University of Maryland Language Science NRT Program

INTERNAL EVALUATION, FINAL 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 in Appendix A.

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 Candidate, 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)

Questions and Methods

This document is a final internal evaluation of the University of Maryland's Language Science NRT Program. 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 Fall 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 group recording.

In addition to these research questions, our team's overall objective was 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.

To date, the research team has published one paper about interdisciplinary scholar identity in the *International Journal of Doctoral Studies* (Culpepper, O'Meara, & Ramirez, 2020) and presented at three academic conferences. We have one paper currently under review with *Studies in Graduate and Postdoctoral Education* (O'Meara & Culpepper, under review). In addition, the survey instrument we developed as part of the internal evaluation was adopted with permission by another UMD NRT program, COMBINE (Computation and Mathematics for Biological Networks). Their evaluation team has also published findings using this instrument (Marbach & Marr, 2018). See Appendix B for an overview of the research papers published, presented, or currently under development by the research team.

Conceptual Model/Theories of Graduate Student Development

We employed multiple theories to examine if, how, and why the NRT program fostered graduate student development and made progress towards stated program goals. Aspects of these theoretical models informed our interview and observational protocols, survey item development, and overall analytic strategy. In this section, we summarize the theories used to inform the internal evaluation. We also provide selected references for further reading.

- *Socialization* (Austin, 2002; Weidman et al., 2001): Socialization refers to the "process by which an individual becomes part of a group, organization, or community", wherein an individual learns the values, cultures, behaviors, attitudes, and expectations of that group (Austin, 2002, p. 96). Socialization is one of the key theories that researchers use to explore and explain graduate student development, as studies show that graduate students who lack access to key socialization experiences (e.g., faculty and peer mentoring; role models; feedback) often experience lower persistence and completion. In this internal evaluation, we used socialization to cue the evaluation team to aspects of graduate training that shaped student development and enculturation into their disciplines and field.

- *Agency* (Jaeger et al., 2017; O'Meara, 2013): Agency refers to the strategic actions and perspectives individuals use as they advance towards their goals. Research shows that one's agency is influenced by individual, organizational, and field and societal factors. For instance, organizational policies and practices have been shown to either facilitate or constrain individual agency in career advancement (Terosky et al., 2014). In this internal evaluation, we used agency as a framework to understand how features of the NRT program facilitated (or constrained) students' sense that they could engage in interdisciplinary research and develop interdisciplinary research skills.

- *Collisions and Social Physics* (Pentland, 2012, 2014; Waber et al., 2010): Theories of social physics explain how new knowledge and creative ideas are spread throughout organizations. One way organizations attempt to engineer the spread of creativity among employees is by orchestrating strategic "collisions," or meaningful interactions, between individuals from different units or workgroups. In this internal evaluation, we used these theories to understand how the NRT program facilitated meaningful interactions between students and faculty from different disciplines.

- *Scholarly Identity Development* (Baker & Lattuca, 2010; Carlone & Johnson, 2007; Culpepper et al., 2020): Scholarly identity development refers to the ways in which academics see themselves (and are seen by others) as legitimate, contributing members of their academic community. In this internal evaluation, these theories helped us to understand how aspects of the NRT program facilitated students' ability to see themselves as interdisciplinary scientists, as well as some of the challenges students with interdisciplinary could experience in developing an interdisciplinary scholarly identity.

- *Networks* (Baker & Lattuca, 2010; Niehaus & O'Meara, 2015; O'Meara et al., 2018): Network theories examine how relationships between individuals are developed and maintained in ways that contribute developmental outcomes such as advancement, learning, and identity development, among others. In this internal evaluation, network theories helped focus our attention on the ways that relationships between and among students and faculty from different disciplines contributed to student learning and development.

Data Sources and Data Analysis

Since 2015, our team completed 6 focus groups (3 student focus groups, 3 faculty focus groups), interviewed 23 NRT fellows, conducted exit interviews with 9 graduating fellows, and observed approximately 60 hours of NRT programs and activities. We conducted 6 institutional informant interviews with key UMD administrators, faculty involved in the NRT program, and UMD graduate school staff. We additionally reviewed the application materials and progress reports submitted by each NRT fellow. See Table 1 for data sources.

We also conducted a survey about student experiences within their doctoral program over three years (2018-2020). In Wave 1 and Wave 2, we compared the experiences of UMD NRT students 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. These results are reported in previous internal evaluation reports. In the most recent survey distribution, we distributed the survey to UMD NRT students only.

In this final report, we analyzed qualitative and quantitative data collected over the course of the internal evaluation to assess the UMD NRT's program progress towards its stated goals. Because our results reflect data collected over time, in this report, we focus on identifying elements of the program that seemed to ***most*** contribute to progress in the stated goal areas,

as well as identify aspects of the program or larger, external forces that seemed to undermine or constrain progress towards goals.

For qualitative data (e.g., interviews, focus groups), our analysis was data and theory-driven, in that we analyzed and coded the transcripts with the theories described in the previous section in mind, aiming to identify aspects of the program that seemed to facilitate things like student agency, scholarly identity development, and socialization. We also coded the data to identify specific components of the NRT program (e.g., Winter Storm) that students described as being salient to their development in the stated goal areas (Table 2). For instance, we noted when students discussed how events like Winter Storm directly contributed to their network growth (Goal 2).

For quantitative data, we present the 2018, 2019, and 2020 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 Wave 2 (2019) and Wave 3 (2020). Because of the small sample size and selection bias in who took the survey, we report mean scores for comparison and benchmarking purposes only.

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 innovative within graduate education more broadly, and encourage change at UMD and in the field. We organize our findings in these three categories.

Graduate Student Development

(1) To enhance doctoral student agency as interdisciplinary researchers

*Aspects of the NRT program that seem to **facilitate** student agency as interdisciplinary researchers.*

- **Interdisciplinary courses and training.** NRT students frequently mentioned that interdisciplinary courses taken as part of the requirements of the NRT program facilitated their agency as interdisciplinary researchers. Courses allowed students to gain research skills that they leveraged in subsequent, independent and collaborative projects. For many students, interdisciplinary courses often represented the first opportunity to move outside of their comfort zone and explore a new discipline or its core theories and/or methods. Survey results (Figure 1 cont.) showed that NRT students reported that they found opportunities to take classes in other departments to be present in their doctoral program.

- **Low-risk opportunities to experiment and collaborate on interdisciplinary projects.** Opportunities were often facilitated by dedicated time for students and faculty to come together around shared research interests during events like Language Science Day and

Winter Storm. Even when interdisciplinary projects "failed," that is, did not get off the ground or result in a tangible project (e.g., a conference paper), students seemed to develop an enhanced understanding of the skills needed to collaborate with others and work outside of their disciplinary comfort zone. Survey results (Figure 2) also showed that UMD students were confident in their ability to collaborate with scientists inside and outside of their field and had increasing confidence in their ability to collaborate with a range of professionals.

- **Committee leadership and opportunities to shape NRT program offerings.** Many NRT students mentioned participating and leading the various student committees as having a direct relationship with the development of skills like organization, collaboration, and teamwork. Survey results (Figure 2) suggested that students felt as though they were encouraged to contribute to the development of their program. Interviews likewise reiterated that serving on committees provided NRT students with opportunities to develop their agency and confidence.

Aspects of the NRT program or larger institutional, field, or disciplinary context that seem to ***constrain*** *student agency as interdisciplinary researchers.*

- **Ambiguity and lack of transparency regarding some program requirements.** Early evaluation results showed that NRT students and faculty sometimes felt confusion or a lack of clarity around aspects of the application process (e.g., how to incorporate feedback or how to develop their interdisciplinary research plan). Focus groups and interviews suggested that over time, the NRT program improved the process surrounding the application in ways that provided greater clarity.

  Ambiguity also arose related to the policy internship. Though students generally agreed that the flexibility of the policy internship was beneficial in that it allowed them to explore their individual interests, some students noted that they lacked clarity in what kinds of activities would "qualify" as a policy internship versus which ones would not. Such ambiguity appeared to undermined students' ability to gain the benefits of the policy internship and also seemed to lessen enthusiasm for participating in the overall NRT program.

  Similarly, there was some evidence that students felts as though their ownership over the program was undermined during some events such as Winter Storm or Language Science Day. Focus groups and interviews suggested that students sometimes had very different opinions about the kinds of activities that were value-added during these LSC community-wide events (e.g., career development activities versus those focused on research skills). When students felt as though their needs were not being addressed during these events, they often reported more dissatisfaction or less engagement with the LSC.

