Inclusive Science
DOI: https://doi.org/10.1128/jmbe.v21i1.1943

JMBE Journal of Microbiology & Biology Education

Supporting Deaf Students in Undergraduate Research Experiences: Perspectives of American Sign Language Interpreters

Laura E. Ott[1], Linda C. Hodges[2], and William R. LaCourse[1,3]*
[1]College of Natural and Mathematical Sciences, University of Maryland, Baltimore County, Baltimore, MD 21250;
[2]Faculty Development Center, University of Maryland, Baltimore County, Baltimore, MD 21250;
[3]Department of Chemistry and Biochemistry, University of Maryland, Baltimore County, Baltimore, MD 21250

Deaf undergraduates are eager to engage in research but often feel marginalized due to lack of appropriate accommodations to allow for effective communication within heterogeneous research teams consisting of hearing peers and/or mentors. In this case study, we interviewed four American Sign Language (ASL) interpreters who provided full-time accommodations to teams consisting of one deaf student and two hearing peers during a six-week internship. We queried the interpreters on their role and experiences in supporting the research teams. Our findings indicate that the interpreters can be a valuable asset to heterogeneous teams by supporting both deaf and hearing individuals and advocating for the deaf student. That said, interpreters also had to overcome challenges unique to interpreting in the research environment, such as deciding when and how to interpret. The insights provided by the interpreters interviewed here are valuable as undergraduate research programs evaluate how to provide appropriate accommodations to deaf students engaged in research. In addition, they also highlight the need for research experience coordinators and mentors to consider supporting diverse teams in developing effective communication strategies and applying universal design for learning to the research environment.

INTRODUCTION

Inclusion of student populations traditionally underrepresented in the STEM fields has become a major emphasis of current STEM educational reform (1–3). Undergraduate research is one of many interventions that have been found to be impactful for promoting the success and retention of underrepresented minority (URM) students in STEM fields (4–8). These students include those with disabilities, who in 2016 accounted for 19.5% of undergraduate STEM enrollments (9). One sub-population of interest within this group, representing 0.5% of the total US population in 2016 (9), are students who have a hearing disability.

A small number of undergraduate research experiences (UREs) specifically targeting the deaf population have been described (10–13). Deaf students who participate in UREs often join heterogeneous research teams consisting of hearing students and/or mentors who may or may not have awareness of Deaf culture (14). Most of these UREs do not provide sign language interpreters or other accommodations during the entire experience because of associated challenges such as costs, irregularity of schedules, and the lack of familiarity that many interpreters have with technical STEM fields (10, 12, 14–16). Instead, many UREs rely on members of the research team who are familiar with the Deaf community or only have accommodations for workshops or meetings associated with the research experience (12–14, 16). In the lab, other forms of communication are used within the heterogeneous teams, such as written exchanges (13, 16).

Deaf students who were surveyed after being involved in a URE noted that they felt isolated and disconnected and that they often missed out on "ambient knowledge" when hearing colleagues did not modify their communication methods (10). The challenge of communication in informal interactions when interpreters were not available was a source of frustration and likely contributed to the deaf students' lack of connection with their heterogeneous teams (10, 14). The idea of having interpreters always available for supporting deaf students in UREs has been mentioned as being unrealistic, but desired (10, 13, 16).

In 2015, we established the BUILD a Bridge to STEM Internship (BBSI) at the University of Maryland, Baltimore County (17). The purpose of this internship is to explore

*Corresponding author. Mailing address: Department of Chemistry and Biochemistry, College of Natural and Mathematical Sciences, University of Maryland, Baltimore County, 1000 Hilltop Circle, Baltimore, MD 21250. Phone: 410-455-2105. E-mail: lacourse@umbc.edu
Received: 29 September 2019, Accepted: 12 December 2019, Published: 10 April 2020

group models of undergraduate research as a means to increase the number of students who can participate in a URE. This six-week summer internship is 40 hours per week and involves novice students working in teams of two to four on authentic projects under the mentorship of research faculty. An additional objective of the internship is to better understand how to engage deaf students in research groups consisting of both hearing and deaf students at a public research institution. Students from Gallaudet University are invited to participate each year, with each student being provided appropriate interpreting accommodations in consultation with our institutional Student Disability Services office. Each research team that has a deaf student is assigned two sign language interpreters who stay with the group throughout the day as they engage in research in the laboratory or field and/or participate in non-lab activities. With a few exceptions, the same interpreters worked with the same team throughout the internship.

