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ARTICLE
Integrating Intercultural Competence into a Neuroscience Curriculum through a Short-Term Study Abroad Program

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We sought to enrich our neuroscience curriculum by developing a study abroad program that would address curricular goals and requirements at several levels. "Neuroscience and Technology in Germany" was designed to include a diversity of participants, integrate intercultural competence in participants, fulfill university core curriculum requirements, build on the Science, Technology, Engineering, and Math (STEM) foundation of our major, and fulfill major electives. We also hoped that it would serve as a synthetic experience allowing students to integrate foundational coursework with novel ideas and real-world research applications. We developed an itinerary that balanced multiple activities to meet those goals. We included scientific visits, STEM-focused museums, and significant cultural and historical sites. Scientific visits covered a range of topics in the field of neuroscience including cellular and pharmacological neuroscience, development, cognition, mental illness, artificial intelligence, and the mind-body problem. Pre-visit academic activities included review lectures on general topics (e.g., visual system), scaffolded literature reading, and discussion of previous literature from our hosts. Post-visit academic activities integrated previous foundational curriculum with new research. Cultural historical activities encouraged comparison between a student's home culture, predominant North American culture, and German culture. The first iteration was successful academically and logistically. In post-program surveys, 87.5% of students felt the program had met the learning objectives (*n*=16). Students agreed that scientific visits and preparatory lectures were relevant to the learning objectives, together with several cultural and historical visits. Students responded positively to an outing to the mountains and found a concentration camp memorial visit moving. They nearly universally reported that the program led to their personal growth. Students did not find several guided tours of STEM-related sites were relevant to our learning objectives, and opinions were mixed as to the balance of structured vs. unstructured time, balance of scientific vs. historical/cultural activities, and how to schedule free time. Students asked for more scientific background preparation, so we modified the upcoming iteration to include a "Neuroscience Boot Camp" prior to departure. We also selected guided tours more carefully and modified scheduling according to student feedback.

Key words: study abroad; Germany; neuroscience

Undergraduate programs in neuroscience continue to grow at all types of institutions from small liberal arts to Carnegie R1 (Rochon et al., 2019). Many institutions have a goal to train their graduates in diversity, equity and inclusion, and may include a focus on intercultural competence (Starr et al., 2022).

George Mason University (Mason) is a Carnegie R1 institution in the Washington, DC environs. It is the largest and most diverse university in Virginia. The Bachelor of Science in Neuroscience was established in 2006, and currently has approximately 300 majors. We are continually seeking to improve our curriculum and course offerings, with a particular focus on increasing students' interactions with research.

Study abroad opportunities are popular, but there were no short-term, faculty-led programs directly for neuroscience majors at Mason prior to the program described herein. Students in neuroscience and related fields had difficulty finding study abroad experiences that could be applied to their major requirements. Here, we describe the initial development of a short-term study abroad program for neuroscience students in Germany, with a particular emphasis on how it fits into the broader curriculum of our major and university core requirements.

Our goals in the development of this study abroad program were to simultaneously address our curricular deficiencies, to host a diverse group of students in the program, and to balance the demands of learning objective achievement, student affordability, and faculty workload.

We developed a short-term, faculty-led study abroad program that centered around visits to neuroscience research laboratories in Germany. In our first iteration, we visited six host labs with diverse research topics ranging from molecular neuropharmacology to artificial intelligence, hearing about the current research projects and interacting with scientific hosts. We included visits to STEM-focused museums that covered a variety of topics such as nitrogen fixation, development of the printing press, discovery of the x-ray, and the history of pharmacy. In addition, we explored sites of cultural and historical significance such as a museum dedicated to the polymath Hildegard of Bingen, and the Ravensbrück concentration camp and Memorial discussing medical experimentation during World War II.

METHODS

Curriculum Development

When designing the curriculum for our study abroad program, we aimed to maximize the application of course credit to degree requirements. Developing courses that could be applied to both Mason's general education curriculum, termed the Mason Core, and the neuroscience major requirements offered students the greatest benefit. We reasoned that curricular efficiency would attract students that would otherwise not consider studying abroad.

We planned to run a six semester hour (SH) program, where students would earn credit for two, three-SH courses while fulfilling up to 4 separate requirements: two Mason Core courses and two neuroscience elective courses. Courses in the Mason Core can count for more than one category, up to 6 SH (George Mason University, 2023). We carefully designed our itinerary and activities to meet contact-hour requirements and learning objectives (LOs) for both the neuroscience program and the Mason Core curriculum. We had the following curricular goals:

1. Develop six SH of coursework.
2. Some or all of the SH should fulfill Mason Core requirements.
3. Courses should serve as neuroscience electives.
4. Courses should be attractive to non-neuroscience majors.
5. Courses should challenge students to integrate knowledge acquired from multiple courses and experiences.
6. The experience should develop the intercultural competence of the participants.

Developing Six Semester Hours of Coursework

We developed two new three SH courses to teach during our study abroad, for a total of six SH (please see syllabus supplement 1). Six SH is considered full-time for the summer term and enables students to apply financial aid toward the program fee. Therefore, a six SH program makes the experience accessible to students who otherwise might not be able to afford it.

Per our accrediting body, 15 contact hours per SH are required. We worked closely with our Global Education Office (GEO) for a definition of contact hours in the study abroad context. Our itinerary and activities, described below, were carefully planned to meet the 90 contact hours required. Both courses were developed as new courses and therefore needed to be approved by the curriculum committees at the college and university level. *NEUR 355: Cross Cultural Studies in Scientific Inquiry* focused mostly on the cultural and historical aspects of our experiences, and *NEUR 473: Current Neuroscience Research in Germany* was designed to focus on the scientific and innovative aspects of our host country. We developed our curriculum around the learning objectives for these courses (Table 1).