- **Workload Tensions.** One of the biggest themes over the course of the evaluation showed that students experienced workload challenges related to participating in the NRT program in ways that could constrain their agency. Although students saw value in

most NRT activities, students faced difficulty in maintaining home department obligations with NRT-related committee obligations, outreach events, and other LSC-related time commitments. In addition to the real tensions in workload, NRT students also expressed concerns about the tendency for some students who participate in the community to "free load" off of the work of others. For instance, students who took on leadership roles on committees often reported feeling as though they did the bulk of the work to provide resources to the community, while other students received the benefits of the without putting in equal amounts of effort.

- **Siloes and Organization.** Despite very intentional collaborations and structures set up by the LSC and NRT program to facilitate connection across departments and fields, there were times when department or program norms or specific requirements took precedent or could contradict with student desire to engage in interdisciplinary work.

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

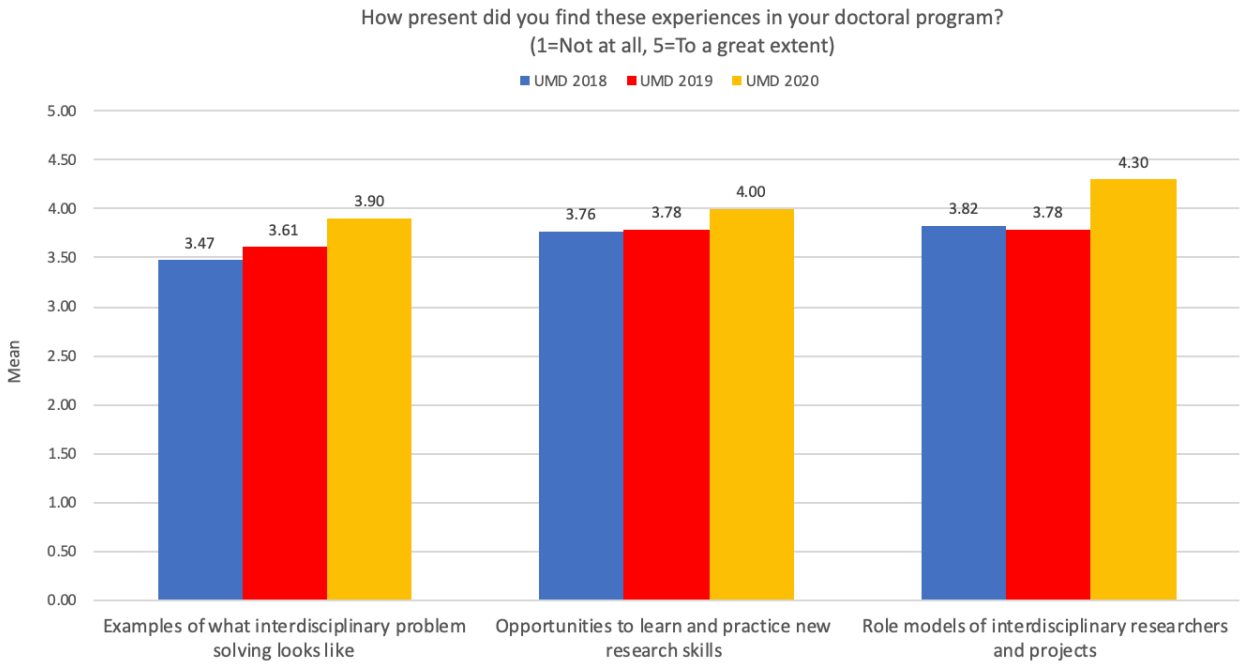


Figure 1 (cont.). Presence of activities in doctoral program that enhance student agency as interdisciplinary researchers