In this paper, we describe the experiences of American Sign Language (ASL) interpreters who supported the heterogeneous teams in the BBSI in the summer of 2018. At the end of the program, we conducted interviews with these interpreters, querying them on the advantages and disadvantages of their engagement with teams in their daily work, the functions they assumed throughout the process, and the role they played during the URE. Our work suggests that full-time interpreters in UREs play a vital role in managing expectations and educating both hearing and deaf team members, while also possibly supporting the integration of deaf students into the research team. They do, however, face special challenges that require prior preparation and planning and the acuity and flexibility to know when and how to interpret given the specific constraints of the research environment. The insights from the interpreters in our study can inform other programs as they plan research experiences for heterogeneous teams of hearing and deaf students, increasing the effectiveness and efficiency of this resource for their students.

METHODS

This study was granted exempt approval from the UMBC Institutional Review Board. Four ASL interpreters were interviewed in this study, with each interpreter referred to hereafter by a unique identifier. Each interpreter was assigned to support the BBSI through the UMBC Student Disability Services Office and had varying levels of familiarity with interpreting in the research environment. The interpreters worked in pairs that remained relatively consistent throughout the internship. Each pair of interpreters supported a team that consisted of one deaf student from Gallaudet University and two hearing students from local community colleges (Table 1). Both deaf students preferred to communicate via ASL. The students were nominated for the internship by representatives from their home institutions and worked in the labs of research faculty at UMBC during the internship.

At the conclusion of the internship, a single interview was conducted by one of the coauthors (LCH) with the four ASL interpreters. The interview took place one week after the conclusion of the internship and lasted approximately 45 minutes. The interview was audio recorded and a transcript of the interview was made via Speechpad. During the interview, we asked interpreters:

- How they viewed their role in providing support to the research team
- How using ASL enabled or hindered communication on the team
- What challenges they faced interpreting in a research environment

We used grounded theory approaches (18, 19) to conduct iterative readings of the transcripts and derived themes directly from interpreters' responses, rather than predicting ideas *a priori*. We used the turn-at-talk as our basis for analysis (20) and coded each turn according to the themes it represented. The turn-at-talk is a stretch of talk by one speaker in a conversation that is sequentially positioned with respect to those of other speakers and that performs or contributes to a social action within the conversation. Two of the coauthors (LEO and LCH) coded the transcripts independently. Individual assessments matched 75% to 80% of the time and differences were resolved by consensus (21). Analysis of the transcripts from the interviews with the ASL interpreters revealed multiple concepts that could be condensed into three major themes.

RESULTS

Three major themes emerged from analysis of the transcripts with the ASL interpreters. These themes centered on deciding the following: what role the interpreter assumed

TABLE 1
Demographics of the heterogeneous research teams and interpreters.

Team	Interpreters	Deaf Student(s)	Hearing-Abled Student(s)	Focus of Research Project
1	A and B	1 (male)	2 (both female)	Natural sciences
2	C and D	1 (male)	2 (both female)	Engineering

in the research environment, when to interpret, and how to interpret given the demands and constraints of a research environment. The rest of this section provides sample dialogue from the interview that illustrates these themes.

Deciding what role interpreters assumed in the research environment

When we queried interpreters about how they viewed their role in the research process, they reflected on their service to both deaf and hearing populations and their function as educators.

> C: Well, we try to not really be members of the team, although our role is to be close and available so that if anybody wants to even just make a short comment, that can happen.

