WIP: Developing an Interview Protocol to Unveil the Stories of Neurodivergent Engineering Students

Leslie A Brown, Utah State University

Leslie Brown is an Engineering Education PhD student at Utah State University. She recently completed a Master's degree in Engineering Education at Utah State University with thesis focus on training high school STEM teachers to implement engineering curriculum into their classrooms.

Dr. Catherine McGough Spence, Minnesota State University, Mankato

Catherine Spence is an Associate Professor at Iron Range Engineering in the Integrated Engineering Department at Minnesota State University, Mankato. She received her PhD in Engineering and Science Education in 2019 and a BS in Electrical Engineering in 2014 at Clemson University.

Autumn Cuellar, Utah State University

Autumn Cuellar is a Ph.D. student in Engineering Education. Her undergraduate and master's careers were both in Computer Science. She believes that everyone can achieve their goals, regardless of physical ability. This is why Autumn strives to make engineering accessible for everyone.

Kartik Thakkar, Utah State University
Hamid Karimi, Utah State University

I obtained my Ph.D. in Computer Science from Michigan State University (MSU) in 2021. My main research interest during my Ph.D. was artificial intelligence (AI) for social good and focused on several exciting directions, including AI in education, computational politics, and misinformation detection.

Dr. Marissa A Tsugawa, Utah State University - Engineering Education

Marissa Tsugawa is an assistant professor at Utah State University who leverages mixed-methods research to explore neurodiversity and identity and motivation in engineering. They completed their Ph.D. in Engineering Education where they focused on motivation and identity for engineering graduate students.

WIP: Developing an Interview Protocol to Unveil the Stories of Neurodivergent Engineering Students

Abstract:

This Work in Progress (WIP) paper will present an interview protocol development that leverages social media analysis for capturing narratives of neurodivergent (e.g., ADHD, autistic, dyslexic) engineering students. The work presented in this WIP is part of a larger mixed-methods sequential research project which aims to capture neurodivergent engineering student narratives that describe their engineering experiences in terms of strengths and challenges.

Through social media analysis, we identified key language used by the neurodivergent community (e.g., neurodivergent, spoon, forget). We developed a few initial themes such as multiple pathways to recognizing one's identity of being neurodivergent, multiple ways in which neurodivergence symptoms are experienced, and the ways in which an individual internally and outwardly interacts with their own symptoms.

To capture neurodivergent narratives, we plan on conducting semi-structured interviews with neurodivergent engineering students three times over the semester (beginning, middle, end). Initial interview protocols for each interview will be developed and adjusted throughout the interview data collection process. An initial compilation of relevant interview questions was compiled from previous research and from the objectives of the research study. This initial pool of questions will then be refined based on our thematic findings and using the nuanced language identified on the social media platforms TikTok, Reddit, and Twitter. Results of this work will be presented in this paper as an interview protocol that will continue to be adapted as part of this larger research study, but can also be used as a starting point for researchers exploring similar topics in capturing the experience of neurodivergent engineering students.

Introduction

The purpose of this work-in-progress (WIP) paper is to develop an initial interview protocol leveraging results from a natural language processing analysis that captures neurodivergent engineering student narratives. Neurodivergent individuals have strengths and characteristics that align well with success in engineering, such as pattern recognition, attention to detail, and creativity [1]. Yet, engineering programs struggle to retain neurodivergent individuals [2], [3], and neurodivergent individuals experience decreased job attainment in engineering after graduation [4], [5]. Our research approaches neurodivergence with a strengths and challenges lens to highlight the nature of being neurodivergent [6]. In this research, we define neurodivergence as natural cognitive psychological human differences [1], [6]. Nerodivergence encompasses disorders such as anxiety, ADHD, OCD, bipolar disorder, PTSD, etc.) [6].
This approach supports our work by aligning neurodivergent engineering student experiences with the language used in the general neurodivergent population on social media communities. We leverage such language to develop a narrative inquiry protocol to capture student stories.

