit [because you participant in] all of these other related things. So I think that there is some downside there. I think that the way that that plays out is different in different departments. So, for example, in Linguistics, a huge portion of the faculty are connected to the Language Science Center. Psychology, only a couple people in psych that have anything to with Language Science Center because they study things like clinical psychology, I mean things that have nothing to do with language. The way that it impacts the individual is very different in departments where there are small minority, and when the department as a whole is not invested in language science, even if individuals are, compared to the cases where the department as a whole is.

When prompted, institutional informants did not indicate any formal changes had been made to departmental policies that sought to address the increased workload. One indicated that they had made accommodations for faculty to teach outside of the department or co-teach classes.

1) Feedback on graduate student professional development

a) We note that our data showed graduate student professional development has historically been concentrated within the departments/colleges, with varying levels of support for graduate students depending on their location within the institution. While some departments provide regular professional development on topics such as the academic job search or regular opportunities for students to present their research, there are elements of the NRT/LSC professional development such as the elevator pitch or communicating to non-academic audiences that are less common within current departmental offerings.

Some LSC-participating departments have re-calibrated their professional development opportunities since the NRT program began. For instance, one department changed some of its professional development seminars in response to those being offered by the LSC to reduce duplication and to ensure student participation. A faculty member summarized these changes by noting:

We're a small department, so [professional development] really only works if everyone's [present]. It's one thing to have a professional development activity for 15 students, it's really another thing to have it for 4 or 5...it doesn't work. And so, it holds when the cohort is active together, but now, the Language Science Center has started and NACS has started trying to do some, the students who happen to be in all three are feeling like they're getting too much of their time taken up with it. It's becoming a little competitive. But that's only for the subset of students who are in all of them.

b) In some ways, the NRT/LSC's professional development opportunities intersect with what the Graduate School/Career Center offer to students on a campus level. The LSC started increasing graduate student professional development efforts before, and/or at the same time the Graduate School did, and it could be argued there is some duplication of effort (which is an issue across campus, not just for the LSC). For instance, we noted that the Graduate School offers programs on delivering successful speeches or communication research in context that map onto some of the NRT student development goals.

The LSC has experienced some success in crossing departmental silos, whereas graduate student professional development at the campus level is still in its nascent stages in bringing together students from across units. One of the key factors in the LSC success in doing graduate student professional development across departments is faculty buy-in: students pay attention to professional development when their advisor recommends it.

Students also benefit from the application of the general professional development principles and ideas to language science-specific careers. Likewise, having professional development locally strengthens community. As such, LSC might want to continue to evaluate where the duplication serves a needed purpose or where there are places to differentiate and not do everything in house.

2) Feedback on the role of the LSC/NRT in student recruitment

a) The NRT/LSC plays a critical role in attracting students who have an inclination towards interdisciplinary language science research. In particular, students who attended Language Science Lunch Talks or other LSC events as prospective students noted that they were attracted to the sense of community they observed. A few quotes illustrate this theme:

I chose Maryland, there was one other school that I could have chosen, and I chose Maryland specifically because...well I didn't know much about the LSC, or what it was,

but I knew within the linguistics department there was a lot of interdisciplinarity within linguistics. I knew that I liked syntax but I also loved running experiments, so I knew that I wanted to do both and use them to answer questions that touched on both. I had some idea that I wanted to do something interdisciplinary already.

The extent to which experimental and theoretical lines of inquiry are meshed together here, I think, is very unusual and very good. And I mean, I expected to have that combination. When I came here for an open house, that was one of the things that I found attractive.

I certainly know that the Language Science Center was a real interest to me even when I was applying. It was something that I didn't hear anyone anywhere else talk about, that this sort of interdisciplinary community that existed. Pretty much as soon as I showed up, I knew that I wanted to get involved with different events and different things around campus because that was the sort of approach that really appealed to me. The fact that people actually talked to each other across departments and collaborated on different projects. That there was actually this sort of collaboration rather than competition in getting things done. I knew as soon as I set foot onto campus, I would be expected to do that...it's just been a part of what makes Maryland special.

I didn't actually know about the community before I came, but I came for a campus visit and sat in on the lunch talk and talked to some people who were involved in this type of thing. I thought, "Well this is really interesting, it's an interesting community here." I interviewed at another school and specifically asked them questions about that type of thing and they were like, "Oh no we don't talk to those people." That definitely had an impact. The fact that there was money involved was certainly attractive, but I don't ... Had it not been a monetary thing, I don't think that would've stopped me from getting involved.

One of the things that made UMD so appealing to me was that as I was visiting different schools during the decision process, I had established a set of questions that I was asking people and one of them was how feasible would it be for me to build connections with other departments such that I am able to work with folks on the psychology side, etc. And people would give varying levels of, "Oh yeah that would be doable or whatever." And that was a question that I never had to ask here, it was already part of the fabric of the place.

b) While the financial incentive for participating in the NRT/LSC is useful and appreciated, many students would participate regardless of the trainee award. A few quotes illustrate this theme:

I kind of knew that there was this Language Science Center...and it was a community of people from different departments, and I was like that sounds really cool. But I didn't really know the extent, I didn't know anything about the NRT grant or anything like that for students. I knew that there was some funding available, but I thought it was mostly just for travel.

When I made my decision, one of the biggest selling points was the interdisciplinary opportunities that the LSC offered...The LSC offers this real opportunity to do more than engage in discussion but engage in actual research in areas that would intersect with mine and help improve my growth as a researcher.

c) Some faculty suggested that the NRT/LSC had increased the caliber and quality of students that they are able to recruit to UMD. Students are often deciding between UMD and other top programs and the LSC is often seen as the critical factor in bringing them to UMD.

So, for us, being part of a broader language community is what allows us to be compared with, I mean it gives us that kind of breadth that allows us to be on the same stage with departments that have 50 faculty.

To our department, it has made a huge difference in the quality of the students that are applying and the quality of students we're getting. Not just the quality of the students, but the types of students that it is having students apply who want to, specifically want that kind of, that experience, and that makes us more of a destination.