> D: ...everyone in the room is a consumer because anyone who might want to use our services, if they have something to say, whether it's in sign language or in spoken English, then we are there and available for them.

One interpreter pointed out that sometimes they needed to advocate for the deaf individual as a team member and educate the hearing members of the team, which might mean mediating group process:

> D: Or even turn-taking in a meeting, like, when they're talking over each other, saying, "Can we please talk one at a time?" So, controlling the communication a little bit so that it's effective for interpretation is definitely part of our role…in settings like this, education becomes so important, it becomes the role of the interpreter. But sometimes, the deaf person will want to take on that role and that's something we try to respect.

Deciding when to interpret

The configuration of the research environment offered challenges to visual communication.

> D: I would say the other time when interpreting is not required…is when a demonstration that is completely and fully visual is happening, and the person will be explaining exactly what they're doing. In that case, watching is more effective to learn how it's done. [A]s the interpreter, you direct their attention visually to what's going on, and then when they add something that is not visual, you interpret that and then continue to kind of let them know that what's going on is definitely visual and that their attention is in the right place. It all takes trust, though.

> C: Or they're demonstrating something that you can see on a computer screen, but the scientist is using a probe or something that's under the microscope that's being projected onto the screen and they're talking the whole time. And all the hearing people are watching and passively listening, but it's always a choice what to look at for the deaf consumer.

> B: …in a dark room, you would want to say everything out front…and then not talk once you go in there. And then, only one of us might go in there or maybe not even go in there in this tight room.

Additionally, interpreters had to decide when to insert themselves into the communication of the research teams.

> D: I feel like interpreting was not effective or was not the best solution typically when someone had their nose in their lab work and their actual research. Like, if someone's measuring out and micropipetting and you're trying to wave your hands in their face, that's more distracting than it is helpful for communication at that time. And then, unfortunately, it might be really important information, and you know that information is lost or you're scrambling to try to remember it. Then you have to ask after the fact, [after] the whole conversation might have taken place, so it's not going to happen the exact same way even when you say, "Hey, can you do that again," now that the measuring is done.

Interpreters also noted that they sometimes held back on interpreting to promote the process of relationship building in the heterogeneous teams:

> A: …sometimes it may be best not to interpret something when a team member…is at least trying to communicate directly…Either a deaf team member is trying to communicate directly with another hearing team member or vice versa. And in those interactions, giving them a second to… make that direct connection with each other, and then either the interpreter can see that it is not working or the deaf person usually will request that the interpreter come and interpret that interaction. But there are definitely times in the lab that I would sit back for a second because I knew that they had developed a relationship, that they could at least do some quick question, yes or no sort of thing. And in that way, I would say, if I were to jump in as an interpreter, it would impede that relationship development. Not that it would impede the communication.

Deciding how to interpret

One area that the interpreters mentioned frequently during the interview was the importance of advanced preparation and familiarity with scientific vocabulary:

> D: …We read the articles to try to keep up with the vocabulary…
>
> C: Yes, we Googled terms that were used in the individual labs that we were working in.
>
> D: …the more that we are centralized and able to even just overhear some of the day-to-day goings on in the lab, [the more it] helps expose us to the vernacular, makes us more comfortable…[and] it really helps interpreting.

The interpreters also highlighted the need to identify optimal translations for the consumer. This was particularly evident when there were not established signs for a word.

> C: It's very helpful to see what they're doing because often the sign for something is the motion of what you do. For example, pipetting is really just a mime of using a pipette...Otherwise, you might just spell "pipetting" all the time which is not too meaningful or efficient.
>
> A: Often I had to ask either the research experts in the field or other team members to make sure I was using the correct term for that very specific procedure or aspect of the research.

Finally, interpreters noted that using the same interpreters consistently was really important to address the challenge of specific and accurate vocabulary.