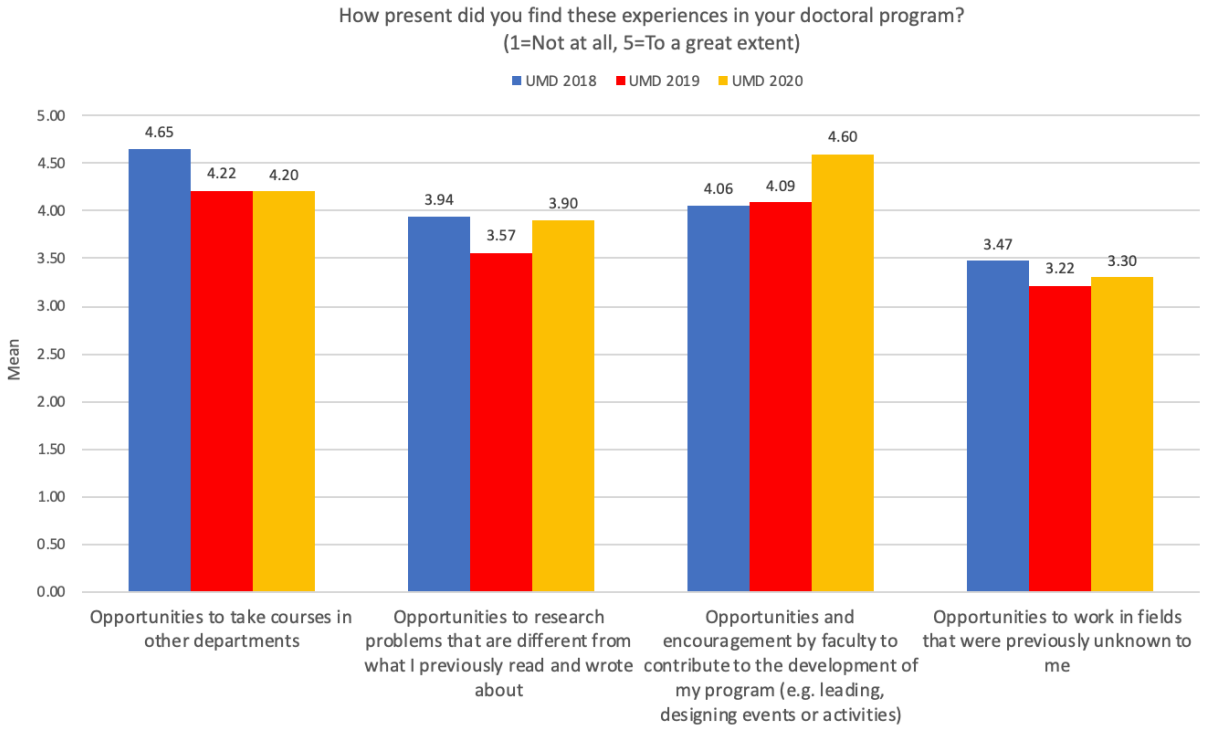


Figure 2. Student confidence in agency as interdisciplinary researchers

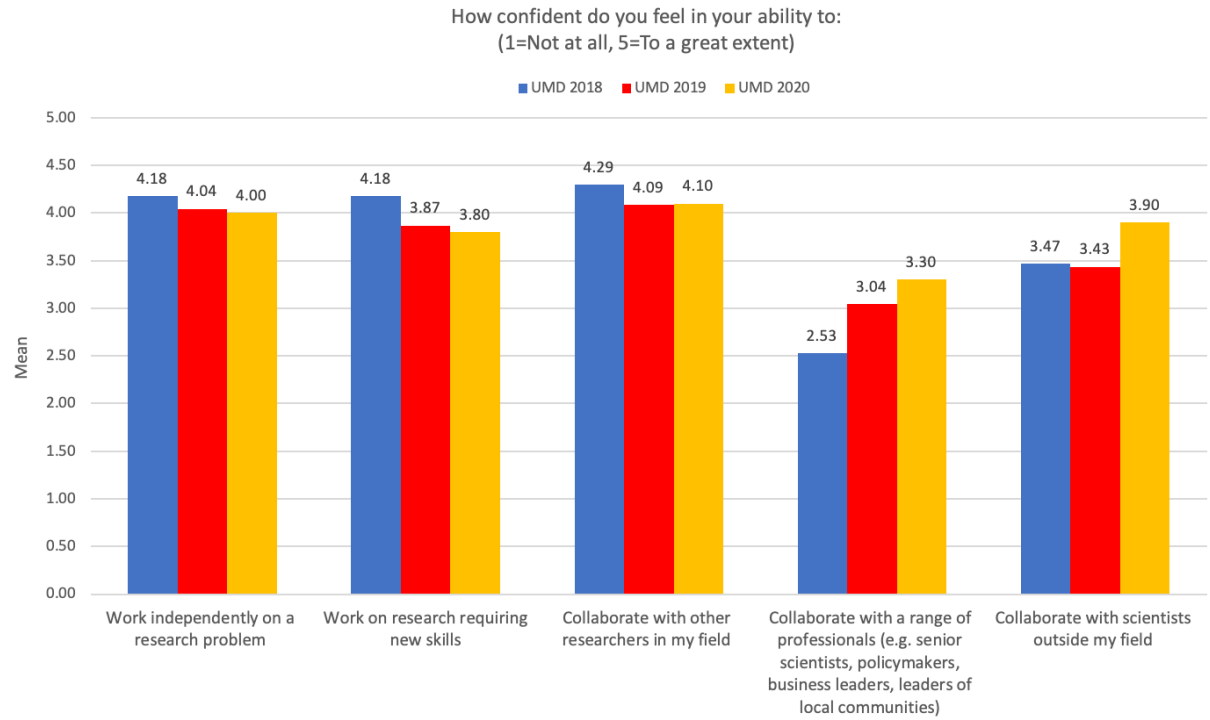
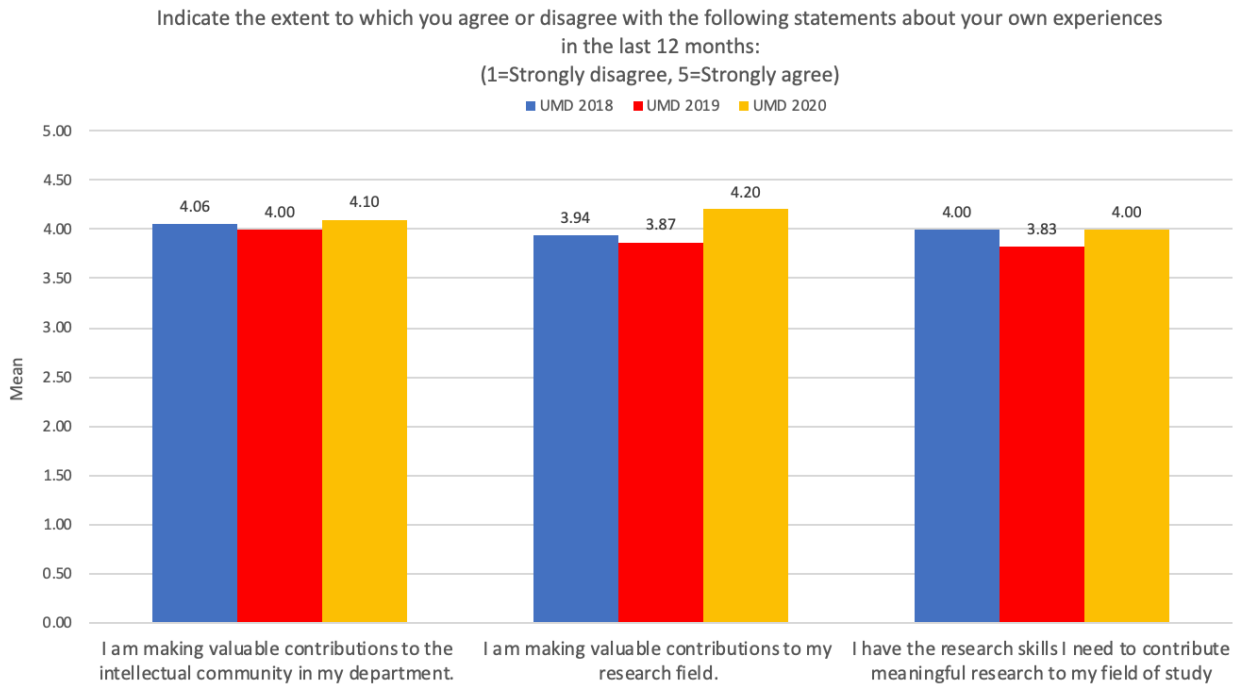


Figure 3. Student perspectives on agency as interdisciplinary researchers



(2) To change the nature of student professional networks

*Aspects of the NRT program that seem to **facilitate** network growth.*

- **Infrastructure of the Language Science Center.** Survey results (e.g., Figure 5) showed that NRT students reported that they had strong, positive network connections who provided feedback and support. By providing regular, formal and informal meetings of students and faculty from different departments and units across campus, the LSC provided a network structure that facilitated students' network growth. NRT students frequently mentioned that regular events like Language Science Lunch Talks and Winter Storm allowed them to develop their networks and to get access to individuals who shared their broad interest in the language sciences.

- **Academic offerings and interdisciplinary course plans.** Many students reported that interdisciplinary seminars and the requirement to take courses in other disciplines was the initial way that they developed interdisciplinary network connections with students and faculty. Thus, coursework represented a way for students to not only develop tangible research skills but also develop the social ties needed to establish their interdisciplinary network.

*Aspects of the NRT program or larger context that sometimes **constrain** network growth.*

- **Disciplinary and departmental divisions.** Though all students expressed that their networks had grown as a result of the NRT program, at least in terms of students and faculty that they knew in other departments or in other disciplines, students varied in the extent to which their cross-disciplinary networks had resulted in *deeper* network connections. While some students launched projects with students and faculty from outside of their own discipline, often as a result of a connection made in class or by participating in a meeting of an interdisciplinary research team during Winter Storm (e.g., Teams and Themes), other students indicated that they had only collaborated with students and faculty within their own departments. This indicates that the tendency towards associating with individuals from one's own discipline remained a salient tension in shaping NRT students' networks.

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

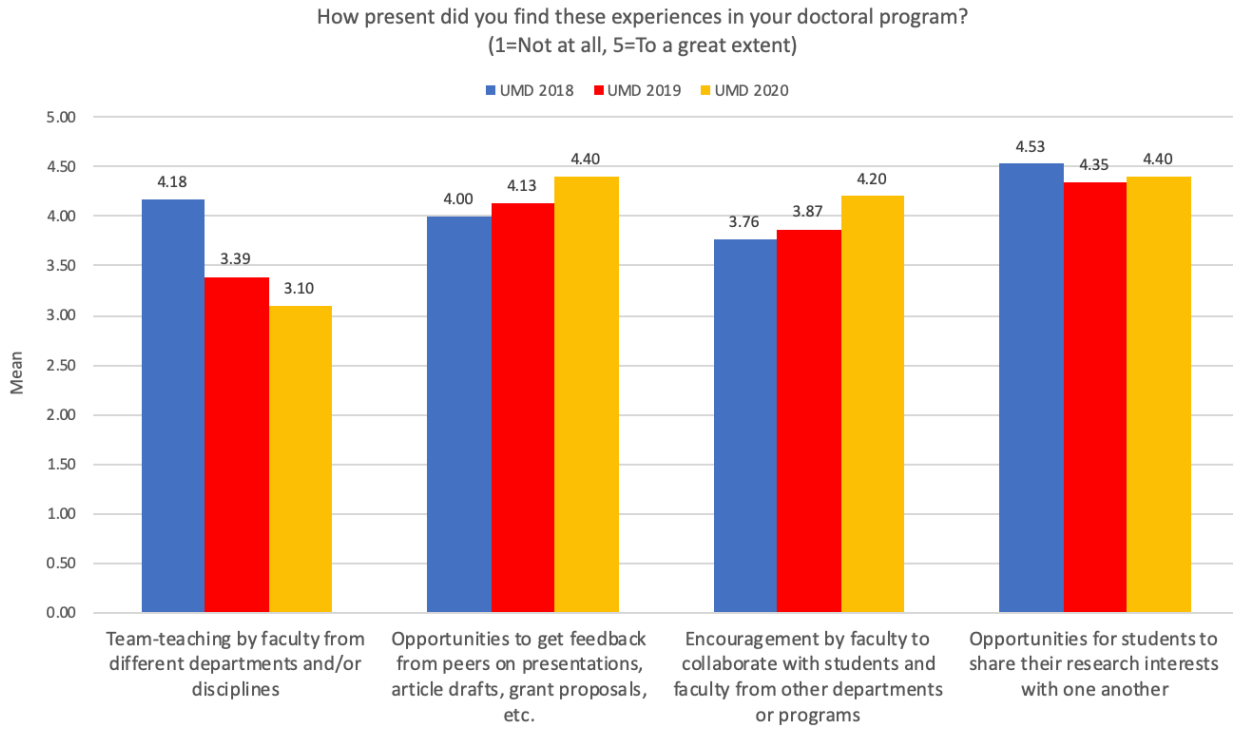
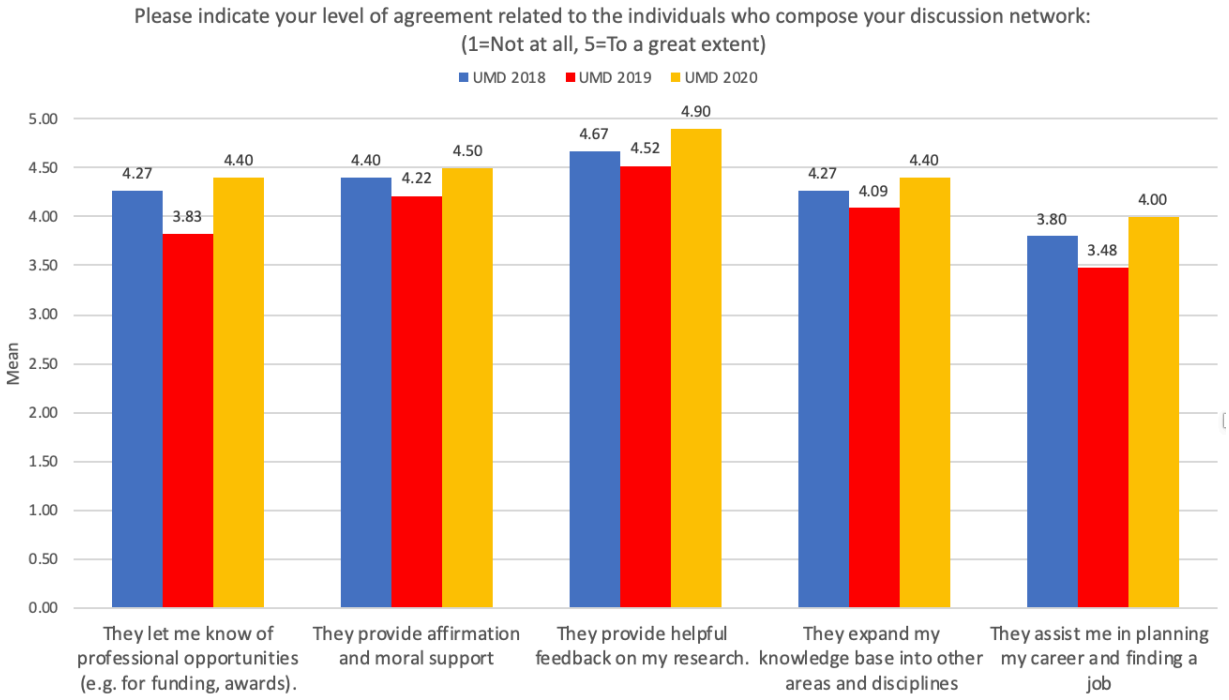