Meeting Mason Core Requirements

Readers are encouraged to consider whether new

Learning Objectives
• Explain how the scientific research system differs between Germany and the US
• Communicate and interact with international scientists about their work
• Describe the research and impact of research happening in the laboratories we visit, to include work related to neurodevelopment, optogenetics, artificial intelligence, glial biology, and more
• Develop logical follow-up studies based on our laboratory visits
• Explore the world historical and cultural impact of scientific discoveries in Germany
• Discuss the cultural differences observed between the German culture and subcultures and those of your own predominant North American culture and the cultures of your families of origin
• Analyze experiences in light of scientific, historical and cultural readings based on provided prompts

Table 1. Neuroscience and Technology in Germany learning objectives.

neuroscience-based study abroad programs can be designed to be used in their institution's core curriculum. For example, all Mason undergraduate students are required to take a three SH "Global Understanding" course and a three SH "Synthesis or Capstone" course (George Mason University, 2023), among others, as part of the Mason Core. Before our study abroad program, there were no NEUR-specific course options for "Global Understanding" or "Synthesis", so students took courses outside the major to fulfill these requirements. Developing courses that met Mason Core requirements allowed students to incorporate more neuroscience into their degree program. Moreover, Biology, Psychology, and Bioengineering students are also required to fulfill the "Synthesis" and "Global Understanding" requirements, making the program attractive to a broader audience.

Meeting Upper-Level Neuroscience Major Requirements

Mason's neuroscience major is interdisciplinary, incorporating the Mason Core, STEM foundation courses, a neuroscience core, and neuroscience electives. Neuroscience electives comprise 23 SH, though the number of NEUR-specific offerings each semester is limited. We developed our study abroad courses to apply as neuroscience electives, expanding the options to enrich neuroscience-specific elective offerings in the curriculum. Additionally, a six SH program can fulfill over a quarter of the neuroscience elective requirement in under four weeks.

Attracting Non-Neuroscience Students Through Collaborative Interdepartmental Course Development

We considered that students from other majors may also be interested in the program, and that including a diversity of academic perspectives would benefit all. To this end, we collaborated with the Biology, Psychology, and Bioengineering programs to cross-list our study abroad courses with Special Topics courses in these majors (e.g., *BIOL 435: Selected Topics in Biology*). This had the benefit of facilitating participation of students from these majors, widening the group from which we could recruit, and strengthening campus partnerships. In addition, we obtained an "integrative studies" designation, which allowed students from any major to participate as long as they met the prerequisites for the program. Ultimately, participants had seven different course numbers to choose from for the same two courses. All courses had the same academic requirements (except for one assignment for bioengineering majors). We discovered that students were confused as to which course numbers they should register for during enrollment. Future iterations of the program will include more targeted academic advising of participants for course selection.

Offering More Integrative Content in the Curriculum

We sought to develop a curriculum that integrated and synthesized learning from multiple courses, topics, and levels. In our study abroad program, students used their STEM foundation of biology, chemistry, physics, math, and statistics to evaluate papers, understand research projects, and ask questions of host investigators. In addition, these activities solidified learning from our neuroscience core curriculum. Most importantly, offering a short-term, intensive course allowed better student access to integrative activities. For example, volunteering in a research lab during the semester is a highly integrative activity, but may not be accessible to students with heavy work or family obligations.

Selecting Participants

Neuroscience Majors and Students in Related Fields

We targeted marketing to neuroscience, psychology, biology, and bioengineering majors through class visits, email, and reaching out to professors and advisors in those majors. Furthermore, we opened the program to students from other universities and community college students that had met the prerequisites. In addition to including a diverse pool of participants, we wanted to have a large pool of potential applicants for financial viability.

Selection Process

Due to the integrative nature of the courses and the direct interpersonal interactions with host scientists, we utilized student selection criteria that would allow for a diverse but well-prepared applicant pool. Students were required to have earned a C or better in a cell biology course, have nine SH of courses in neuroscience, biology, psychology or bioengineering, have a 2.75 overall GPA, and undergo a selection interview.

Interviews occurred via Zoom and were 30-minutes (requiring 10-12 hours per faculty total). The questions of the interview were intended to assess interest, academic preparation, ability to articulate scientific concepts, and travel readiness. We also attempted to set expectations. For example, it was important that students understood these courses would be academically intensive. We felt this initial screening, while more rigorous and faculty time-intensive than other study abroad programs, was necessary to assure students gained the most out of the program and were prepared for interacting with the hosts (Please see interview questions, supplement 2).

Thirty students completed applications, met the prerequisite criteria, and were invited for interviews. Twenty-four students were interviewed, and 23 were accepted. Ultimately, 16 students committed to the program, including one community college student, one bioengineering major, one biology major, and 13 neuroscience majors. All were juniors and seniors, except one sophomore. Therefore, we achieved our goal of having an academically diverse group and including enough students to provide financial viability.

Working with the Global Education Office at Mason

In developing both the curriculum and logistics of the course, we chose to "utilize the existing infrastructure" (Ruscio and Korey, 2012). Mason has a small but scrappy Global Education Office (GEO) that coordinates study abroad activities. They were very helpful in the design, marketing, and implementation of the program. The GEO also managed the fiscal aspects of the program, developed our budget, and managed limitations. For example, because Neuroscience and Technology in Germany employed two instructors, we needed at least 16 students for financial viability.

Developing Scientific Visits

One of the instructors, Dr. Herin, was trained post-doctorally in Germany and had a network of co-trainees that became principal investigators. Most of the lab visits were arranged through email and social media contacts with her network. A pre-course discovery trip was planned, but was canceled due to the COVID pandemic for both 2020 and 2021. We therefore lead the program without previously vetting scientific visits, sites, and logistics. Scientific visits were usually a half-day and consisted of a lab tour, research talks, and time to interact and discuss research with the host lab members.