> D: ...so they don't say you kill the [invertebrate organism], they say that you sacrificed them. But the sign for "sacrifice" doesn't match the concept of killing…so they set up the sign "die" or "kill," but they voiced "sacrifice." ...So if you're a substitute interpreter and you're just here for today, then you're going to say, "Oh, do we kill it now?" And everyone in the room is going to say, "Hey, you're supposed to say 'sacrifice.'" It looks like the deaf person messed up because we make that seamless as part of our job…we know what we're supposed to say, but if you're not consistently on the job in a research setting where there's so much vocabulary, that would be really challenging.

DISCUSSION AND CONCLUSIONS

A unique aspect of this URE was that interpreting accommodations were provided for all aspects of the six-week internship, providing a conduit for ongoing communication. Although the interpreters were with the teams for the entire research experience, they viewed themselves not as team members but as professionals whose roles were to provide services to both deaf and hearing clients and facilitate communication throughout the group. Their statements address the common misconception that the role of ASL interpreters is only to provide services to deaf individuals. In fact, they serve all populations, often mediating conversation to promote constructive communication within heterogeneous groups.

The interpreters interviewed here also saw themselves as educators and advocates for the Deaf community. By managing communication amongst hearing individuals, they allowed deaf participants to be actively involved in the conversation. The interpreters' advocacy role may have the potential to alleviate deaf students' feelings of being left out of the research experience, as previously described (10, 14–16). The interpreters, however, did highlight the importance of respecting the role of the deaf individual to advocate for their own needs and/or educate their hearing peers about the Deaf community independently. This flexibility has the potential to strengthen both the autonomy and the connection of the deaf student within the heterogeneous research team. The interpreters continually evaluated the situation (as interpreters do) to decide when to interpret—when it was best to intrude or stand back and allow students to work or communicate on their own.

Interpreting in the research environment did not come without challenges, however, such as deciding when and how to interpret. Many deaf students miss out on content even when interpreters are present and are well trained in the discipline (12, 13, 22, 23). The interpreters in our study alluded to this, as they often had to decide how best to interpret scientific information and discourse, especially when signs are not established for a term. They felt compelled to prepare in advance by reading the scientific materials students were working with and looking up vocabulary. They also noted the advantage of being on the scene consistently, during both formal and informal activities, to deepen their understanding of terminology.

While the interpreters interviewed here had to overcome challenges unique to the research environment, UREs that use interpreters sporadically may suffer from the same disadvantages, without the added advantage of developing more intimate knowledge of processes, procedures, and personalities of research teams. Likewise, the catalyst for connection provided by the availability of full-time, consistent interpreters may ameliorate the sense of marginalization that deaf students have previously reported in heterogeneous research teams (14–16). The insights provided by the ASL interpreters interviewed here can be

valuable as programs plan for including deaf students in UREs and help programs to weigh costs and benefits of providing full-time interpreters. In addition, the issues highlighted here capture general communication challenges in diverse research teams—teams that may consist of students for whom English is not their first language or students who exhibit various forms of neurodiversity. URE coordinators and mentors can support more inclusive practices by providing training in effective group communication and universal design for learning principles as they apply to the research environment.

ACKNOWLEDGMENTS

We gratefully acknowledge Michael Canale from UMBC Student Disability Services for his thoughtful review of this manuscript. Research reported here was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Numbers TL4GM118989, UL1GM118988, and RL5GM118987. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The authors declare that they have no conflicts of interest.