Having a really strong culture of cross disciplinary work is something that is a draw. It makes us unique from other places and then for the people who want that will see it as a destination. So that you get people who are coming for that, not just people who are applying to Maryland because they want to be in this part of the country. Not that there's anything wrong with those people, but having this other reason why people apply brings in a larger quantity of high quality students.

In sum, the NRT has been one of several important ways the LSC has aided in recruitment.

3) Feedback on Student and Faculty Workload

In our previous report, we noted that several students noted that they felt concerned about the extra work required of them to complete the NRT and participate in the broader LSC community. In this round of data collection, we likewise noted some of this concern from both students and faculty, as was demonstrated during the feedback session in February.

All students indicated that they experienced varying levels of involvement with the LSC over the course of their PhD careers. At some point, most served as LSC leaders in some way, becoming deeply involved in a committee or research project. However, they realized that they needed to strategically step away from the LSC as their reached their final year to focus on their research and dissertations.

For some students, there were elements of push and pull to participating in the NRT. On the push side, they appreciated the community and could name multiple, tangible benefits that they experienced as a result of their LSC affiliation. On the pull side, some students saw that their involvement had slowed their time to degree completion or pulled them away from department-based research in favor of activities that were enjoyable but not necessarily rewarded in terms of research productivity or other traditional markers of PhD success. One student illustrated this tension in the following quote:

There's always a tension between all the value that the LSC confers and all the work that it creates for grad students and faculty who are involved. I know that there has been tension there with respect to, "I don't need more work," especially if people are deriving direct and massive benefit from that interdisciplinary community. How do we maintain this community and the value it confers, with getting people to buy in without it feeling like too much of a burden? That's a huge burden and I don't know how to solve it. I don't have any criticisms for people for trying to address those challenges.

Similarly, in our previous report, we also noted the perception that there has been a drop-off in faculty participation in NRT/LSC activities and events. We observed some positive progress in this area, especially as related to the faculty committee that led planning for Winter Storm

2019. In the LSLT feedback session, students appeared to positively receive faculty involvement in Winter Storm. Yet, institutional informants reiterated the finding that faculty perceive involvement in the LSC/NRT to be an additional workload burden, which may limit faculty involvement. One informant summarized this theme when he said:

I think that everybody does see it as another thing that's being added to their plate. I think there are a lot of us who say, "Okay, well, you know, that's just how it is." So, if we want to do collaborative research, then, yeah, it's true, we're going have to belong to more than one group. And, so, in my case, you know, it's the LSC, and it's NACS... I think some of us, that's just the way we work, what we're interested in. So, we are working on some problems, and those problems, you might find answers to them from more than one field. I find it invigorating. But I think other people, I think this would be true to say that if you go and talk to people, some people find it's extra work.

Recommendations

Graduate Student Outcomes

There is evidence that the NRT program and the LSC more generally is making positive progress towards achieving the five student goals. We see the strongest evidence that the NRT program is exposing students to colleagues, knowledge, and ideas in disciplines outside of their home units; changing student networks; and fostering students' interdisciplinary communication and collaboration skills.

On the other hand, we note a few areas on which program leaders might wish to focus. When we compared NRT student survey responses from Wave 1 to Wave 2, we observed a small but consistent downward trend. For instance, of the 39 survey items reported in Figures 1-10 above and repeated in Tables 4-8 in Appendix C, there was decrease on 25 items from Wave 1 to Wave 2. We recognize that (a) the sample of students changed from Wave 1 to Wave 2 and (b) due to the size of the sample, the results are not statistically significant. Yet, we wanted to note these trends as an area program leader may wish to monitor. We also heard concerns by students and faculty about the level of workload and sustained involvement in the LSC and lack of clarity or confusion around required professional development activities.

Recommendations to consider:

- Use a Language Science Lunch Talk as a forum to tackle the workload and participation problem as a community. At said meeting, provide opportunities for faculty and student input and present some alternatives that may reduce the perception and reality that student ownership and participation in LSC/NRT programs and activities are inherently in tension with workload concerns.
- More clearly articulate which professional development activities are being done locally, within the LSC/NRT, for specific reasons and which professional development activities might be handled by The Graduate School and/or academic departments.
- Re-think what activities and requirements are required versus not required and provide rationale to students and faculty about such considerations. Such requirements, policies, and procedures could be outlined in an NRT Student Handbook, which could be regularly revised by program leaders with student and faculty feedback in mind. Such guidelines may assist in providing clarity and transparency to students and faculty around participation in the NRT program.

Graduate Education Reform

There is evidence that the NRT and LSC acts a nationally recognized model in language science and has been a catalytic and substantive support for other interdisciplinary programs on campus.

Recommendations to consider:

- Much like meetings convened by the PIs of the NIH T-32 program, the LSC could convene an annual meeting with other UMD units interested in interdisciplinary graduate education and professional development as a mechanism for spreading ideas around campus. Many of these types of meetings are already happening informally between LSC program staff and other units, but formalizing meetings could be a way for

all graduate units to share best practices. This event could be in partnership with the Graduate School and the other NRT programs on campus.

- Create a brief on NRT best practices that can be posted to the LSC website and shared with other language science graduate programs.
- Consider presenting at the Council of Graduate Schools, IDERN, or other graduate education conferences.

Institutional Change

We see mixed evidence regarding the role of the NRT/LSC in fostering organizational change. On one hand, the LSC has facilitated professional relationships across UMD silos, provided new graduate training models adapted by other units, and created new ways for faculty and students to work together. On the other hand, UMD and the LSC within it, still experience some of the same barriers in terms of:

- More traditional promotion and tenure system that rewards individual effort.
- Organization of faculty into departments and even centers that act as the major reward system.

Recommendations to consider:

- Identify one or two specific organizational changes (field-wide or institutional-wide) that the LSC/NRT leaders think would (a) most contribute interdisciplinary institutional change and (b) are likely to happen by the end of the grant in 2020. Examples of such organizational changes could be credit for team-taught courses, co-advising credits or policies, or practices governing PI-splits.