We arranged visits with hosts whose work spanned many of the Society for Neuroscience themes (Table 2) and a range of topics, with an emphasis on the theme of neural excitability, synapses, and glia. Most of our students had foundational knowledge in this area from their courses, allowing for meaningful interactions with the hosts. The levels of analysis covered ranged from molecular to philosophical: molecular pharmacology (Nicke), optogenetics and tool development (Nagel and Gao), cell biology (Madry), circuits (Geiger), systems (Weigelt), mental illness (Uhlhaas), and theoretical/ artificial intelligence (Nikolić; Table 2).

Logistics

We worked with a service provider, Customized Educational Programs Abroad (CEPA), to organize lodging, transportation, and other logistics outside of the scientific visits. For lodging, we used a hub system in which we stayed in a major city and made day trips from our lodging (Table 3). This minimized the travel "wear-and-tear" on the students. The instructors worked to keep costs down for the program when working with the service provider. For example, we rearranged the potential itinerary when we discovered that there was going to be a conference in one of our hub cities that would drive the cost of lodging up.

We used public transportation for most transfers for several reasons: 1) the system of public transportation in Germany is extensive, affordable, and efficient; 2) we desired to keep the carbon footprint of the program low; 3) learning to use the public transportation system was a part of the cross-cultural experience; and 4) we wanted to develop intercultural competence in the students by integration with German residents as much as possible. We utilized private coaches for a few transfers in which using the public transport would have hindered our learning objectives for that day.

The students had a brief introductory German lesson but did not need to speak German to participate in the required activities of the program. The international language of science is English, and all presentations in labs and museums were in English, though a few of the museums we visited did not have English interpretations for the visuals.

Host and Institution	SFN Themes and Topics	Topics covered in visit
Sarah Weigelt-Technical University Dortmund	Development; Sensory Systems Vision	• Development of the visual system in humans • fMRI studies in children • Public health approaches to myopia
Danko Nikolić-Frankfurt Institute for Advanced Study	Cognition Computation, modeling, and simulation	• Practopoiesis- a philosophical explanation of the mind-body problem • AI in neuroscience
Georg Nagel and Shiqiang Gao- Julius Maximilians University of Würzburg	Physiological methods	• Development of optogenetic tools and applications in neuroscience and biology
Annette Nicke-Ludwig Maximilians University Munich	Transmitter Receptors and Ligand-Gated Ion Channels	• P2X and nicotinic receptor pharmacology
Christian Madry-Charité Medical University Berlin	Glial Mechanisms Neurodegenerative Disorders and Injury	• Microglia physiology in health and disease
Jörg Geiger-Charité Medical University Berlin	Neural Excitability, Synapses and Glia Synaptic Plasticity	• Physiology of interneurons in cortical networks • Multi-neuron patch-clamp in animal and human brain slices
Peter Uhlhaas-Charité Medical University Berlin	Schizophrenia	• Neurophysiology of cognitive dysfunction • Developing biomarkers of schizophrenia using EEG and EMG

Table 2. Laboratory hosts, locations, associated SFN themes, and topics.

Day	Base City	Activities
-2	Fairfax, VA	Orientation at Mason
-1	Fairfax, VA	Orientation at Mason
0	Fly	Fly to Germany
1	Frankfurt	Arrival | Orientation | Welcome Dinner
2	Frankfurt	Academic Overview | Free Time
3	Frankfurt	German Lessons | Frankfurt City Tour
4	Frankfurt	Lecture | Individual Check-ins with Students
5	Frankfurt	Dortmund Day Trip: Sarah Weigelt Lab Visit at Technisches Universität Dortmund
6	Frankfurt	Lecture | Danko Nikolić Lab Visit
7	Frankfurt	Heidelberg Day Trip: Choose 2 from Pharmacy Museum, Prinzhorn Museum, and Bosch Museum
8	Frankfurt	Mainz and Bingen am Rhein Day Trip: Gutenberg Museum Guided Tour and Workshop | Museum am Strom
9	Frankfurt	Würzburg Day Trip: Würzburg City Tour, Georg Nagel Lab Visit at University Würzburg, and Röntgen Memorial Tour
10	Frankfurt	Free Day
11	Frankfurt	Free Day
12	Frankfurt / Munich	Travel to Munich | Orientation
13	Munich	Munich City Tour | Lecture
14	Munich	Deutsches Museum Guided Tour
15	Munich	Zugspitze Day Trip
16	Munich	Annette Nicke Lab Visit at Technisches Universität Munich
17	Munich / Berlin	Travel to Berlin | Orientation
18	Berlin	Ravensbrück Memorial | Group Discussion
19	Berlin	Berlin Adlershof Technology and Media Park Tour | Lecture
20	Berlin	Christian Madry, Jörg Geiger, and Peter Uhlhaas Lab Visits at Charité/ Humboldt University
21	Berlin	Prepare Presentations
22	Berlin	Presentations | Celebration Meal
23	Fly	Fly Home

Table 3. Itinerary for 2022 Neuroscience and Technology in Germany Study Abroad.

The academic portion of the program included preparatory lectures in the host scientific team's research area to prepare students for interacting with the hosts. Surprisingly, a major cost of the program was classroom/meeting space. For this reason, we tried to minimize use of formal classroom space by planning lectures and discussions in parks (risky with the weather), hotel lobbies (not private), and on chartered buses (hard to hear). Future iterations of the program will seek more low-cost formal meeting spaces and a include a "Neuroscience Boot Camp" prior to departure.