As part of a larger mixed-methods study, we observed the current language used in the neurodivergent community on platforms such as TikTok and Reddit in the first phase of the study [7]. In the second phase, we will conduct a narrative analysis to capture strengths and challenges in neurodivergent individuals' experiences. We are using a participant-centered approach informed by the quantitative portion of this study to develop an interview protocol for the qualitative phase [6], [8]. This work-in-progress paper is guided by the following research question: How can natural language processing results be used to develop a narrative interview protocol for neurodivergent engineering education students?

Methods

In this paper, we present the development of an interview protocol for the qualitative strand of a larger mixed-methods study. The first part of the study involved quantitatively analyzing natural language on social media through Latent Dirichlet Allocation (LDA). LDA is a natural language processing algorithm that uses statistics to cluster words from a group of documents into topics. These topics represent the highest probability that the group of words speaks for the whole document group [9]. LDA allows researchers to use terminology that is common in specialized groups, like the neurodivergent community [10]. Using the background learned from the quantitative strand of the study, we aim to apply this neurodivergent language to the engineering education community. Specifically, we are using a narrative inquiry approach to uncover neurodivergent engineering student stories, to capture a story or narrative of the lived experience [11].

The key terms identified through LDA analysis informed the development of the interview protocol. Using LDA to inform the narrative interview protocol is a new approach to understanding neurodivergent stories in an engineering education context.
We chose the narrative inquiry approach for this study because of the ability narrative inquiry provides to uncover the intersectional stories of neurodivergent engineering students. To understand the needs of the interview protocol, we will first identify the goals of the protocol and how the protocol will be used within the context of narrative analysis.

Research Design

During the Spring 2025 semester, we will interview neurodivergent engineering students at a land-grant, space-grant university in the Rocky Mountain region of the United States. We will interview each student three times throughout the semester to capture neurodivergent engineering student experiences. According to Kim [12], approximately three rounds of interviews should take place to fully understand the interviewee's lived experience; in this project, interviews will occur three times throughout a single semester. Further, to build rapport and avoid potential power dynamics, the narrative interviews will be conducted by the graduate students on the project rather than faculty members [8]. We anticipate that 24 students will complete the series of three interviews. Each student will be compensated for their time during the interview and they will receive compensation for following up with the research team to ensure that the stories written about them are accurate [13].

Participant Selection and Recruitment

While narrative inquiry can involve multiple forms of qualitative data collection such as interviews, observations, and artifacts, for this study we will focus on narrative interviews. Students will be recruited using convenience sampling methods via emails to the student's school email addresses as well as flyers posted throughout the College of Engineering building [14]. Participating students must be diagnosed or self-diagnosed as neurodivergent, over the age of 18, and enrolled in the undergraduate engineering program at the institution.

Data Collection: The Narrative Interview

In narrative interviews, the intent of the interview is to record the lived experiences of the participant and elucidate the participant's meaning rather than verify the researcher's preconceived conclusion [8], [13]. The interviewer avoids bringing their agenda to the conversation and allows the participant's story to emerge through the interview questions [12], [15]. Furthermore, it is important to collaborate with the participant throughout the writing process, to ensure that the collaborative story between the researcher and the participant is being told authentically [8], [13]. The first question of a narrative interview is typically an open-ended question, which prompts the participant to tell their story in a narrative format [15]. This first question is a general prompt directed at the area of research, however, the question must be phrased to allow a broad range of responses and minimize bias. By using broad questions, students may interpret and answer the question authentically and personally [15].

In narrative interviews, the interviewer should focus on listening without interrupting and taking note of any follow-up questions to ask the participant after the participant finishes their story [12]. Often in narrative interviews, agenda topics serve as an unstructured guide as opposed to the confines of structured interview questions. Semi-structured interview protocols have been used in narrative inquiry [12], [13], [15]; however, we chose to use an unstructured approach to allow the participant to narrate their experiences [12]. Interviews are anticipated to last for 60 to 90 minutes, beginning with a broad narrative question where participants share their experiences, followed by a conversational phase with clarifying and probing questions.