Future Evaluation Plans

To wrap up internal evaluation efforts in the 2019-2020 academic term, our team recommends the following evaluation activities

- Observations of co-taught courses (if offered)
- Interviews with faculty teaching co-taught courses
- Third and final distribution of the NRT student survey
- Dissemination of findings through presentations and papers (See Appendix B for overview of presentations and papers)

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UMD Language Science Center (n.d.). *Language science fellow graduate programs*. Retrieved from <https://owl.english.purdue.edu/owl/resource/560/10/>

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Appendix A: Yearly Evaluation Timeline

- Focus Groups
 - One focus group annually with faculty (December) and students (January)
- Interviews
 - One on one interviews with students after they have been in the program for at least one semester.
 - One on one interview with graduating students prior to degree completion.
- Observations
 - Ongoing
 - Language Science Day (October)
 - Winter Storm (January)
 - Maryland Day (March/April)
 - Language Science Talks (Weekly)
 - Outreach activities (ongoing)
- Survey
 - Annually each October to UMD students and three non-UMD peer institutions (University of Connecticut, University of Wisconsin, Ohio State University).
 - CVs collected annually.

Appendix B: Presentation and Paper Abstracts

PRESENTATIONS

1. O'Meara, K., Culpepper, D.K., Ramirez, A. (2018, November). *What's the big picture? Becoming an interdisciplinary scholar in one NRT graduate training program in the language sciences*. Roundtable paper presentation at the Association for the Study of Higher Education Annual Meeting; Tampa, FL.
2. Culpepper, D.K., & Phillips, C. (2018, September). *A virtuous relationship: Pushing forward graduate education research and practice through internal evaluation*. National Science Foundation Research Traineeship (NRT) Annual Meeting, Arlington, VA.

PAPERS

1. Culpepper, D. K., & O'Meara, K. (Conference proposal submission to the Association for the Study of Higher Education 2019 conference). *Fostering collisions in interdisciplinary graduate education: A social physics approach*.

This ethnographic case study draws from four years of data collection in the University of Maryland's Language Science Center, an interdisciplinary research and student training center which houses an NSF-funded National Research Traineeship (NRT) Program. Using the lens of social physics (Pentland, 2014), we sought to understand how graduate training programs foster collisions, that is, meaningful interactions, between students and faculty from different disciplinary backgrounds. We found that NRT program activities fostered exploration, idea flow, and engagement among an interdisciplinary community of language scientists, though these collisions sometimes generated tensions within the community.

2. Culpepper, D. K., O'Meara, K., & Ramirez, A. (under review). *Plugging in: How graduate programs shape doctoral student identity as interdisciplinary scientists*.

Across the public and private sectors, there is a strong push for developing interdisciplinary solutions to society's problems. However, many colleges and universities are not organized to encourage interdisciplinary training for graduate students or foster the development of a scholarly identity that is interdisciplinary in nature. The purpose of this paper is to understand how graduate programs shape doctoral students' scholarly identity as interdisciplinary scientists via a qualitative, ethnographic case study of the University of Maryland's Language Science Center. We found that curricular and co-curricular NRT program activities contributed to students' development as interdisciplinary scientists by connecting doctoral students to a pre-existing, interdisciplinary network of students and faculty; increasing doctoral student competence in the methods, cultures, and perspectives of other disciplines; encouraging doctoral students to find common ground with scholars from different disciplinary backgrounds; and broadening doctoral students' views of the potential impact and application of their work.

Appendix C: Tables and Figures

Table 2. Data Sources

Type of Source	Date	# of Participants Per Event*
Observations		
Language Science Center Community Meetings	Spring 2015, Fall 2017	40
Language Science Day (3)	Fall 2015, 2017, 2018	200
Winter Storm (4)	Winter 2016, 2017, 2018, 2019	50
Outreach Activities (5) (Maryland Day, Science Career Day, STEM Festival)	Spring 2016 – Spring 2018	20-250
Lunch Talks (6)	Fall 2016 -Spring 2018	30
Focus Groups		
Student Focus Group 1 was attended by students who were a part of the language science community, were NRT fellows, or were in the process of applying to become fellows.	Spring 2016	10
Faculty Focus Group 1 was attended by those serving as advisors/mentors for NRT students.	Spring 2016	7
Student Focus Group 2 was attended by active NRT fellows.	Fall 2016	11
Faculty Focus Group 2 was attended by those serving as advisors/mentors for NRT students.	Fall 2016	4
Faculty Focus Group 3 was attended by those serving as advisors/mentors for NRT students.	Fall 2017	3
Student Focus Group 3 was attended by active NRT fellows.	Spring 2018	13
One-on-One Interviews		
Interviews with the majority of Cohort 1 students	Fall 2016	5
Interviews with the remaining Cohort 1 students (2) and all Cohort 2 students	Spring 2017-Fall 2017	8
Interviews with Cohort 3 students	Spring 2018	5

Interviews with graduating Cohort 1 students	Spring 2018	5
Interviews with key institutional informants	Fall 2018-Spring 2019	6
Student Applications and Progress Reports		
Students submit applications to join the NRT fellowship.	Fall 2014 – Spring 2019	19
Students submit regularly updated progress reports. The applications and the progress reports contain each student’s CV, research and professional goals, and a research proposal.	Spring 2016 - Spring 2019	19
Survey		
NRT Student Survey Wave 1 (Total Participants, UMD Participants)	Winter 2018	45, 17
NRT Student Survey Wave 2 (Total Participants, UMD Participants)	Winter 2019	60, 23