We chose to utilize two instructors for a variety of reasons. 1. The instructors had diverse and complementary expertise. Dr. Lewis is trained in developmental neurobiology with technical expertise in model organisms and imaging techniques, and Dr. Herin is trained as a molecular pharmacologist with technical expertise in electrophysiology. 2. The workload for setting up the first iteration of the course was considerable. 3. With COVID still a threat, two instructors could provide a back-up in case one instructor became ill or needed to stay with a student who fell ill. 4. Potential interpersonal conflict among students could more easily be diffused with two instructors. 5. Grading and presentation duties were divided, making the in-country workload more manageable.

Managing Costs

Studying abroad can be cost-prohibitive for many students. As outlined above, we sought to make the program as accessible as possible to a diversity of students through curricular density (fulfilling up to four course requirements), interdepartmental collaboration, and financial aid eligibility. Costs for faculty-led programs like ours can be crudely divided into two aspects: tuition for six SH and the cost of travel. Eligible students may use financial aid to pay for the tuition, according to their financial aid packages. We encouraged students to speak with their financial aid counselors about their individual situations.

The program fee for the second iteration (2024) is projected to be $5,995, including $3,253 tuition and $2,742 travel expenses.

Tuition of $3,253 includes:

- 6 SH of in-state tuition
- Salary of one faculty (split between two leaders)
- Books and program materials
- Meeting spaces

Travel expenses of $2,742 include:

- All accommodations including breakfasts
- Two celebration meals
- All program-related transportation
- Cultural visits and tours (Figure 1)
- Entry to museums and guides
- Guided city and site tours
- All faculty costs required by the program including airfare and meals.

Students pay for their own airfare, lunches and dinners, and personal expenses such as laundry, free time activities, and souvenirs.

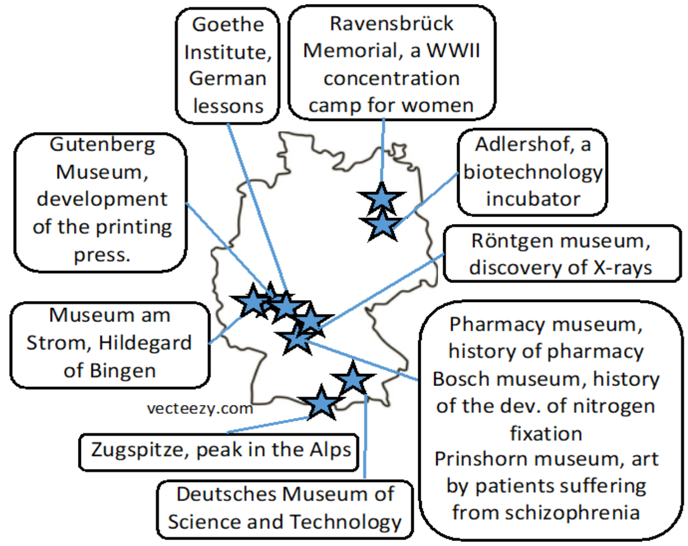

Figure 1. Main cultural and historical activities for Neuroscience and Technology in Germany in Summer 2022.

ACTIVITES AND ACADEMIC REQUIREMENTS

Activities

There were seven scientific visits (Table 2) distributed among three main hubs: Frankfurt, Munich, and Berlin. Scientific visits and activities to other cities such as Dortmund, Heidelberg, Würzburg, etc. were day trips using public transportation or by chartered bus. Students were asked to prepare for visits by attending preparatory lectures, reading 2-3 scientific papers for each visit, and discussing figures from the papers.

Assignments and Grading

Students were assessed through a range of competencies and modalities. They engaged in reading, writing, reflection, small group discussion, individual presentations, and large group participation (Table 4 and Table 5). Due to potentially unpredictable WiFi reception while traveling, we arranged for written assignments to be turned in either electronically via Blackboard or on paper notebooks at the students' discretion. Students were to bring two notebooks so that when we were grading one, they could be working in the other. This arrangement turned out to be absolutely necessary.

Engagement and Participation

Both courses assessed participation according to a rubric that was modified from Eastern Mennonite University (Eastern Mennonite University, 2023). Rubric items included whether students came prepared for discussions by reading the papers and evaluated the level of critical thinking displayed in scientific discussions and interactions.

Scientific Visit Reports

Scientific Visit Reports required students to reflect on the

Grading Item	% of total grade
Engagement and Participation	40
5 x Scientific Visit Reports	30
5 x Historical/Cultural Context Discussions	15
Next Steps Study Presentation	15

Table 4. Course requirements for NEUR 473: Capstone in Neuroscience: Current Neuroscience Research in Germany.

research they encountered during the lab visits. Students were to summarize, analyze, critique, and propose the next steps of the scientific studies they read about and heard about during the scientific visit.

Historical and Cultural Context Discussion
Students did preparatory readings before historical and cultural activities, such as Oliver Sacks' chapter on Hildegard of Bingen in "The Man Who Mistook his wife for a Hat" (Sacks, 1998). After the activities, students were given a prompt to discuss in small, self-selected groups. Groups turned in summaries of their discussions.

Next Steps Presentation
At the end of the course, students were to choose one scientific visit that particularly interested them and develop a research proposal for the next steps of the research program. Students gave an oral presentation with questions from peers and professors, and were graded according to a rubric.

Analytical Notebook
To assess cultural learning, students were given prompts for personal reflection to respond to analytically. Examples of prompts include:

- Write about your first impressions of Germany and German culture. How is it similar or different from your home culture and/or what you expected? Analyze reasons for these similarities or differences.
- Discuss what you saw/learned at the museum. Focus on
    - Tie-ins to what we have seen/learned already in the program
    - Using critical thinking about neuroscience, pharmacology, and cell biology, especially displays and presentations, what are your scientific critiques?
- Write about what you learned at the Ravensbrück Memorial site, any misconceptions you had, and what you spoke to others about throughout the week. What kind of processing did you do after our group discussion?