Figure 5. Individuals who compose student discussion networks



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

*Aspects of NRT program that seem to **<u>facilitate</u>** student understanding of research problems and contexts, or ability to communicate across audiences, channels, and goals.*

- **Presentations from and to interdisciplinary academic audiences.** NRT students frequently reported that attending and presenting at NRT events, particularly Language Science Lunch Talks, gave them opportunities to learn about the perspectives and methods of other disciplines and an increased understanding of how other disciplines view or interpret research problems.

- **Regular interdisciplinary feedback.** The expectation that NRT student give and receive feedback from interdisciplinary audiences was also incorporated in many NRT activities, such as Language Science Lunch Talks and Winter Storm. By giving and receiving feedback, students learned about the perspectives of other disciplines and also were able to practice how to frame their research problem for different audiences.

- **Outreach activities and practice with scientific communication.** Students who participated in outreach activities felt these experiences facilitated growth in communication skills and translation.

*Larger contexts that seemed to sometimes **constrain** student understanding of research problems and contexts, or ability to communicate across audiences, channels, and goals.*

- **Disciplinary orientations towards applied and theoretical work.** NRT students varied in the extent to which they felt as though their research interests had policy, applied, or "real-world" implications, often stemming from the disciplinary orientations of their fields. While NRT students in applied fields showed greater interest in considering how their research might impact social change, NRT students in more theoretical fields were often more hesitant to articulate how their research might be applied. Likewise, disciplinary orientations towards applied or theoretical research seemed to shape the kind of feedback students sought. Some students expressed a greater interest receiving feedback on theories or knowledge base than application or practice.

- **More limited access to non-academic audiences.** NRT students expressed slightly lower confidence in explaining research to non-academic audiences compared to peers or academics in other disciplines (Figure 6). Interview results suggested that although NRT students had exposure to non-academic audiences through activities like outreach, they still expressed less confidence in articulating the importance of research to non-academic audiences.

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

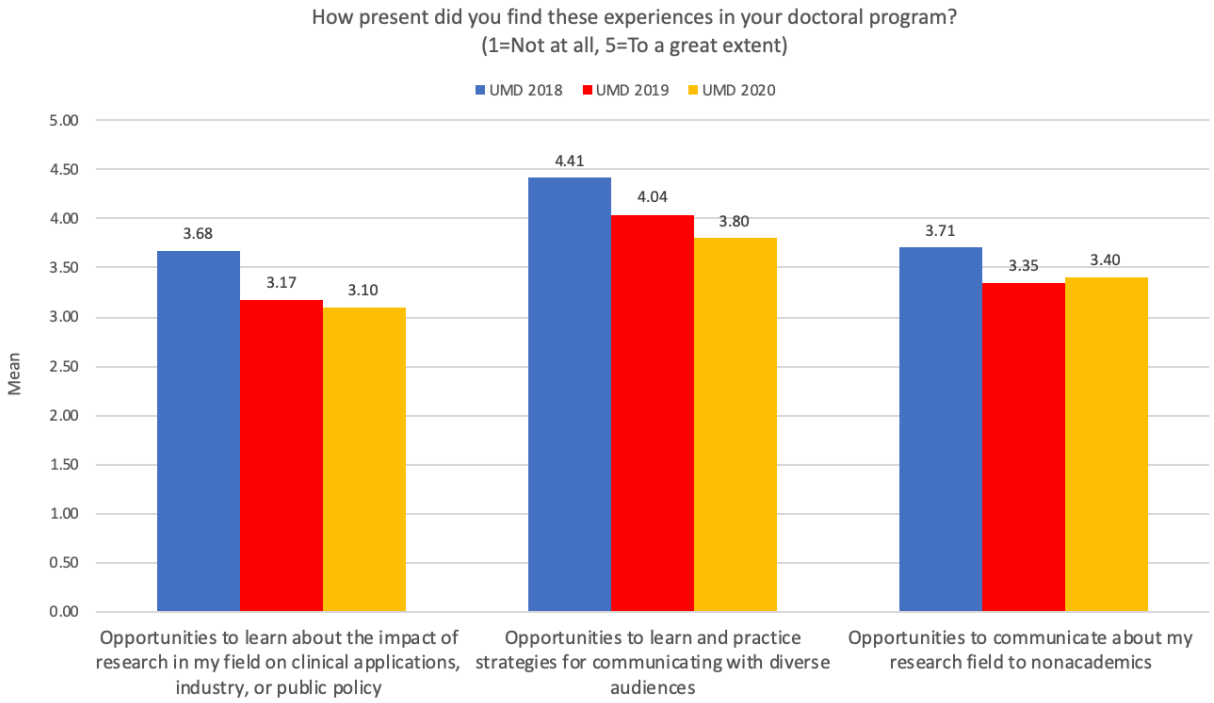
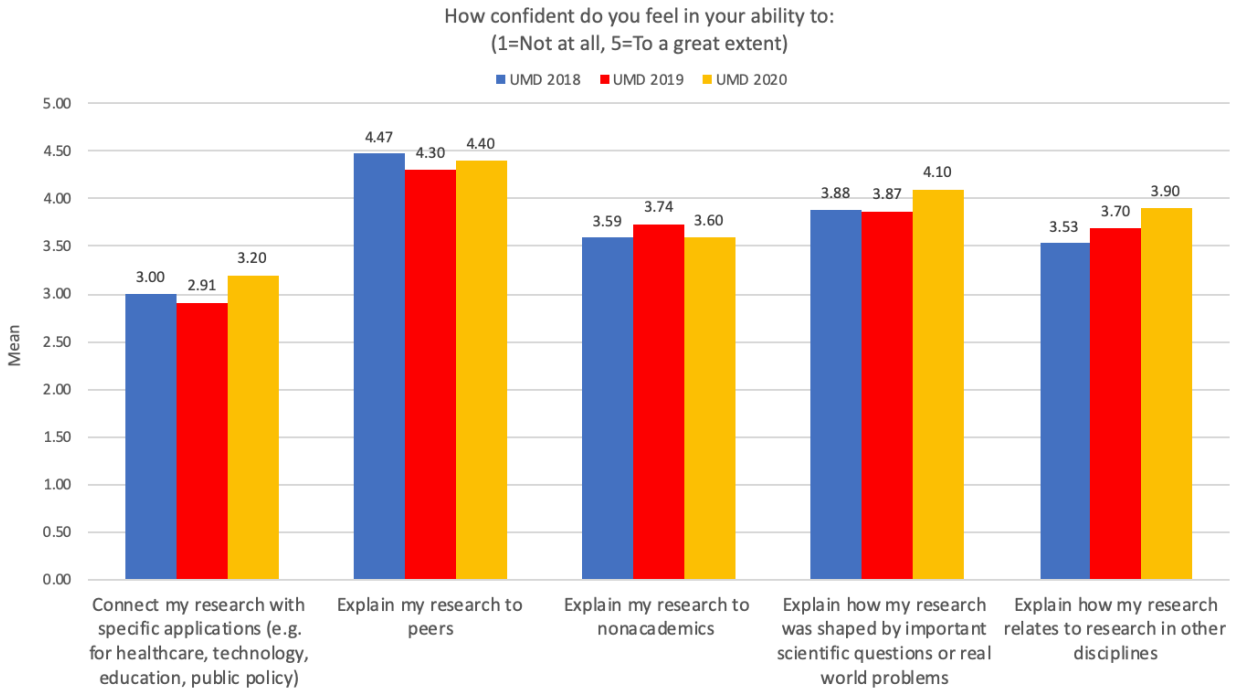