*Participant numbers for observations are approximate

Table 3. Sample Characteristics

	<u>2018</u>		<u>2019</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
Institution				
UMD	17	38%	23	38%
University of Connecticut	13	29%	18	30%
Ohio State University	9	20%	14	23%
University of Wisconsin	6	13%	5	8%
Non-UMD Students Total	28	62%	37	62%
Gender				
Male	17	41%	26	44%
Female	22	54%	33	56%
Prefer to Self Describe/Unknown	6	13%	1	0%
Race/Ethnicity				
African-American/Black	0	0%	3	5%
Asian-American/Pacific Islander	4	9%	6	10%
Latino/Hispanic	2	4%	0	0%
Native American	0	0%	0	0%
White	26	58%	43	72%
Biracial/Multiracial	1	2%	4	7%
Prefer to Self Describe/Unknown	12	27%	4	7%
Years in Program				

Less than 1 year	2	5%	2	3%
1 yrs	6	15%	3	5%
2 yrs	8	20%	16	27%
3 yrs	14	34%	13	22%
4 yrs	6	15%	9	15%
5 yrs	4	10%	11	18%
6 yrs	1	2%	1	2%
7 yrs	0	0%	1	2%
More than 7 years/Unknown	4	9%	0	0%
Graduated	0	0%	4	7%
Current students		100%	56	93%

Program Stage

Early/mid coursework	13	29%	13	22%
Late coursework	14	31%	12	20%
Proposal/qualifying exams	6	13%	15	25%
Dissertation	8	18%	16	27%
Graduated	4	9%	4	7%

Career Goals (Current Students N=56)*

Academia: combined research and teaching	15	33%	28	50%
Academia: Teaching-focused	4	9%	2	4%
Academia: research-focused	6	13%	3	5%
Research in industry or government	7	16%	7	13%

Education	0	0%	2	4%
Healthcare	1	2%	2	4%
Government/policy	0	0%	0	0%
Communications/journalism/science writing	0	0%	0	0%
Other/Unknown**	12	27%	12	21%

*Due to N<5, we did not report the current occupations of graduate students.

**Other included academic administration, research hospital, clinical research institutes, and interested in more than one career path.

Figures 1-6. Participation in Graduate Student Training Activities: Research-Related Activities

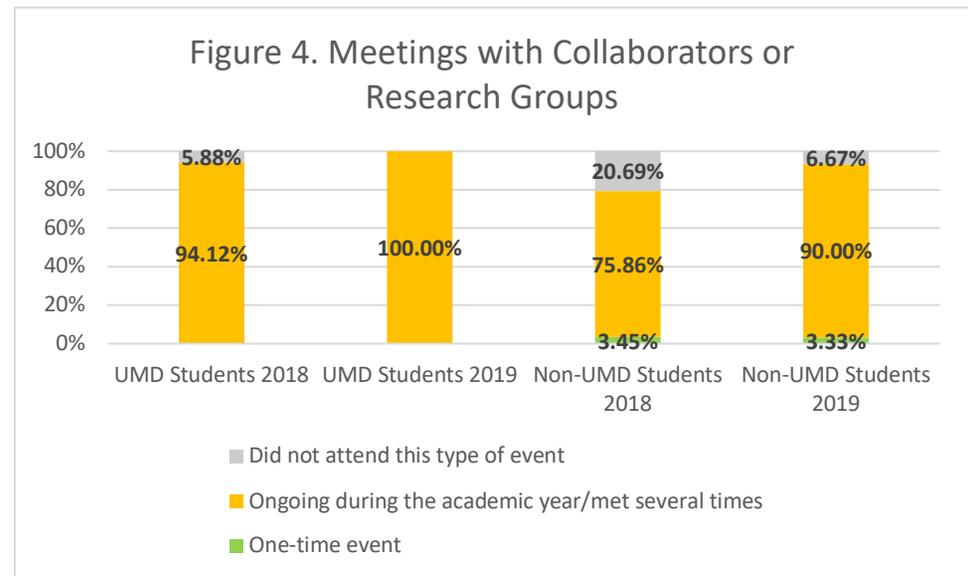
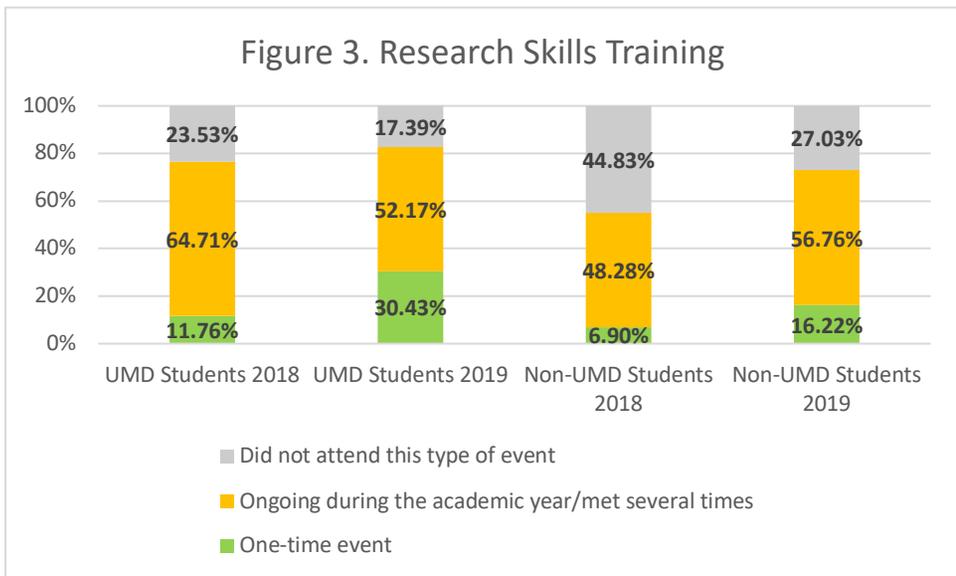
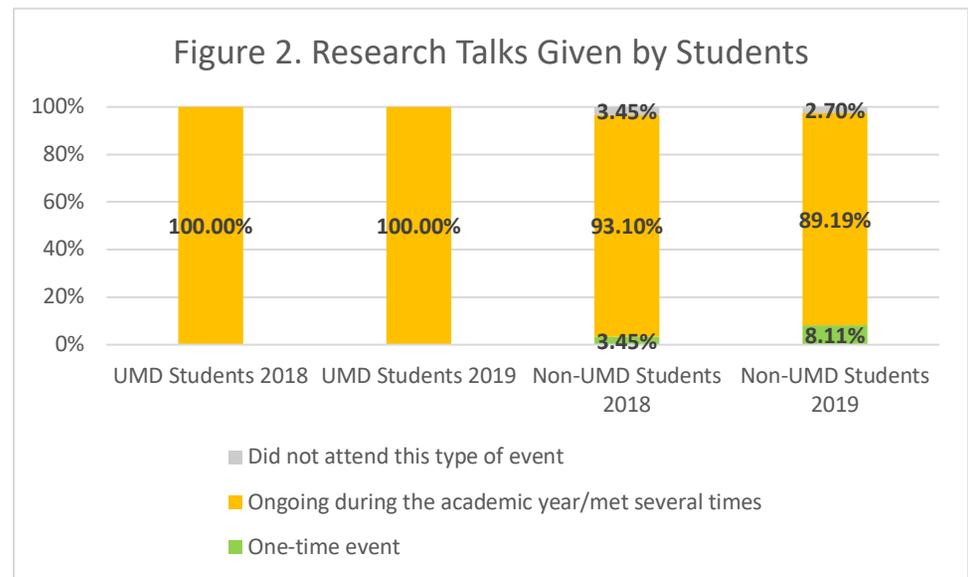
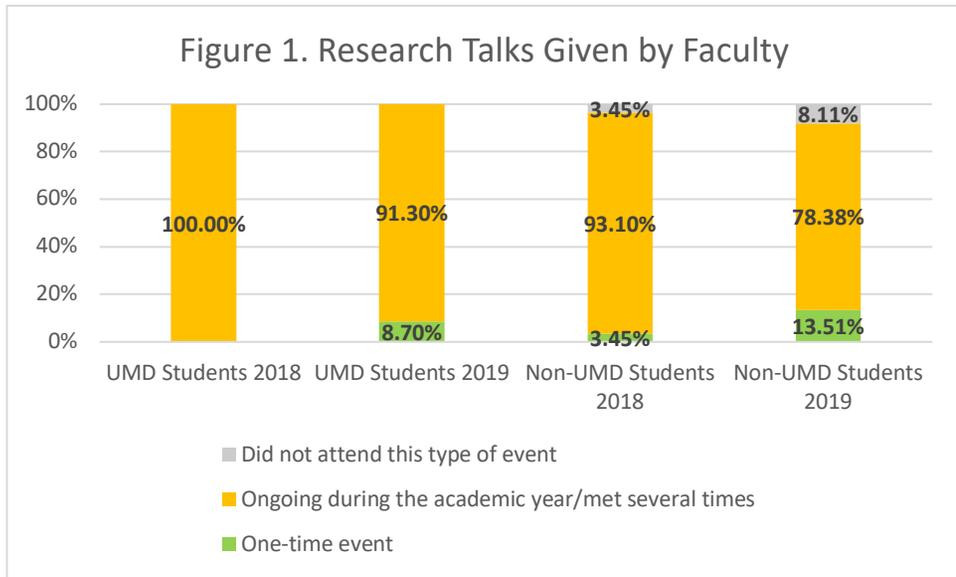