Literature Cue Sheets
Students needed to read 2-3 scientific articles published by the host labs. The articles were suggested to us by the lab hosts and ranged from long reviews, standard primary literature, and theoretical papers. Students read the articles aided by a literature cue sheet that allowed students to focus their reading. The cue sheets were handed in and graded for completion. Common misinterpretations or knowledge gaps were addressed in discussions before the lab visits.

Grading Item	% of total grade
Engagement and Participation	40
6 x Analytical Notebook Entries	20
7 x Literature Cue Sheets	20
Final Integrative Essay	20

Table 5. Course requirements for NEUR 461: Cross-Cultural Studies in Scientific Inquiry.

Final Integrative Essay
Students were asked to reflect in written form on their experience at the conclusion of the course. This assignment was to meet learning objectives for the "Global Understanding" Mason Core course, and was therefore focused on personal growth, cultural differences, and intercultural competence. Students were asked to "select one topic/experience that strikes you as particularly cross-cultural and deal with it in depth, including both reflection and insight."

Example prompts included:

- Compare what you learned about the process of science between Germany and the U.S. Evaluate possible benefits, drawbacks, and consequences of each system.
- What are you realizing during or after the program about the ways you interact with people, whether group members, family, or others? What do you see that you like? Dislike? What comes easily? What is more difficult?
- Pick an incident that occurred, to which you reacted strongly, and spend time reflecting on it. Describe the incident in detail, reflect on why you reacted the way you did, get more information (if necessary), think of some steps/differences for the next time you encounter a similar incident.

SURVEY RESULTS

At the conclusion of the program, students completed a survey about their experiences. The purpose of the survey was to assess strengths and weaknesses of the program and target avenues for change in future iterations. The survey was available to students on their final day in-country and closed three days after their return. We administered the survey through the learning management system. Survey participation was a course requirement (a small number of points was awarded to all who completed the survey) and responses were anonymous. We solicited feedback about: 1. how well the students felt our learning objectives were met through our activities, 2. the balance of scientific and historical/cultural content within the program, 3. logistics, 4. the student's personal growth, and 5. suggestions for change. The questions were a combination of qualitative feedback and Likert scale questions. All

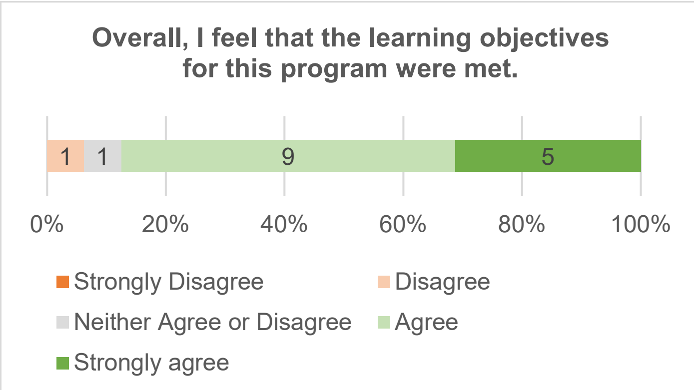

Figure 2. Student impressions on how well we met our learning objectives through the study abroad program. Numbers represent the number of students who chose each response (*n* = 16).

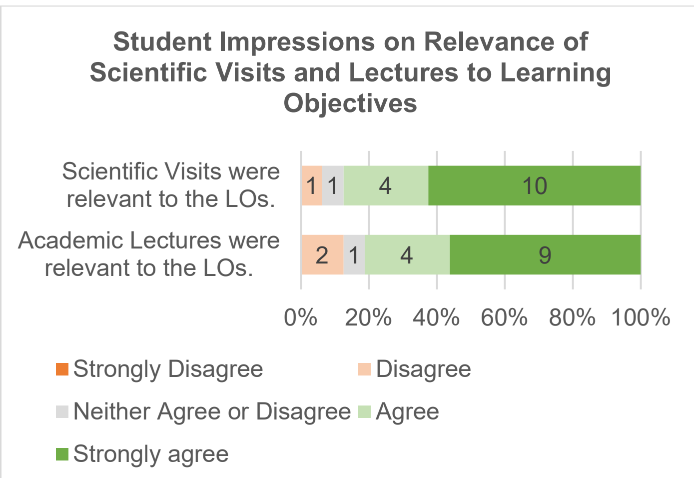

Figure 3. Survey results for relevance of Scientific Visits and Lectures to learning objectives. Numbers represent the number of students who chose each response (*n* = 16).

students completed the survey. In general, short answer responses were detailed and lengthy, representing student's eagerness to provide feedback.

Questions About Meeting the Learning Objectives

Students were presented with the learning objectives (Table 1) at the beginning of the survey and asked to rate how well they felt the program and activities met the objectives.

Students Felt the Program Overall Met Its Learning Objectives

Most students (87.5%) agreed with the statement "Overall, I feel that the learning objectives for this program were met" (Figure 2).