Figure 7. Student confidence in ability to connect research problems to context and/or to communicate to diverse audiences



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

*Aspects of NRT program that appear to **facilitate** students' ability to pursue a career within or outside of academia.*

- **Normalization of non-academic careers and "alt-ac" pathways.** One of the most important ways that the NRT program facilitate students' ability to pursue academic or non-academic careers was by giving students exposure to non-academic careers or "alt-academic" career pathways. NRT students (particularly those who were more interested in careers in industry) reported that the NRT program's professional development opportunities (e.g., internships, individual development plans) gave them insight into what non-academic career pathways could be.

- **Access to language scientists inside and outside of academia.** NRT students also reported that many NRT professional development opportunities allowed them to see non-academic career paths specifically related to language science (as opposed to more generic discussions of non-academic careers). Access to language scientists who pursued non-academic jobs and encouragement to conduct informational interviews with such individuals facilitated students' ability to understand how their specific skills could be used in industry, healthcare, etc.

Aspects of larger context relevant to this goal.

- **Duplication of professional development opportunities.** Although NRT professional development opportunities offered NRT students opportunities to explore non-academic careers, interviews with institutional informants showed that NRT students also had access to professional development from their departments, other graduate training programs, and from centralized UMD resources (e.g., the graduate school). These additional professional development opportunities meant that, at times, students felt as though the professional development offered through the NRT was redundant.

- **Lack of interest in non-academic careers.** Similarly, although NRT professional development activities appeared to be particularly useful for students interested in non-academic pathways, many NRT students expressed interest in academic careers and thus felt as though the emphasis on non-academic professional development did not meet their career interests.

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

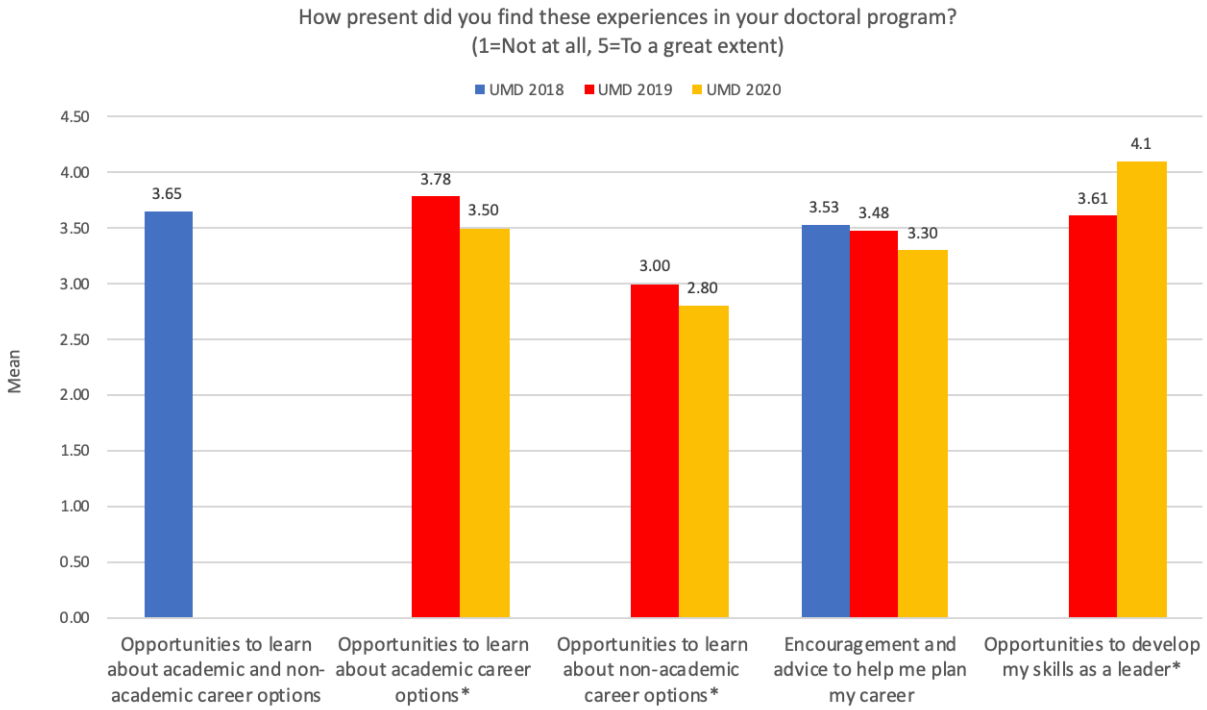


Figure 9. Student confidence in ability to pursue academic and non-academic careers

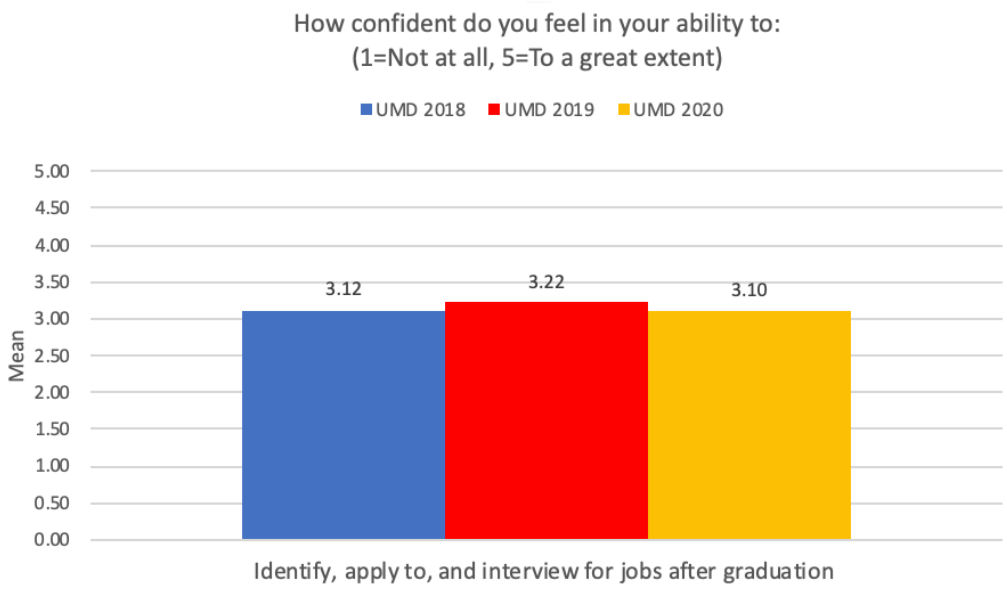
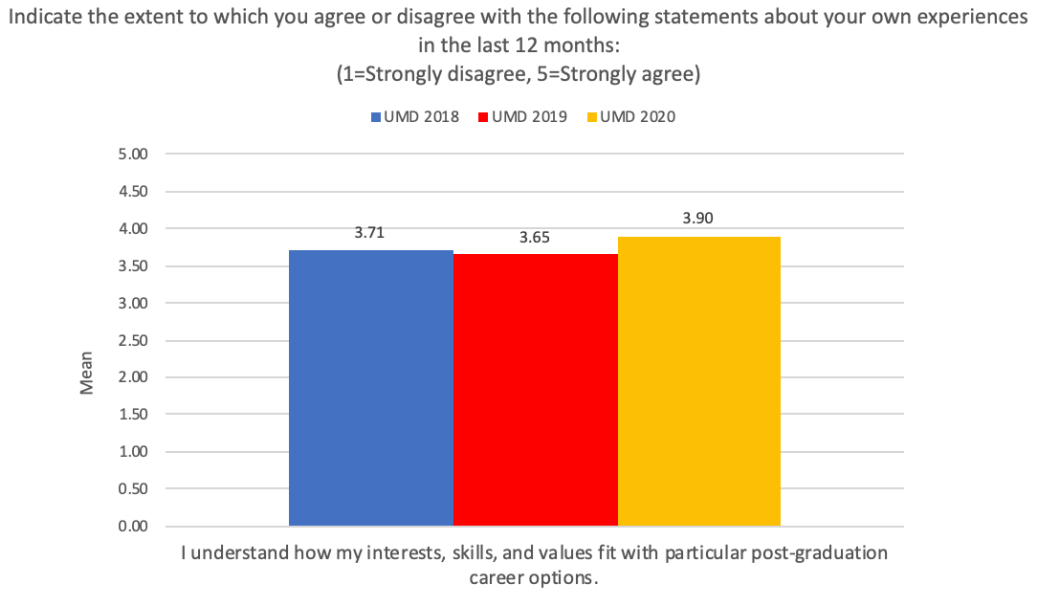