REFERENCES

1. Estrada M, Burnett M, Campbell AG, Campbell PB, Denetclaw WF, Gutiérrez CG, Hurtado S, John GH, Matsui J, McGee R, Okpodu CM, Robinson TJ, Summers MF, Werner-Washburne M, Zavala M. 2016. Improving underrepresented minority student persistence in STEM. CBE Life Sci Educ 15:es5.
2. President's Council of Advisors on Science and Technology (PCAST). 2012. Engage to excel: producing one million additional college graduates with degrees in science, technology, engineering, and mathematics. Executive Office of the President, Washington, DC.
3. National Academy of Sciences. 2011. Expanding underrepresented minority participation: America's science and technology talent at the crossroads. The National Academies Press, Washington, DC.
4. Bauer KW, Bennett JS. 2003. Alumni perceptions used to assess undergraduate research experience. J Higher Educ 74:210–230.
5. Council on Undergraduate Research. 2009. Broadening participation in undergraduate research: fostering excellence and enhancing the impact. Council on Undergraduate Research, Washington, DC.
6. Eagan K, Hurtado S, Chang M, Garcia G, Herrera F, Garibay J. 2013. Making a difference in science education: the impact of undergraduate research programs. Am Educ Res J 50:683.
7. Lopatto D. 2007. Undergraduate research experiences support science career decisions and active learning. CBE Life Sci Educ 6:297.
8. Pender M, Marcotte DE, Domingo MRS, Maton KI. 2010. The STEM pipeline: the role of summer research experience in minority students' Ph.D. aspirations. Educ Pol Anal Arch 18:30.
9. National Science Foundation, Center for Science and Engineering Statistics. 2019. Women, minorities, and persons with disabilities in science and engineering: 2019. Special Report NSF 19-304. Arlington, VA.
10. Gehret AU, Trussell JW, Michel LV. 2017. Approaching undergraduate research with students who are deaf and hard-of-hearing. J Sci Educ Students Disabil 20:20–35.
11. Solomon CM, Braun D, Kushalnagar R, Ladner RE, Lundberg D, Painter R, Nuzzo R. 2012. Workshop for emerging deaf and hard of hearing scientists: a white paper. Washington, DC.
12. Pagano T, Ross AD, Smith SB. 2015. Undergraduate research involving deaf and hard-of-hearing students in interdisciplinary science projects. Educ Sci 5:146–165.
13. Smith SB, Ross AD, Pagano T. 2016. Chemical and biological research with deaf and hard-of-hearing students and professionals: ensuring a safe and successful laboratory environment. J Chem Health Safety 23:24–31.
14. Braun DC, Gormally C, Clark MD. 2017. The Deaf Mentoring Survey: a community cultural wealth framework for measuring mentoring effectiveness with underrepresented students. CBE Life Sci Educ 16:ar10.
15. Braun DC, Clark MD, Marchut AE, Solomon CM, Majocha M, Davenport Z, Kushalnagar RS, Listman J, Hauser PC, Gormally C. 2018. Welcoming deaf students into STEM: recommendations for university science education. CBE Life Sci Educ 17:es10.
16. Majocha M, Davenport Z, Braun DC, Gormally C. 2018. "Everyone was nice…but I was still left out": an interview study about deaf interns' research experiences in STEM. J Microbiol Biol Educ 19.
17. LaCourse WR, Sutphin KL, Ott LE, Maton KI, McDermott P, Bieberich C, Farabaugh P, Rous P. 2017. Think 500, not 50! A scalable approach to student success in STEM. BMC Proc 11(Suppl 12):24.
18. Glaser BG, Strauss AL. 1967. The discovery of grounded theory: strategies for qualitative research. Aldire, Chicago, IL.
19. Strauss AL, Corbin JM. 1998. Basics of qualitative research: techniques and procedures for developing grounded theory. Sage, Thousand Oaks, CA.
20. Sacks H, Schegloff EA, Jefferson G. 1974. A simplest systematics for the organization of turn-taking for conversation. Language 50:696–735.
21. Saldaña J. 2015. The coding manual for qualitative researchers. Sage Publications, Inc., Thousand Oaks, CA.
22. Schick B, Williams KR, Kupermintz H. 2005. Look who's being left behind: educational interpreters and access to education for deaf and hard-of-hearing students. J Deaf Studies Deaf Educ 11:3–20.
23. Marschark M, Sapere P, Convertino C, Seewagen R, Maltzen H. 2004. Comprehension of sign language interpreting: deciphering a complex task situation. Sign Language Studies 4:345–368.