Students Felt the Scientific Portion of the Program Met the Learning Objectives

We asked about the scientific visits, lectures, and individual activities to determine which were perceived as most relevant and providing the most benefit to student learning. Most students agreed that the scientific visits (87.5%) and

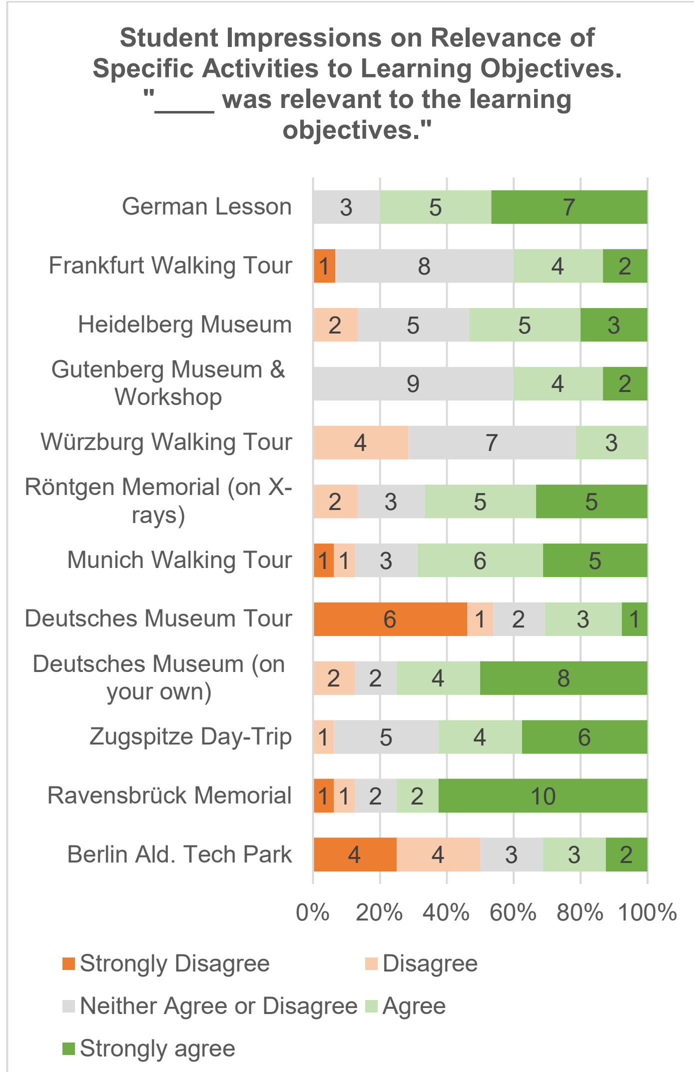

Figure 4. Survey results for relevance of individual activities to the learning objectives. Numbers represent the number of students who chose each response (*n* = 16).

academic lectures (81.25%) were relevant to the learning objectives (Figure 3). In qualitative feedback about the academic lectures, students frequently expressed the desire for more background lecture material and that lecture sessions, which were typically 2-4 hours long, be broken into shorter pieces.

Responses to Museums and Cultural Activities were Mixed with Regard to the Learning Objectives

The individual activities that students found most relevant were German lessons, the self-guided exploration of the Deutsches Museum, and the Ravensbrück Memorial visit, with >=70% agreeing that these were relevant to the learning objectives. Other activities students rated highly were the guided tour of the Röntgen memorial (about X-rays), the guided walking tour of Munich, and the day trip to the Zugspitze, an alpine mountain (Figure 4). We were surprised by how highly relevant to LOs students rated the Zugspitze trip, because this was not academic in nature and

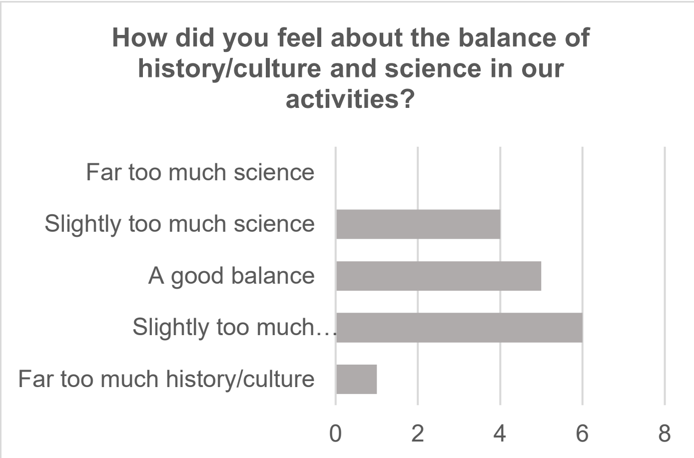

Figure 5. Student feelings about the balance of science with history/culture. Numbers represent the number of students who chose each response (n = 16).

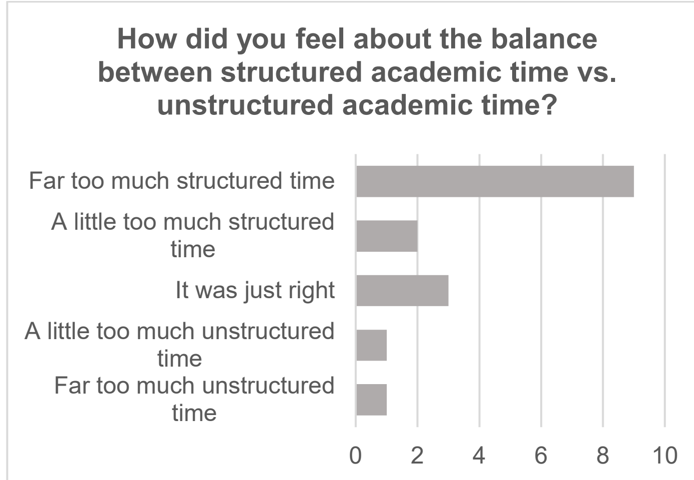

Figure 6. Student feelings about the balance of structured vs. unstructured time. Numbers represent the number of students who chose each response (*n* = 16).