Figure 10. Student perspectives on ability to pursue careers post-graduation



Graduate Education Reform

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

- **Sharing best practices with programs and units on campus.** Interviews with campus administrators and faculty members indicated that the LSC experienced some success in sharing best practices with other units and graduate programs on campus. For example, other UMD NRT programs emulated the LSC's intensive, winter professional development program (Winter Storm). Administrators indicated that the LSC's success in attaining successive IGERT and NRT grants likely contributed to other units on campus

being awarded subsequent NRT grants in two ways. First, LSC leaders provided advice and mentorship to other UMD faculty members seeking NRT funding. Second, the national reputation of the LSC's NRT program helped other units make successful bids for funding. On the other hand, the spread of these best practices seemed more limited to units (primarily in STEM fields) that had applied to the NRT program. Greater attention could be paid to sharing practices with directors of graduate programs in professional fields and/or the humanities, the graduate school, and directly with graduate students.

- **Sharing best practices with other institutions.** Faculty members at other institutions frequently invited LSC leaders to share practices and lessons learned from the IGERT and NRT program. This appeared to happen more frequently with other language science programs, indicating that LSC leaders leveraged their own disciplinary/field networks to disseminate their results. For example, institutions like the University of Connecticut and Ohio State University appeared to adopt some of the LSC's practices (e.g., professional development activities, leadership opportunities). Greater attention could be paid to sharing results with associations and organizations outside of the language sciences (e.g., The Council of Graduate Schools, the Big 10 Academic Alliance, or other national higher education associations).

- **Reliance on external funding.** Interviews with campus administrators and faculty members revealed that one of the barriers to promoting interdisciplinary graduate education on campus was the reliance on external funds to support training activities. Faculty members and administrators indicated that LSC program staff were critical to the success of the program. Informants were skeptical that the LSC's success could be sustained without funds for central staffing and were unclear on how the structure would be sustained after the NSF grant ended.

Institutional Change

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

- **Structure for interdisciplinary networking.** Similar to results indicating that the LSC facilitated interdisciplinary student networks, we found some evidence that LSC activities fostered greater networking among faculty members interested in interdisciplinary collaboration. For instance, interviews with campus administrators (e.g., department chairs) indicated that by participating in the IGERT and NRT program, faculty members in certain units and departments (e.g., Linguistics, Hearing and Speech) had launched interdisciplinary collaborations (both research and teaching). Faculty members also gained greater awareness of potential research collaborators by attending LSC events such as Language Science Lunch Talks and Language Science Day, and through their students who participated in LSC events.

- **Workload and rewards barriers.** Many faculty members and administrators indicated that the LSC provided graduate students with training activities that departments and individual advisors would otherwise be unable to provide. However, even with centralized staff and programs, faculty members affiliated with the LSC often reported that it was difficult to manage their departmental service loads with LSC service requests (e.g., presence at weekly lunch talks or other events). Likewise, faculty members reported that service within the LSC was often not "counted" towards departmental service expectations. Combined, such factors undermined the extent to which some faculty members could participate in interdisciplinary research activities sponsored by the LSC.

Summary

This report summarized the internal evaluation of the University of Maryland's Language Science NRT program, conducted between 2015 and 2020. Overall, we found substantial evidence that the NRT program made progress towards its goals of enhancing student agency as interdisciplinary researchers, changing the nature of student professional networks, enhancing student understanding of research problems and contexts, enhancing student ability to communicate about research, and enhancing student career development. Evaluation results showed that training activities such as weekly research talks (Language Science Lunch Talks), professional development training (Winter Storm), interdisciplinary research teams and reading groups, outreach activities, interdisciplinary courses, leadership opportunities, and other NRT activities all contributed to student development in the five student goal areas. Although features of the larger academic context (e.g., organizational silos) and disciplinary forces (e.g., paradigms and orientations) sometimes constrained student development, the LSC overall provided a structure that facilitated interdisciplinary collaboration and student learning in the language sciences at UMD.

Results also indicated that LSC program leaders made progress, albeit more limited, towards their goals of sharing best practices in graduate training and reducing the barriers to interdisciplinary research for faculty. By providing mentoring and advice to other graduate programs interested in NRT funding (both at UMD and at other institutions), LSC program leaders disseminated best practices and lessons learned. While service expectations and workload concerns sometimes limited faculty involvement in LSC training activities, the LSC's NRT program also facilitated interdisciplinary collaboration between faculty members by enhancing their awareness of other faculty members interested in language science.

Tables and Figures

Table 1. Data Sources

Type of Source	Date	Number of Participants*
Observations		
Community Meetings (2)	Spring 2015, Fall 2017	20-40
Language Science Day (3)	Fall 2015, 2017, 2018	200
Winter Storm (4)	Winter 2016, 2017, 2018, 2019	50
Outreach Activities (3)	Spring 2016, Fall 2017, Spring 2018	20-250
Language Science Lunch Talk (6)	Fall 2016, Spring 2017, Fall 2017 (2), Spring 2018 (2)	20-30
Lunch Talk	Spring 2017	25
Lunch Talks (2)	Fall 2017	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	Fall 2016	4
Student Focus Group 2 was attended by active NRT fellows only.	Fall 2016	11
Faculty Focus Group 2	Spring 2016	7
Faculty Focus Group 3	Fall 2017	3
Student Focus Group 3 was attended by active NRT fellows only.	Spring 2018	13
One-on-one Interviews		
Interviews with Cohort 1 and 2 students	Fall 2016	5
Interviews with the remaining Cohort 1, 2, and 3 students.	Spring 2017-Fall 2017	8
Interviews with Cohort 4 students	Spring 2018	6

Follow-up interviews with Cohort 1 students graduating in 2018	Spring 2018	6
Institutional Informant Interviews	Fall 2018-Spring 2019	6
Follow-up interviews with Cohort 2 graduating students	Spring 2019	3
Interviews with Cohort 5 students	Fall 2019	4
Student Applications and Progress Reports		
Students submit applications to join the NRT fellowship.	Fall 2014 – Fall 2019	25
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	13
Student Surveys		
NRT Student Survey Wave 1	Fall 2017-Spring 2018	17 (UMD), 28 (Non-UMD)
NRT Student Survey Wave 2	Fall 2018-Spring 2019	23 (UMD), 37 (Non-UMD)
NRT Student Survey Wave 3	Fall 2019/Spring 2020	10 (UMD)

*Participant numbers for observations are approximate

Table 2. NRT program activities students mentioned as contributing to their development

