

Approaching Undergraduate Research with Students who are Deaf and Hard of Hearing

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Enhancing participation in STEM

- New initiatives are desperately needed to increase the U.S. workforce in science, technology, engineering and mathematics (STEM) in order to maintain global competitiveness¹.
- Attrition from STEM is severe: nearly half of all entering STEM majors switch to non-STEM majors².



¹ President's Council of Advisors on Science. (2012)

² Chen, X. (2013). *STEM attrition: College students' paths into and out of STEM fields* (NCES 2014-001).

Barriers to STEM

- Within the U.S., representation of deaf and hard-of-hearing (DHH) individuals in STEM careers is less than that of their hearing counterparts^{1,2}.
- Barriers to entering STEM fields that DHH students may experience include limited exposure to spoken English translating into struggles with English vocabulary, English sentence structure, and overall world knowledge^{3,4,5}.
- At the postsecondary level, classroom accommodations to facilitate access to STEM information are not universally available⁶.

¹ Nagle, K., Newman, L. A., Shaver, D. M., & Marschark, M. (2016). *American Annals of the Deaf*, 160(5), 467–482.

² Pagliaro, C. M., & Kritzer, K. L. (2013). *Journal of Deaf Studies and Deaf Education*, 18(2), 139–160.

³ Convertino, C., Borgna, G., Marschark, M., & Durkin, A. (2014). *Journal of Deaf Studies and Deaf Education*, 19(4), 471–483.

⁴ Sarchet, T., Marschark, M., Borgna, G., Convertino, C. M., Sapere, P., & Dirmyer, R. (2014). *Journal of Postsecondary Education and Disability*, 27(2), 161–178.

⁵ Wolbers, K., Dostal, H., & Bowers, L. (2010). *Journal of Deaf Studies and Deaf Education*, 17(1), 19–38.

⁶ Powell, D., Hyde, M., & Punch, R. (2014). *Journal of Deaf Studies and Deaf Education*, 19(1), 126–140.



Reducing attrition: The undergraduate research experience

- Undergraduate research (UR) experiences have been shown to increase students' understanding and awareness of graduate school opportunities, confidence in applying for graduate school and success of matriculation^{1,2,3}.
- UR experiences have also been shown to instill higher learning gains in scientific writing, working independently, and self-confidence for underrepresented students compared with other students⁴.

¹ Eagan, M. K., Hurtado, S., Chang, M. J., Garcia, G. A., Herrera, F. A., & Garibay, J. C. (2013). *American Educational Research Journal*, 50(4), 683–713.

² Russell, S. H., Hancock, M. P., & McCullough, J. (2007). *Science*, 316(5824), 548–549.

³ Seymour, E., Hunter, A.-B., Laursen, S. L., & DeAntoni, T. (2004). *Science Education*, 88(4), 493–534.

⁴ Lopatto, D. (2007). *CBE Life Sciences Education*, 6(4), 297–306.



DHH students in UR experiences

- Perceived identity incompatibility with STEM stereotypes is a significant factor for DHH student attrition^{1,2}
- Role models help cultivate students' perceived compatibility with STEM³
- Research advisors that mentor **effectively** often become role models⁴

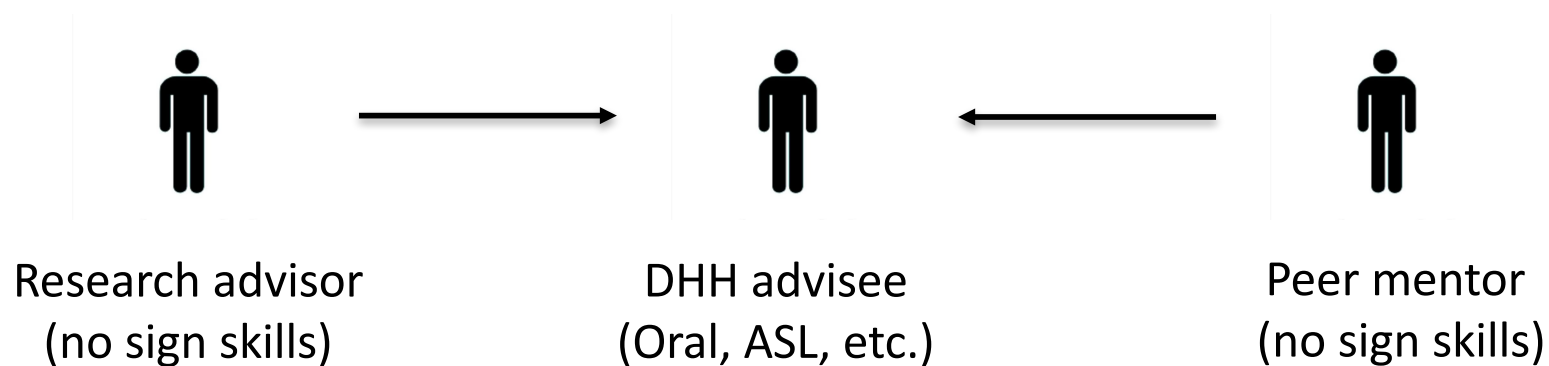
Providing potential mentors with the tools necessary to effectively mentor DHH students could enhance the number of UR opportunities.