Figure 5. Cross-Listed Courses

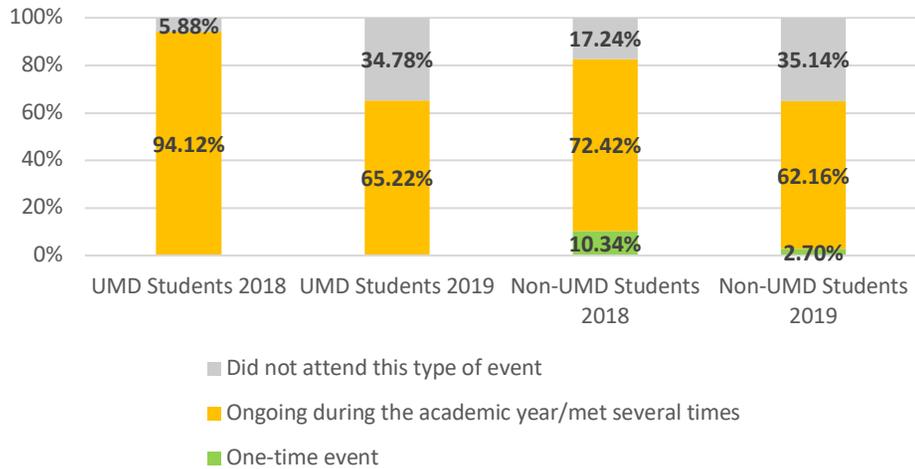
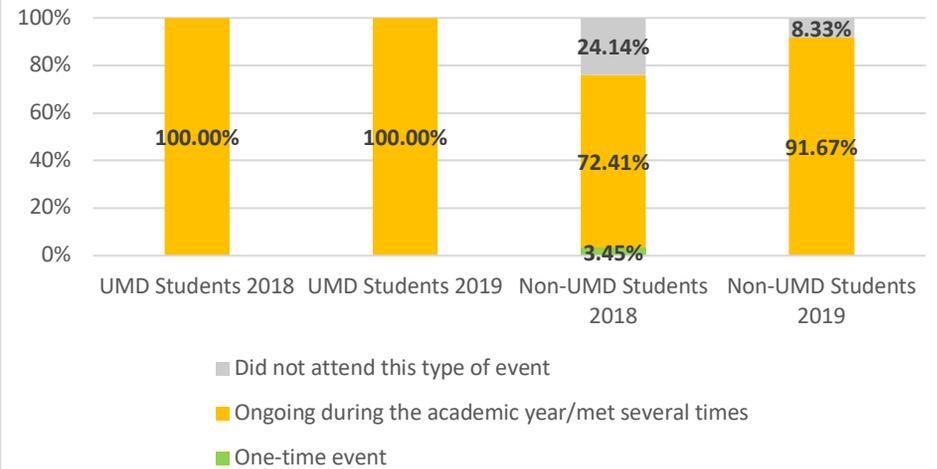