Data Analysis

Once the team has completed all of the interviews in the Spring 2025 semester, we will compare key phrases found in the interviews with results from quantitative analysis. We will also use these interviews to provide context and meaning behind key phrases used by undergraduate engineering students. Using the software MAXQDA, we will analyze the interviews using in-vivo coding methods [16]. In-vivo coding methods were chosen so that the research team could assign labels to quotes or phrases within interviews. For the second cycle of coding, we plan to use pattern coding to identify common themes among general student types [16]. Throughout the second cycle coding process, we will also generate a codebook based on the in-vivo labels, example quotes, and code patterns [17]. Once the codebook is complete, we will compare key phrases and patterns between the quantitative and qualitative strands of the larger study.

After the coding process, we will use thematic analysis to create generalized vignettes of neurodivergent students. The purpose of the vignettes is to tell a generalized story of neurodivergent students in engineering education, as well as provide further context and understand how a neurodivergent engineering student may interpret their lived experience [18]. With these vignettes, we hope to explore general contexts and actions that neurodivergent engineering students can relate to [19].

Narrative Interview Protocol Development

To develop the interview protocol for these three rounds, we analyzed existing literature, brainstormed potential interview questions, and pulled key language and themes from the topics identified in the LDA analysis. First, initial interview protocol questions were based on an interview protocol using a person-centered approach for neurodivergent students [20]. We then reviewed the overarching research questions from the project and preliminary results from the LDA analysis to contribute potential interview questions [10]. We combined both the interview protocol and the LDA processing to create an interview protocol that reflects on the experiences of neurodivergent engineering students. The questions were presented to the research team and neurodiversity researchers; questions that were potentially problematic or outside of the scope of the research project were removed.

Instructions are provided with the interview protocol to encourage the interviewers to follow best practices for narrative interview protocols, such as setting the stage to remove power dynamics, by dressing casually and starting with informal conversation.

Preliminary Results – Overview of the Protocol

The full protocol including instructions to the interviewer is included in the Appendix. In this section, we outline the overarching questions, and key follow-up questions to watch for that resulted from the development of this protocol.

In the first interview, we will prompt the participant to “Describe your engineering experiences.” If the participant asks for clarification we will prompt: Consider what have been high points of your experiences– what has gone well? And consider what are some challenges that you have experienced in engineering?” A list of key terms will be provided to the interviewer as words or experiences. If these key terms are brought up, the interviewer will ask follow-up questions about the key terms after the initial narrative. This first interview will provide us with an initial, uninterrupted narrative to identify what is said and left unsaid by the participant [12].

In the second interview, we will present the participant with a Google slide that has 20 of the top and most relevant keyword groupings. We will then explain that the word groupings come from common words brought up in social media posts by neurodivergent individuals. We will ask the participant to review the word groupings to identify any that bring to mind a story or experience from this semester and ask them to explain that experience. The Google slide will be used to give the student a more tangible look at the words (i.e. the ability to move the words around as needed/desired and reduce the bias from ordering the words in any particular way).

In the third interview, we will ask the student to describe their engineering experiences throughout the semester. This third interview will be conducted at the end of the semester so that we get an overall reflective picture of the student's experiences in engineering throughout the semester. We will then review their narrative from the first two interviews and ask them for any clarifications or updates to their narrative.

Summary

The LDA analysis revealed keyword groupings used to describe neurodivergent experiences by the neurodiverse community in social media. These keywords then helped inform the development of a three-part narrative interview protocol that focuses on eliciting a narrative of experiences in engineering, then elicits specific stories related to keywords to provide further meaning and context-specific to engineering for those experiences, and finally holistically assesses strengths and challenges across an engineering semester for a neurodiverse individual.