¹ Good, C., Rattan, A., & Dweck, C. S. (2012). *Journal of Personality and Social Psychology*, 102(4), 700–717.
² Rosenthal, L., London, B., Levy, S. R., & Lobel, M. (2011). *Sex Roles*, 65(9–10), 725–736.
³ Shin, J. E. L., Levy, S. R., & London, B. (2016). *Journal of Applied Social Psychology*, 46(7), 410–427.
⁴ Bliska, J. B. (2016). The importance of role models in research. *PLOS Pathog*, 12(6), e1005426.

“Heterogeneous” communication lab environments

- DHH students’ learning and assimilation into the mainstream classroom is well researched, but not in the mainstream research lab
- Previous research on advising DHH students in the research lab detailed descriptions of laboratory safety strategies¹ and successful projects in biological and chemical research².
- “Heterogeneous” communication settings defined as DHH students in research laboratories working side-by-side with hearing individuals, irrespective of the communication mode of the DHH student².



¹ Smith, S. B., Ross, A. D., & Pagano, T. (2016). *Journal of Chemical Health and Safety*, 23(1), 24–31.

² Pagano, T., Ross, A., & Smith, S. B. (2015). *Education Sciences*, 5(2), 146–165.

Pilot Study Research Questions:

- What are the specific challenges faced when training DHH students in molecular bioscience research?
- What attitudinal/pedagogical approaches might be needed to effectively mentor DHH students who are involved in bioscience research?



Pilot Study Research Method

- Post-graduate survey
 - 1) What were the major challenges you faced as part of your undergraduate research experience?
 - 2) What strategies would you suggest for working with DHH students during an undergraduate research experience?
- Requirements:
 - Had documented hearing loss
 - Previously participated in undergraduate research including at least one full-time summer experience
 - Were advised by an undergraduate advisor who does not sign (Dr. Michel)
 - Secured enrollment in STEM or medical graduate programs



Pilot study participants

Advisee	RIT Program of Study	Graduation Term	Current Affiliation
Female	BS Biochemistry	2114	PhD Biochemistry, Ohio State University (4 th year)
Male	BS Biochemistry	2145	MS Bioinformatics, Rochester Institute of Technology (1 st year)
Female	BS Biomedical Sciences	2135	Philadelphia College of Osteopathic Medicine (2 nd year)



Student survey responses: Challenges

Feelings of isolation stem from heterogeneous communication

- *This “isolation” bothered me the most when a person comes to me and say, “Remember how so-and-so did this over the weekend – it was so funny! What, you didn’t know?”, making my “isolation” glaringly obvious and painful.*
- *To truly feel like you belong to the lab, you have to develop a connection with the other students. This was hard for me as the students all spoke as (a) group, making it impossible for me to follow along . . . I just didn’t become good friends with my lab partners. I was there to do research and that’s what I did. I had friends outside of lab.*



Communication challenges: Faculty observations

Group setting communication during lab meetings

- Simultaneous conversations with both informal and technical language made interpreting a challenge
 - DHH advisees would sometimes ignore the “chaos” of the room and engage in direct conversation with the interpreter.
- Advisor lacks control of information the DHH advisee receives
 - The interpreter initially used the same sign to describe two scientifically distinct processes involving protein structure.
 - New signs were created to better communicate the difference between the two terms, but this situation would not have happened without the interpreter’s initiative.



Communication challenges: Faculty observations

Peer mentoring holds risk for perpetuating isolation

- A peer mentor complained to the research advisor that the DHH mentee was either distracted or incapable of understanding what they were teaching.
- The DHH mentee also complained that the relationship was strained and that training was suffering as a result.
- The advisor established a new peer mentor-mentee relationship to help alleviate the tension.