Figure 6. Lab Meetings



Figures 7 - 11. Participation in Graduate Student Training Activities: Professional Development Activities

Figure 7. Internship

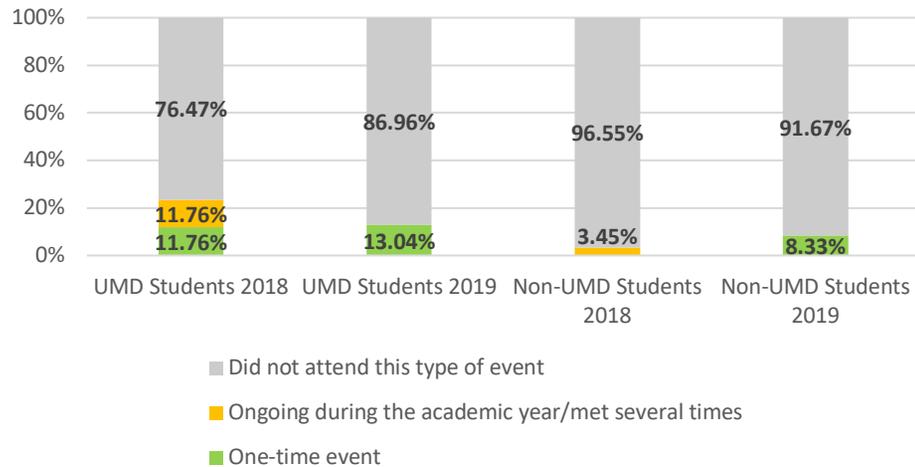


Figure 8. Professional Skills Training

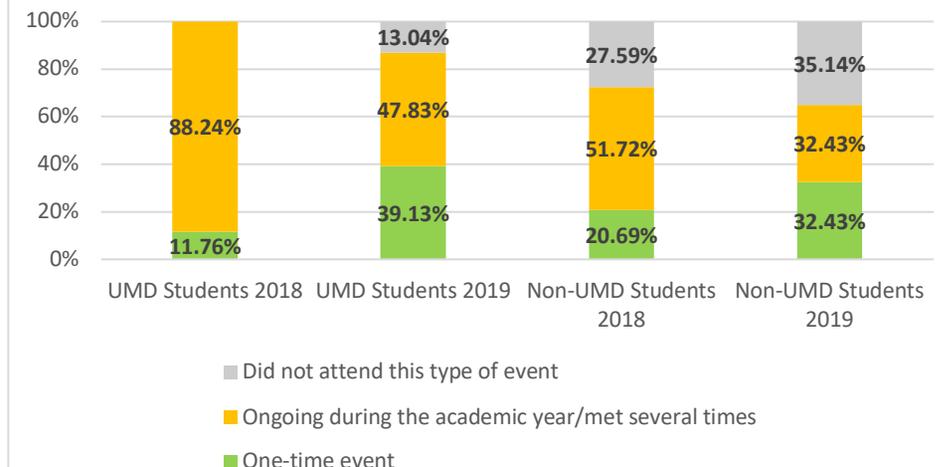


Figure 9. Reading Groups

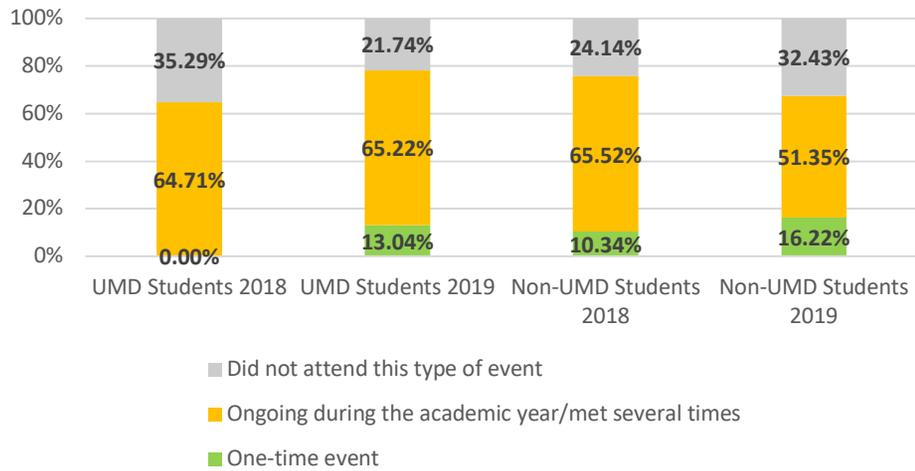