We believe that the work started with this interview protocol can inform researchers working in this space in developing strengths and challenges-based interview protocols utilizing language used to describe strengths and challenges experienced by neurodivergent people.

Acknowledgements
This work is supported by the National Science Foundation (Award #: EEC-2306830 and EEC-2306831).

References

[1] T. Armstrong, "The myth of the normal brain: Embracing neurodiversity," *AMA J. Ethics*, vol. 17, no. 4, pp. 348–352, Apr. 2015.

[2] M. Sanchez-Pena, X. R. Xu, N. Ramirez, and N. Sambamurthy, "Engineering students and professionals living with a mental illness: an exploration of their experiences and challenges," in *2019 IEEE Frontiers in Education Conference (FIE)*, IEEE, Oct. 2019, pp. 1–5.

[3] E. Cage and J. Howes, "Dropping out and moving on: A qualitative study of autistic people's experiences of university," *Autism*, vol. 24, no. 7, pp. 1664–1675, Oct. 2020.

[4] The Institution of Engineering and Technology, "Neurodiversity in engineering and technology - A 2023 report," The Institution of Engineering and Technology, 2023. [Online]. Available: https://www.theiet.org/media/paqhz25y/neurodiversity-in-engineering-and-technology-full-report.pdf

[5] A. Crabtree *et al.*, "Recruiting and retaining autistic talent in STEMM," *iScience*, vol. 27, no. 3, p. 109080, Mar. 2024.

[6] A. Cuellar, B. Webster, S. Solanki, C. Spence, and M. Tsugawa, "Examination of Ableist Educational Systems and Structures that Limit Access to Engineering Education through Narratives," in *2022 ASEE Annual Conference & Exposition*, peer.asee.org, 2022. [Online]. Available: https://peer.asee.org/41800.pdf

[7] A. Cuellar, S. Principato, S. Solanki, C. Spence, and M. Tsugawa, "Work in Progress: Transferability of a Neurodivergent Codebook Developed from TikTok to Neurodivergent Engineers," in *2023 ASEE Annual Conference & Exposition Proceedings*, ASEE Conferences, 2024. doi: 10.18260/1-2--44378.

[8] C. C. Wang and S. K. Geale, "The power of story: Narrative inquiry as a methodology in nursing research," *Int. J. Nurs. Sci.*, vol. 2, no. 2, pp. 195–198, Jun. 2015.

[9] H. Jelodar *et al.*, "Latent Dirichlet allocation (LDA) and topic modeling: models, applications, a survey," *Multimed. Tools Appl.*, vol. 78, no. 11, pp. 15169–15211, Jun. 2019.

[10] S. Solanki, K. Kheiri, M. Tsugawa, and H. Karimi, "Leveraging social media analytics in engineering education research," in *2023 ASEE Annual Conference & Exposition*, 2023. doi: 10.18260/1-2--43472.

[11] J. Esposito and V. E. Evans-Winters, *Introduction to intersectional qualitative research*. Thousand Oaks, CA: SAGE Publications, 2021.

[12] J.-H. Kim, *Understanding narrative inquiry: The crafting and analysis of stories as research*. Thousand Oaks, CA: SAGE Publications, 2015.

[13] F. M. Connelly and D. J. Clandinin, "Stories of experience and narrative inquiry," *Educ. Res.*, vol. 19, no. 5, pp. 2–14, Jun. 1990.

[14] V. Lopez and D. Whitehead, "Sampling data and data collection in qualitative research," in *Nursing and Midwifery Research*, Z. Schneider and D. Whitehead, Eds., researchgate.net, 2012, pp. 123–140.

[15] C. Anderson and S. Kirkpatrick, "Narrative interviewing," *Int. J. Clin. Pharm.*, vol. 38, no. 3, pp. 631–634, Jun. 2016.

[16] J. Saldaña, *The Coding Manual for Qualitative Researchers*. SAGE Publications, 2021.