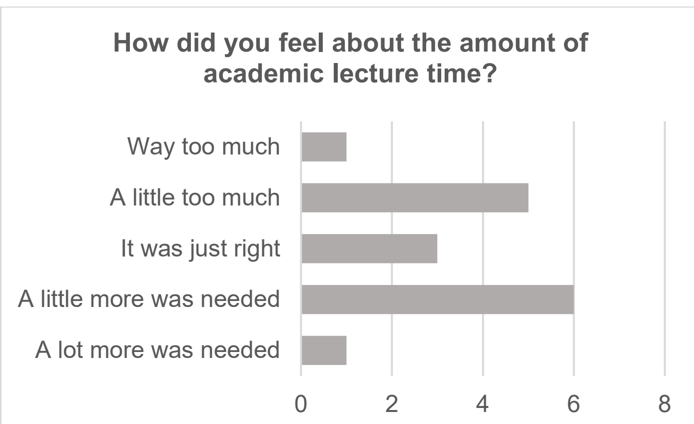

Figure 7. Student feelings about the amount of academic lecture time. Numbers represent the number of students who chose each response (*n* = 16).

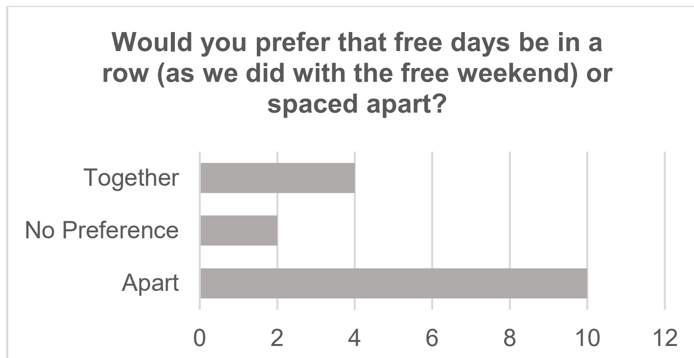

Figure 8. Student feelings about the amount of academic lecture time. Numbers represent the number of students who chose each response (n = 16).

was planned “just for fun”. In qualitative feedback, several students admitted they inflated the relevance of the Zugspitze trip to reflect its importance as a team building and social day. Others reported that it gave them a better sense of the environment and landscape outside of cities. Several reported it was their favorite activity in Germany.

The activities students found least relevant were the guided tour of the Deutsches Museum and the guided tour of Berlin Aldershof Technology Park (Figure 4). Interestingly, the guided tour of the Deutsches Museum was the lowest-rated activity, while self-guided exploration of the same museum was one of the highest-rated activities. We attribute this to a particularly poor tour guide, who gave us incorrect and biased information. We were, however, able to turn this experience into a critical thinking exercise.

Questions About Balance

Responses were Mixed over Science vs. History / Culture Balance

We asked students how they felt about the balance of history/culture and science in our activities. These responses were variable, with some students reporting there was too much science, some reporting there was a good balance, and some reporting there was too much history/culture. This may be reflective of individual student’s expectations or preferences (Figure 5).

Respondents Wanted More Unstructured Time

We asked students how they felt about the balance of structured academic time, which included lectures, group discussions, and group activities versus unstructured academic time, which included independent reading and writing. A majority of students felt there was far too much structured academic time (Figure 6).

Participants Had Mixed Views on Academic Lecture Time

We asked how students felt about the amount of time spent on academic lectures. Academic lectures were given before each scientific visit and lasted about 2 hours, with a total of 11 hours during the trip. Responses were mixed, with some students feeling there was too much and some feeling more was needed. This may reflect the variable level of

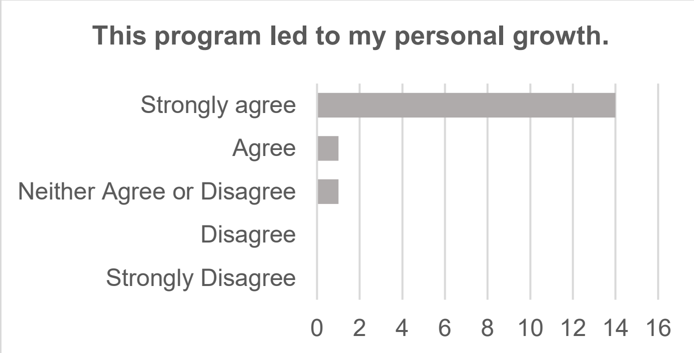

Figure 9: Responses to the statement "This program led to my personal growth." "Personal growth" in this context was self-defined. Numbers represent the number of students who chose each response (*n* = 16).

neuroscience content preparation students had prior to the program. Some students in our group had recently completed their B.S. in Neuroscience, and some had yet to take a neuroscience course. (Figure 7).

Students Preferred More Distributed Free Time

We asked students about their preferences for the distribution of free time. Our program included two free days, which were in a row. Most students (62.5%) would have preferred that these free days be spaced apart (Figure 8).

Question About Personal Growth

Students Nearly Universally Experienced Personal Growth

Lastly, we asked students whether this program led to their personal growth. Nearly all students agreed that this program led to their personal growth (Figure 9). We asked students for additional qualitative feedback on how this program impacted their personal growth. Students wrote extensively on this question, reporting that they learned about themselves, increased their self-confidence and independence, improved their ability to navigate in a foreign country, improved their ability to communicate with others, increased their cultural awareness, developed new learning skills, and renewed their excitement for science (Figure 10).

ASSESSMENTS

Intercultural Competence

Students Demonstrated Intercultural Competence

We assessed student's intercultural competence using their Final Integrative Essay. This assignment required students to "select one topic/experience that strikes you as particularly cross-cultural and deal with it in depth." Students were asked to choose a topic that challenged them to confront cultural differences and think critically about their experiences, including both reflection and insight. Based on the rubric, to receive a 90% or higher on this assignment, essays needed to be "thorough, deeply thoughtful and clearly communicated" and they needed to demonstrate "insight and reflection on cross-cultural issues/experiences." The mean score on the Final Integrative Essay was 96.25% (*SD* = 4.8%) with 14 of 16 students (87.5%) scoring a 90% or higher, suggesting most students demonstrated intercultural competence through their essays.