Student survey responses: Challenges

A lack of access to information in the lab is a significant source of frustration

- *It was unrealistic to have an interpreter on standby for every minute of lab work. Having that would have helped me catch all of the “little whys” and would have enriched my experience.*
- *I would have liked to get more casual training to pick up on these pesky little whys.*



Communication challenges: Faculty observations

Lack of access services

- Priority for these services is given to classrooms and teaching labs.
- Research time was often scheduled last minute and varied week-to-week depending on the experiments and students' schedules.
- Lack of access services in the research lab might be jarring for some DHH students.
 - One student refused to do research in the lab without access services guarantee.



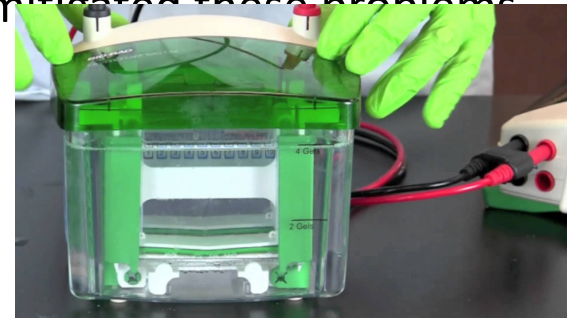
Challenges: Faculty observations

Lack of access to troubleshooting discussions

- Students have extemporaneous discussions to troubleshoot technical issues in lab.
- In the absence of access services, many DHH students were not privy to these discussions.
- Two scenarios were observed to highlight this challenge:
 - A DHH student performed an ELISA experiment multiple times with highly variable results.



Both students had fully written protocols describing the proper procedures but technical nuances were not included that would have mitigated these problems. A DHH student working independently needed to repeat a polymerization procedure six times to make protein gel.



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Student survey responses: Strategies

Lab environment should have flexible communication

- *Find a lab that is more open to uncanonical (sic) methods of communication. The labs that are open to these modes of communication tend to welcome the deaf/HOH student and allow him/her to participate more.*
- *I noticed the “isolation” was significantly less when the lab members assertively participate more in sign language, body language or writing on paper/typing on computer with me.*

Personality traits of a lab mentor

- *Pick an advisor...who is organized and explained/listed the expectations CLEARLY...arranges meetings ahead of time (enough time to request interpreters or transcribers).*
- *Extra patience from the advisor is MANDATORY! It will NOT work out if the deaf/HOH student picks an advisor who is brilliant but refuses to give extra time to the student to work on something.*



Summary: Challenges

- **Student responses highlight that feelings of isolation stem from heterogeneous communication**
 - Supporting faculty observations:
 - Lab group meetings can be tremendously isolating given the communication dynamics
 - Peer mentoring perpetuated isolation in one circumstance
- **Student responses emphasize the lack of access to information in the lab as a significant source of frustration**
 - Supporting faculty observations:
 - Lack of access services during research time
 - Systemic errors were observed to manifest in students' techniques



Summary: Strategies

- **Labs should attempt to develop flexibility in their methods of communication**
 - Body language, written communication (electronic, paper-based, etc.)
- **Student responses highlight the importance of personality in a lab mentor**
 - Organized, clear with expectations, patient
- **Real-time communication in the lab**
 - Develop communication plan in lab meetings
 - Whiteboards
 - Shown to be an effective practice in mainstream classroom¹
 - Dictation software
- **Advanced planning communication strategies**
 - Written protocols provided ahead of experimentation
 - Captioned video tutorials

IMPLICATIONS?



¹ Marchetti, C., Foster, S., Long, G., & Stinson, M. (2012). *Journal of Postsecondary Education and Disability*, 25(1), 51–63.

Summary: Strategies continued

- **Student responses highlight that labs should attempt to develop flexibility in their methods of communication**
 - Body language, written communication (electronic or paper-based)
- **Student responses highlight the importance of personality in a lab mentor**
 - Organized, clear with expectations, patient
- **Research mentor traits**
 - Break up research projects by objectives
 - Designing research projects with clear objectives and measurable end products can help DHH students develop confidence in the lab¹.
 - Meet regularly with advisees and peer mentors to ensure a positive training environment persists

IMPLICATIONS?



¹ Pagano, T., Ross, A., & Smith, S. B. (2015). *Education Sciences*, 5(2), 146–165.

Future directions

- Survey students to assess strategies
- Quiet Science (NSF IUSE proposal)
 - Expand RIT network of hearing research mentors (STEM)
 - Different research settings are likely to incur different mentoring challenges
 - Formally assess student learning in the lab with specific strategies
- Investigate different strategies to help strengthen the communication of scientific language¹



¹ F. R. Ragsdale and K. M. Pedretti, *Am. Biol. Teach.*, vol. 66, no. 9, pp. 621–626, Nov. 2004.