Figure 10. Outreach Activities

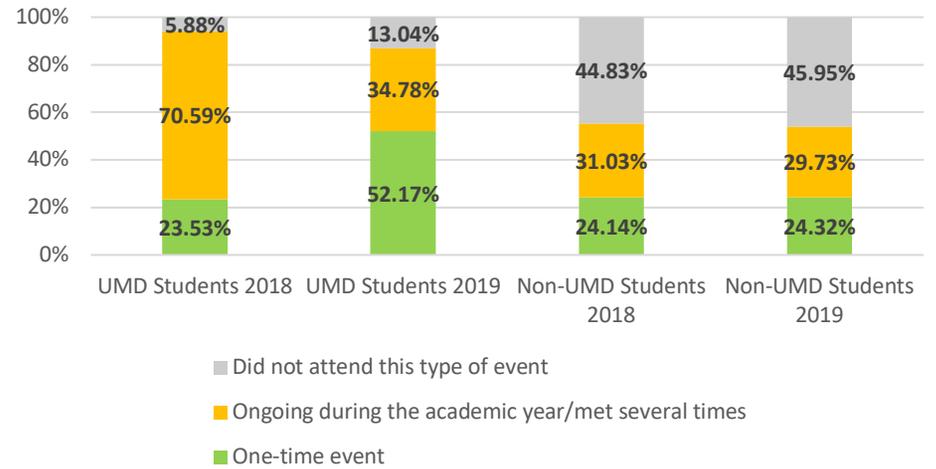
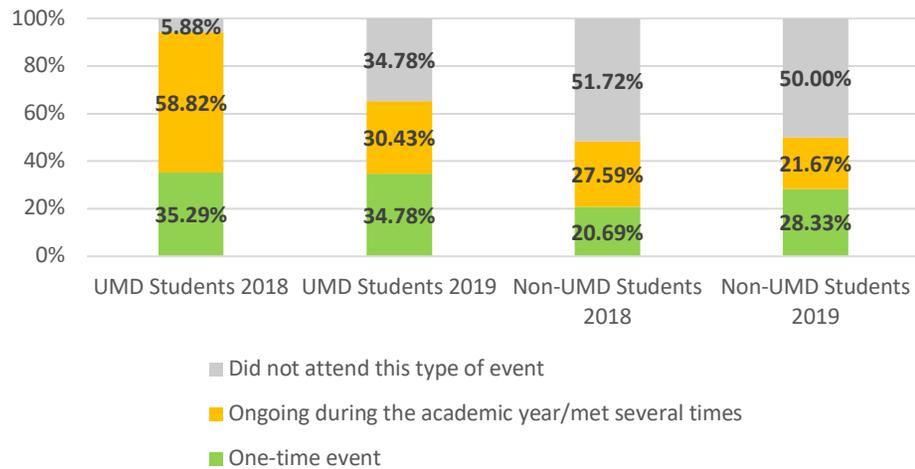


Figure 11. Career Planning



Figures 12-13. Participation in Graduate Student Training Activities: Funding Sources

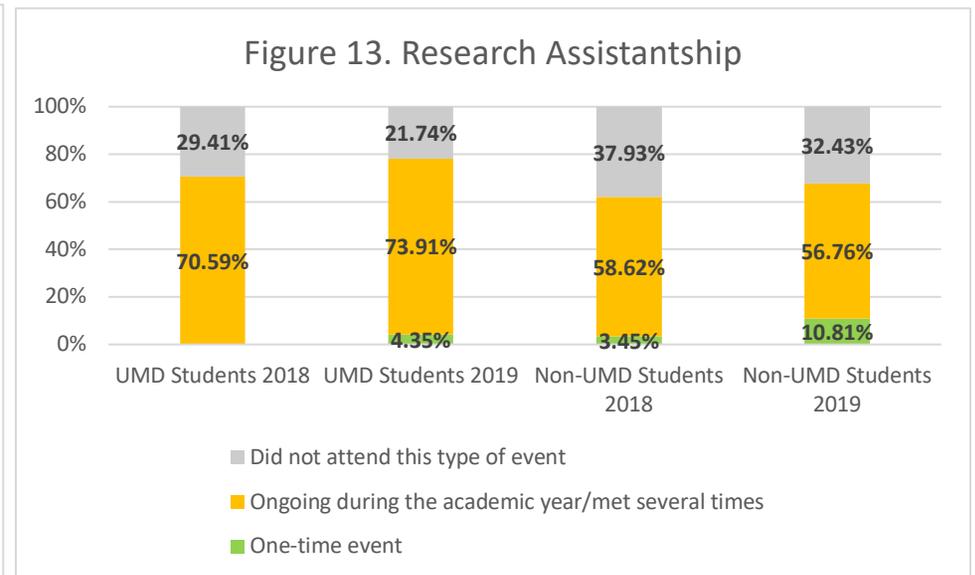
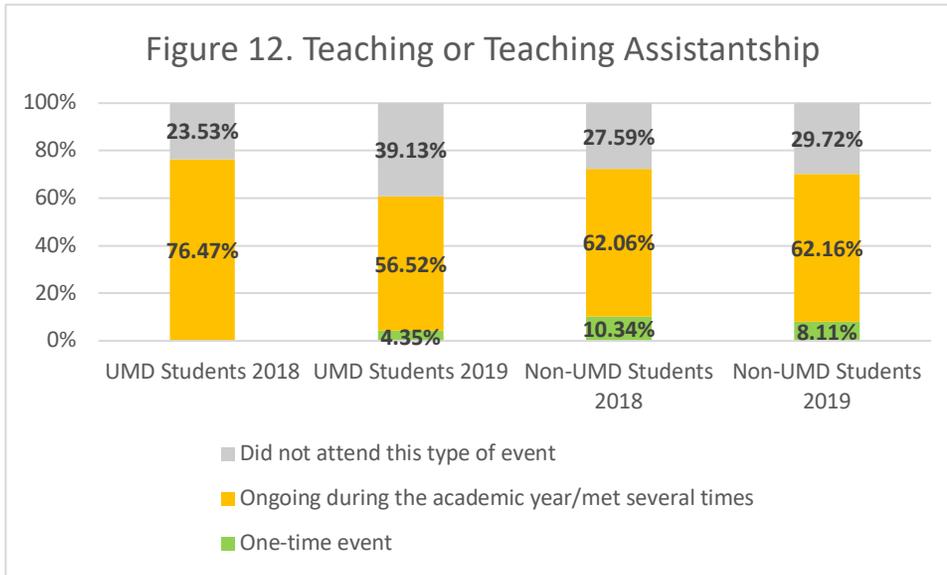