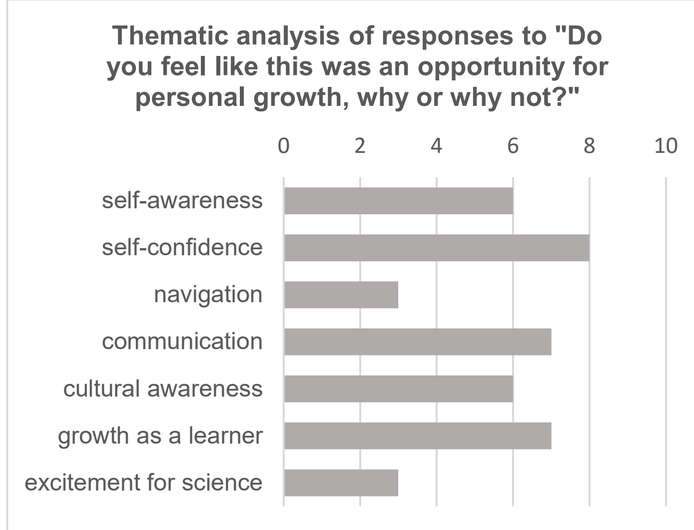

Figure 10: Thematic analysis of qualitative feedback on personal growth. Numbers represent the number of students whose responses addressed the theme (*n* = 15).

Engagement with Research

Most Students Could Accurately Describe Research and Develop Logical Follow-Up Studies

We assessed students' ability to describe the research they encountered during the scientific visits, explain its impact, and develop logical follow-up studies using the Scientific Visit Reports and Next Steps Presentations. The mean score for the Scientific Visit Reports was 90.73% (*SD* = 7.27, *n* = 16) and median score was 93.5%. Eleven students had a mean score over 90%, with three students between 80-89% and two students between 70-79%. Notably, the sole rising sophomore was among the two lowest scoring students, suggesting they may not have been academically prepared enough to fully engage with the level of neuroscience research we encountered on our visits. The mean score on the Next Steps Presentations was 88.2% (*SD* = 7.3, *n* = 16). Eight students had a mean score over 90%, with five students between 80-89% and three students between 70-79%, with no clear pattern between performance and academic level. To improve overall preparedness to interact with the research, we plan to do a multi-day, on-campus "Neuroscience Boot Camp" before the next iteration to bring all students up to speed with the foundational neuroscience principles. We also plan to give students more time and additional guidance to prepare their Next Steps Presentations.

DISCUSSION

Leaders' Qualitative Impressions

Varied Format of Scientific Visits

Because it seemed like a big "ask" when initially contacting the hosts, we asked for time to hear about projects and emphasized that we did not intend for the visit to be burdensome. Therefore, we had a wide variety of formats for the visits. For example, in the first visit students peppered the scientific staff with questions about differences in the educational processes between Germany and North

America, leaving less time for scientific discussion. On another visit, the host prepared a two hour lecture, while a colleague of his dropped by casually and spontaneously included his lab in our tour. In another visit, all of the scientific trainees (~six) in the lab gave 15-20 minute formal presentations. For future iterations and others interested in implementing a similar program, we suggest a more specific dialog about the format of the presentations.

Student Engagement in the First Iteration

We were very pleased at the level of engagement of the students overall. They were eager to meet and engage with the scientific hosts. We marketed the program as an opportunity to meet scientists in top labs. Our preparation emphasized knowledge about the lab to foster question asking and we set expectations that all students would be engaged in some manner with the hosts. We rehearsed discussion questions during academic lectures and preparatory paper discussions, so the students were relatively prepared for question and answer sessions.

Interestingly, due to cultural differences between the North American and German educational systems, multiple hosts reported surprise at the eagerness and engagement of our students. One host reported, “Our students never ask us questions”.

While our students continued to be engaged with the hosts throughout the trip, the level of preparation dictated the type of questions asked. For example, when students were well prepared they asked very specific questions about methods and results in the papers we read. W hen they were less prepared, however, they asked more general open-ended questions. We recommend carefully planning adequate rest times between each visit to make sure there is enough time for preparation.

Cautionary Notes

The intensive nature of the course is unavoidable when trying to balance curricular objectives and budget. In our first iteration, students’ energy and resilience wore down at the end of the trip. One factor may simply be the intensive nature of the course. We planned multiple visits in Berlin in one day for logistical reasons. Even though the students may have been able to be attentive for the full day, they had double the preparation burden in the evenings before and twice the number of assignments to complete in the days following. We plan to address this by spreading lab visits out in future iterations. In addition, group dynamics and interpersonal work is very important; faculty leaders need to be prepared for that. We chose to spend a considerable amount of our orientation time community-building within our group.

At the conclusion of the program our service provider, CEPA, also issued a survey to students and faculty. This survey contained many similar questions and was not received until after we issued our survey to students. Because many questions were redundant and CEPA’s survey was not required for students, participation in CEPA’s survey was poor. In the future, we will work more closely with service providers to avoid redundancy in post-program surveys.

Conclusion

In order to integrate cultural competence into our curriculum, add synthetic/integrative course offerings to our neuroscience majors, offer neuroscience-specific Mason Core courses, and include a diversity of students, we developed a short-term study abroad course to Germany. We focused on visits to research laboratories and prepared the students for interactions with the scientific hosts. We also designed activities and reflections to increase students’ awareness of the dependence of science on background culture.

Overall, students felt our learning objectives were met. Unsurprisingly, students felt both the lectures and scientific visits were relevant to the learning objectives, though their feelings about the relevance of other activities varied. The German lessons, self-guided visit to the Deutsches museum, and visit to the Ravensbrück memorial were rated as most relevant, and qualitative feedback on these was positive. We recommend these as excellent activities for future undergraduate science groups visiting Germany.

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