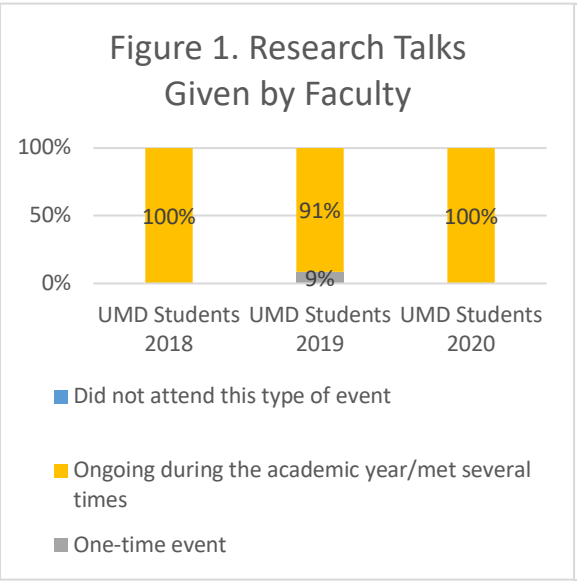
Goals/Activities	Language Science Lunch Talks	Policy Internship/ Policy Activities	Winter Storm	Language Science Day	Outreach	Committee Leadership	Interdisciplinary Courses (co-taught, cross-listed)	Interdisciplinary Research Teams/ Reading Groups
(1) To enhance doctoral student agency as interdisciplinary researchers	18% (4)		32% (7)		5% (1)	37% (8)	45% (10)	18% (4)
(2) To change the nature of student professional networks	50% (11)		50% (11)	37% (8)	18% (4)	23% (5)	50% (11)	37% (8)
(3) To enhance student understanding of particular research problems and the relationship between research problems and contexts	50% (11)	18% (4)	14% (3)	18% (4)	9% (2)	9% (2)	45% (10)	23% (5)
(4) To enhance student ability to communicate about research problems and their contexts, and adjust their communication according to the audience, channel, and goals	59% (13)	3	23% (5)		41% (9)	9% (2)		9% (2)

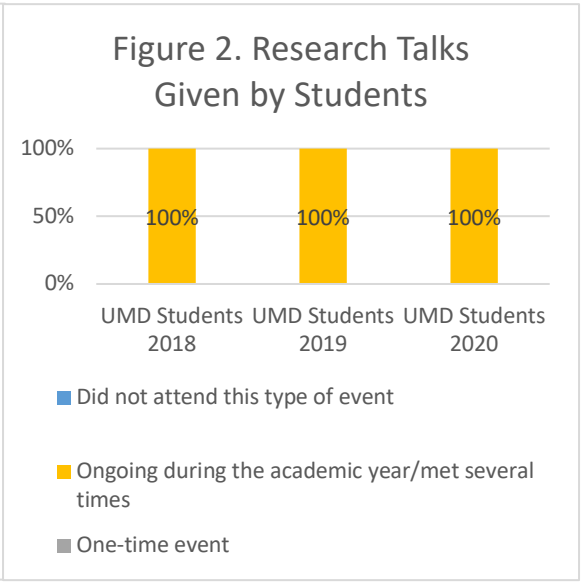
(5) To enhance student ability to choose and successfully pursue a career within or outside academia			5% (1)		5% (1)	9% (2)		5% (1)

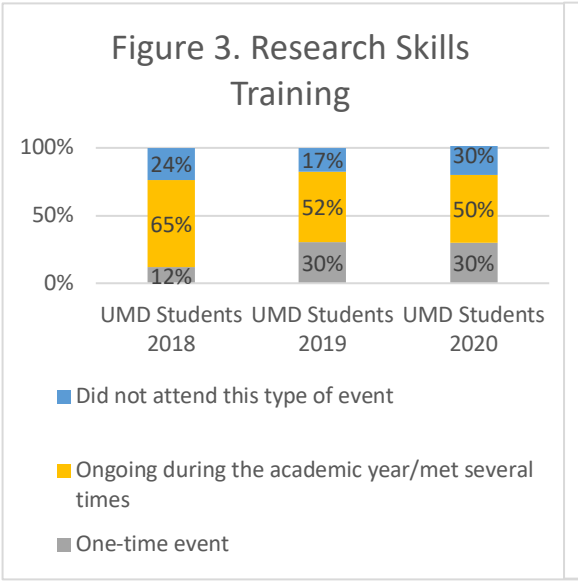
In this table, we describe the NRT project activities that appeared to most contribute to student development along the five student-related NRT program goals. The table is based on interviews with NRT students. Between 2016 and 2019, 25 NRT students were invited to participated in interviews about their experiences in the NRT program. Of those 25, 23 students (92%) opted to participate in the interview. Students were interviewed about mid-way through their participation in the NRT program (typically in the third or fourth year of their doctoral program, or second or third year of participating in the NRT program). To create this table, we coded each student interview transcript (*N*=22) and counted the number of students who mentioned development in a certain area (e.g., student agency) as related to a certain project activity (e.g., outreach activities). We then calculated the percentage of students (X/X) who mentioned the activity as contributing to their development in a certain area.

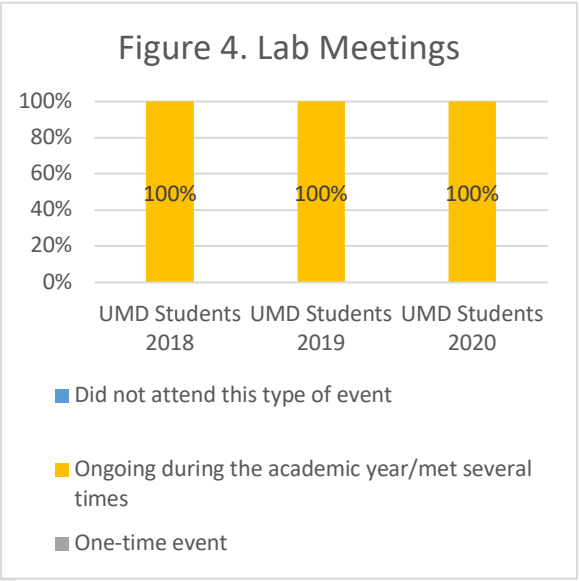
We caution overinterpreting the data presented in this table. First, interview and focus group data showed that NRT students demonstrated substantial growth in many of the stated goal areas; however, often students attributed growth to the NRT program more broadly as opposed to identifying specific program activities that contributed to their development.

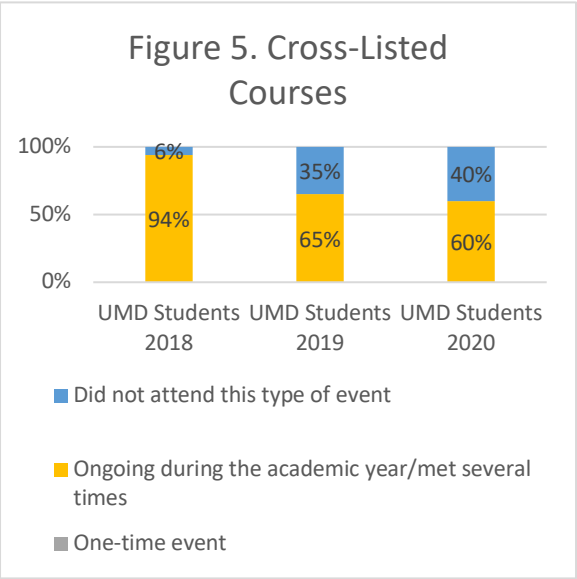
Figures 1-7. *UMD NRT Student Participation in Graduate Student Training Activities: Research-Related Activities*