Table 4. Presence of Doctoral Student Training Opportunities

Survey Item	UMD 2018		UMD 2019		Non-UMD 2018		Non-UMD 2019		UMD COMBINE 2017
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>
Enhancing Agency as Interdisciplinary Researchers									
Examples of what interdisciplinary problem solving looks like	3.47	0.94	3.61	1.03	3.25	0.97	3.65	0.89	3.68
Opportunities to learn and practice new research skills	3.76	1.09	3.78	1.13	3.71	1.08	4.08	0.76	3.64
Role models of interdisciplinary researchers and projects	3.82	0.81	3.78	1.09	3.46	1.07	3.78	1.06	3.68
Opportunities to take courses in other departments	4.65	0.61	4.22	1.09	3.96	0.95	4.32	0.85	
Opportunities to research problems that are different from what I previously read and wrote about	3.94	0.90	3.57	1.16	3.93	0.98	3.41	0.90	2.86
Opportunities and encouragement by faculty to contribute to the development of my program (e.g. leading, designing events or activities)	4.06	0.90	4.09	1.04	3.43	1.02	3.51	1.17	*
Opportunities to work in fields that were previously unknown to me	3.47	1.18	3.22	1.41	3.36	1.16	3.08	0.98	2.64
Change the Nature of Student Networks									
Team-teaching by faculty from different departments and/or disciplines	4.18	0.81	3.39	1.16	2.68	1.25	2.86	1.48	2.82
Opportunities to get feedback from peers on presentations, article drafts, grant proposals, etc.	4.00	0.79	4.13	0.76	4.18	0.90	4.16	0.87	3.64
Encouragement by faculty to collaborate with students and faculty from other departments or programs	3.76	0.97	3.87	1.14	3.46	1.35	3.73	1.02	*
Opportunities for students to share their research interests with one another	4.53	0.62	4.35	0.78	4.11	0.91	4.16	0.76	3.68

*Not included in survey

Table 4 (cont). Presence of Doctoral Student Training Opportunities

Survey Item	UMD 2018		UMD 2019		Non-UMD 2018		Non-UMD 2019		UMD COMBINE 2017
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>
	To enhance student ability to choose and successfully pursue a career within or outside academia								
Opportunities to learn about academic and non-academic career options	3.65	0.86			2.96	1.00			*
Opportunities to learn about academic career options*			3.78	1.13			3.46	0.90	*
Opportunities to learn about non-academic career options*			3.00	1.21			2.73	0.99	*
Encouragement and advice to help me plan my career	3.53	0.94	3.48	1.31	3.21	1.10	3.27	1.04	*
Opportunities to develop my skills as a leader*			3.6087	1.1962			3.2703	1.07	*

*Not included in survey

Table 5. Student Confidence in Research and Collaboration Skills

	UMD 2018		UMD 2019		Non-UMD 2018		Non-UMD 2019		UMD COMBINE 2017
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>
Enhancing Agency as Interdisciplinary Researchers									
Work independently on a research problem	4.18	1.07	4.04	0.98	3.93	0.81	4.03	0.83	3.91*
Work on research requiring new skills	4.18	0.95	3.87	0.81	4.00	1.05	3.92	0.95	
Collaborate with other researchers in my field	4.29	0.85	4.09	0.85	4.04	1.00	3.84	0.80	
Collaborate with a range of professionals (e.g. senior scientists, policymakers, business leaders, leaders of local communities)	2.53	1.07	3.04	1.07	2.64	1.13	2.70	0.85	2.91
Collaborate with scientists outside my field	3.47	0.94	3.43	0.95	3.36	1.03	3.32	0.75	3.59
Enhance student understanding of particular research problems and the relationship between research problems and contexts									
Connect my research with specific applications (e.g. for healthcare, technology, education, public policy)	3.00	1.06	2.91	1.28	3.04	1.00	3.38	0.86	3.73*
Explain my research to peers	4.47	0.62	4.30	0.82	4.04	0.74	4.30	0.62	4.23*
Explain my research to nonacademics	3.59	0.80	3.74	0.96	3.64	0.73	3.86	0.95	4.23*
Explain how my research was shaped by important scientific questions or real world problems	3.88	0.99	3.87	1.14	3.71	1.12	3.86	0.86	
Explain how my research relates to research in other disciplines	3.53	0.80	3.70	0.93	3.50	0.96	3.59	0.83	
To enhance student ability to choose and successfully pursue a career within or outside academia									
Identify, apply to, and interview for jobs after graduation	3.12	1.17	3.22	1.09	2.68	1.19	2.89	0.99	

*Questions worded slightly differently:

Table 6. Student Perceptions of Contributions

Survey Item	UMD 2018		UMD 2019		Non- UMD 2018		Non-UMD 2019		UMD COMBINE 2017
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>
	Enhancing Agency as Interdisciplinary Researchers								
I am making valuable contributions to the intellectual community in my department.	4.06	0.66	4.00	0.74	3.71	0.66	4.08	0.49	3.72
I am making valuable contributions to my research field.	3.94	0.56	3.87	0.76	3.71	0.76	3.86	0.59	3.82
I have the research skills I need to contribute meaningful research to my field of study	4.00	0.71	3.83	0.78	3.71	0.60	3.95	0.62	3.64
To enhance student ability to choose and successfully pursue a career within or outside academia									
I understand how my interests, skills, and values fit with particular post-graduation career options.	3.71	0.59	3.65	1.07	3.61	0.71	3.86	0.67	*

*Not included in survey

Table 7. Student Perceptions of their Networks

Survey Item	UMD 2018		UMD 2019		Non-UMD 2018		Non-UMD 2019	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
	They let me know of professional opportunities (e.g. for funding, awards).	4.27	0.88	3.83	1.11	4.04	0.96	4.03
They provide affirmation and moral support	4.40	0.63	4.22	0.95	4.39	0.69	4.38	0.86
They provide helpful feedback on my research.	4.67	0.49	4.52	0.67	4.57	0.69	4.38	0.79
They expand my knowledge base into other areas and disciplines	4.27	0.59	4.09	0.85	4.29	0.53	4.08	0.86
They assist me in planning my career and finding a job	3.80	0.86	3.48	1.31	3.61	1.66	3.46	0.80

Table 8. Student Knowledge of Research Problems

	UMD 2018		UMD 2019		Non-UMD 2018		Non-UMD 2019	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
	How much of the background knowledge and theories around the issue do you know?	3.85	0.80	3.78	0.60	3.56	0.69	3.70
How many of the necessary research skills and methodologies do you know?	3.85	0.69	3.65	0.57	3.39	0.69	3.65	0.59