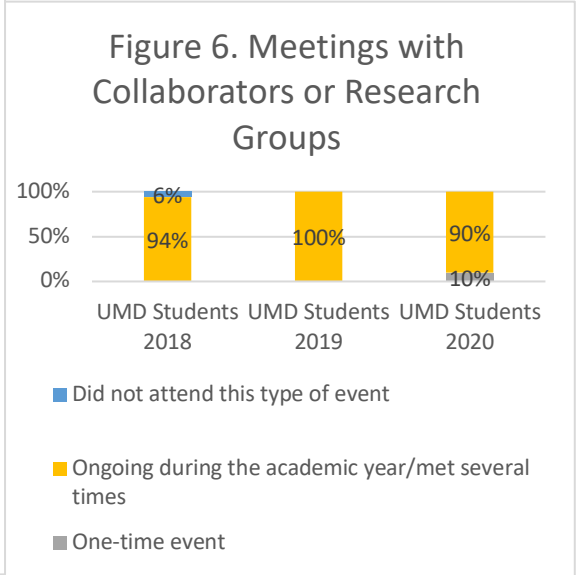


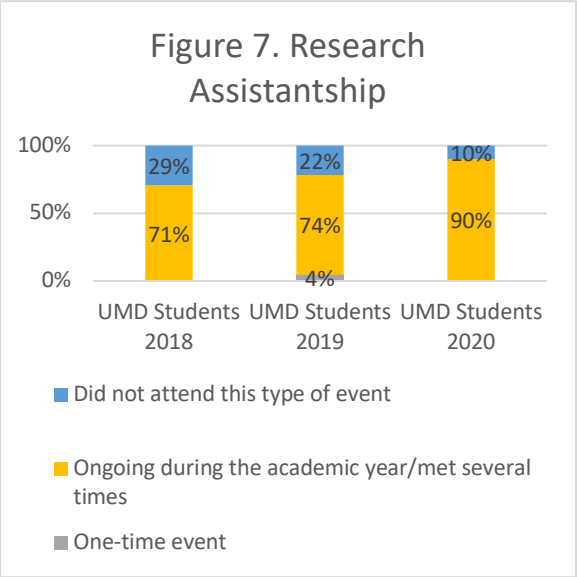




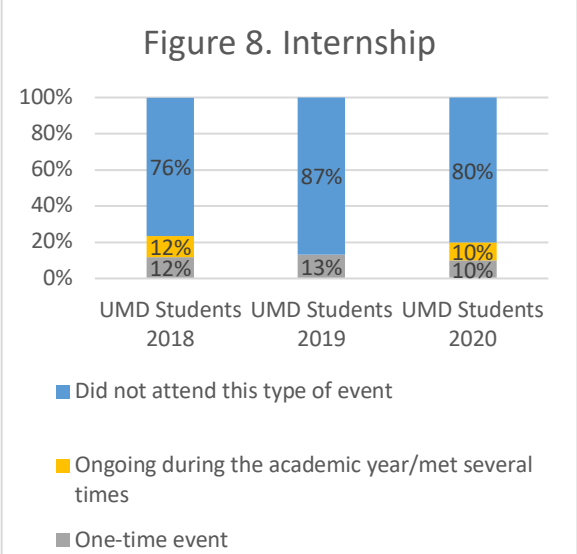


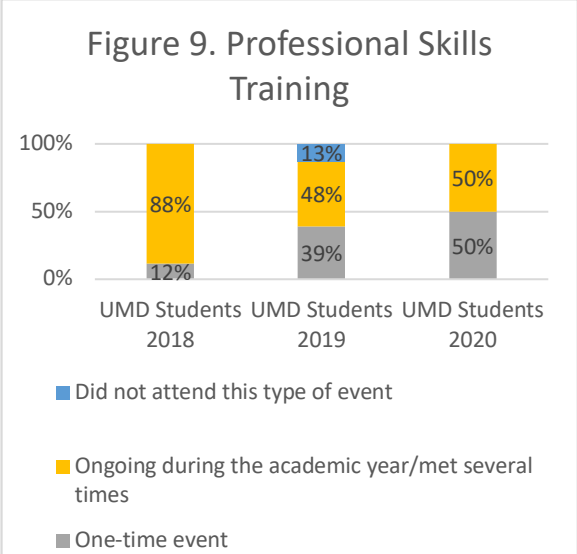


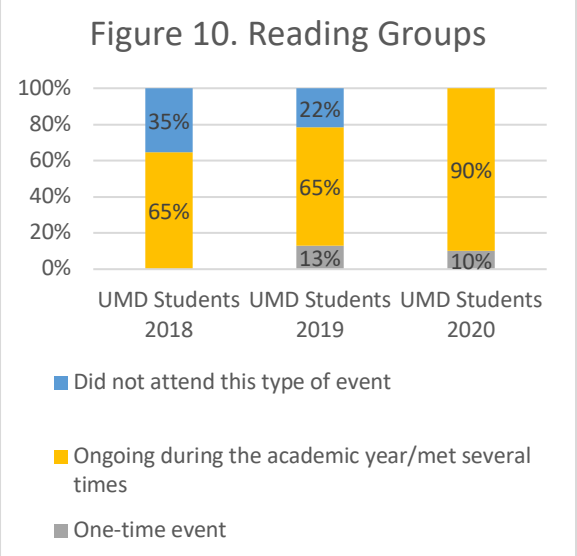


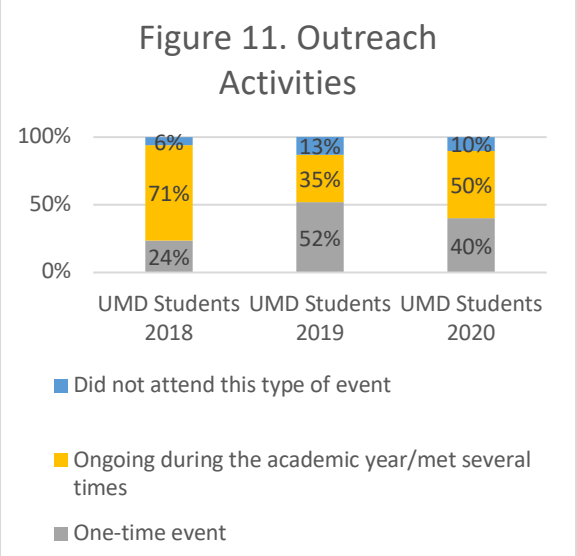


Figures 8-12. ***UMD NRT Student Participation in Graduate Student Training Activities: Professional Development Activities***









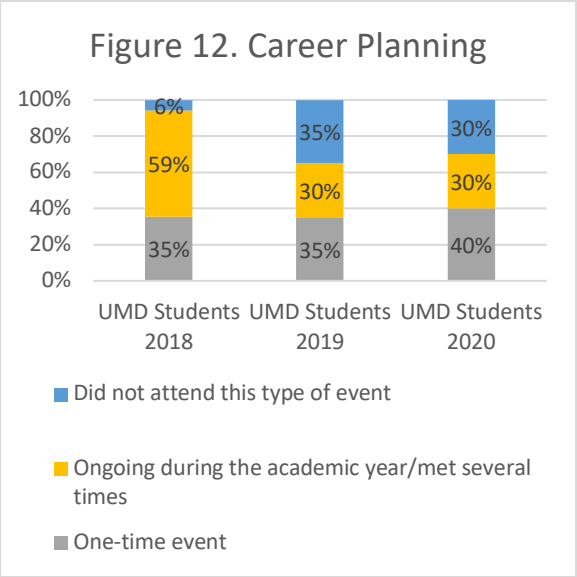
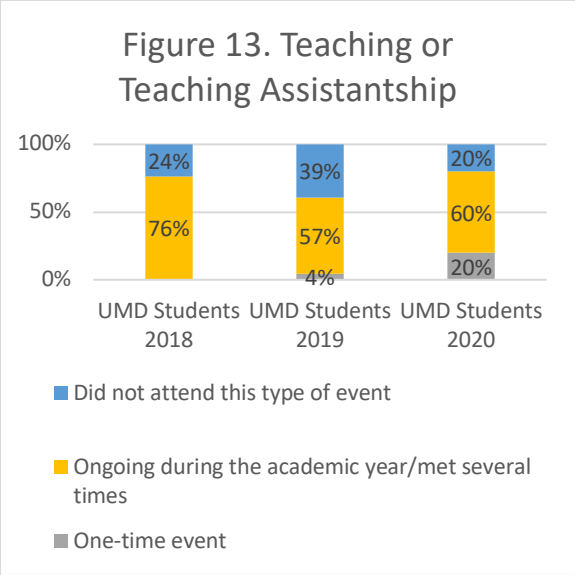


Figure 13. ***UMD NRT Student Participation in Graduate Student Training Activities: Other Activities***



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Appendix A: UMD NRT 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

Appendix B: Presentation and Paper Abstracts

PRESENTATIONS

1. O'Meara, K., & Culpepper, D. (2019, November). *Fostering collisions in interdisciplinary graduate education: A social physics approach.* Paper presentation at the Association for the Study of Higher Education Annual Meeting; Portland, OR.
2. 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.
3. 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. (under review). Fostering collisions in interdisciplinary graduate education: A social physics approach. *Studies in Graduate and Postdoctoral Education.*
Abstract: 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., O'Meara, K., & Ramirez, A. (2020). Plugging in: How one graduate program shaped doctoral students' scholarly identities as interdisciplinary scientists. *International Journal of Doctoral Studies.*
Abstract: 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.
3. 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).