[17] K. M. MacQueen, E. McLellan, K. Kay, and B. Milstein, "Codebook development for team-based qualitative analysis," *CAM J.*, vol. 10, no. 2, pp. 31–36, May 1998.

[18] N. Jenkins, M. Bloor, J. Fischer, L. Berney, and J. Neale, "Putting it in context: the use of vignettes in qualitative interviewing," *Qual. Res.*, vol. 10, no. 2, pp. 175–198, Apr. 2010.

[19] C. Barter and E. Renold, "The use of vignettes in qualitative research," *Social research update*, vol. 25, 1999, [Online]. Available: https://sru.soc.surrey.ac.uk/SRU25.html

[20] C. Cipolla, "' Not So Backwards': A Phenomenological Study on the Lived Experiences of High Achieving Post-Secondary Students with Dyslexia," PhD, Northwest Nazarene University, 2018. [Online]. Available: https://search.proquest.com/openview/98e6964c6bf8335f61863eac394cdcab/1?pq-origsite=gscholar

&cbl=18750

Appendix: Full Interview Protocol

Notes for Interviewer:

The primary goal of this interview is to be an active listener and let the interviewees share their narratives uninterrupted. To create an inviting environment for sharing their story, wear casual clothes, something that is similar to what the students would wear in terms of level of dress. Open the interview with some casual questions such as, “How is your day going?”, “How has the semester been?”, and/or “Did you go to the game on Saturday?” If they are talking for a bit on these points let them keep going, do not cut them off. You want them to talk throughout the interview and get them going early. Avoid bringing in large pieces of technology if possible as they can be distracting/intimidating. Find a space that does not have a formal interview set up (you behind a desk and them on the other side). If the room has more than one seating option let the students pick where they want to sit as that will make them more comfortable (some people don't like having their backs to the door). Having a second person in the room can be helpful so that you can have time to pause and think or someone else can make sure that you have asked all the questions/all answers given by students are actually clear. Try to avoid asking the student to speak in a different tone or volume than their natural speaking voice as this may make them feel uncomfortable or inadequate. Instead, move the recording device around if needed.

Notes to Give to Interviewee:

Before starting the interview frame the interview as a conversation or a dialogue. Inform the student that this is the interview protocol (show them the physical document) and tell them you will ask these questions but you may also ask more to gain an increased understanding of their story. Tell them all data will be kept anonymous and that you want them to express their opinion. Stress that there are no right or wrong answers, only the story they have to tell is what we are interested in. Some questions may seem repetitive but you want to make sure that you are getting the full depth of the story. Inform them that you will be recording the interview so you can go back and listen to their responses verbatim.

First Interview Goals:

- Obtain background information of the participant such as neurodivergent diagnosis process, interest in engineering, and previous salient experiences.
- Learn about participant's semester plans such as what classes they are taking and how they plan to manage the workload.
- Broadly discuss the strengths and challenges of being a neurodivergent and an engineering student.

First Interview Questions:

1. Tell me about yourself. How would you describe yourself to someone new that you just met? (personal or professional)

2. What courses are you currently taking? What does your daily schedule look like?

3. Why did you choose engineering? What attracted you to engineering?

4. Describe your engineering experiences. What are some high points of your experiences? What has gone well?

5. What are some challenges that you have experienced in engineering?

Second Interview Goals:

- Review the first interview to remember participant details
- Receive a description of the participant's engineering experience
- Receive updates about the semester to add to the narrative
- Discuss strengths and challenges occurring in the current semester
- Identify key events causing stress or stress relief

Second Interview Questions:

1. Last time you discussed [review summary with the student]. Is there anything you want to clarify or update about your semester?

2. [Present the keywords found from social media analysis to the interviewee. Ask them to pick any that stand out to them related to their engineering experiences.] Tell us a story related to this word from your engineering experiences this semester.

Third Interview Goals:

- Review the previous interviews to remember participant details

- Receive updates on how the semester concluded
- Discuss concluding strengths and challenges
- Develop a narrative for each participant

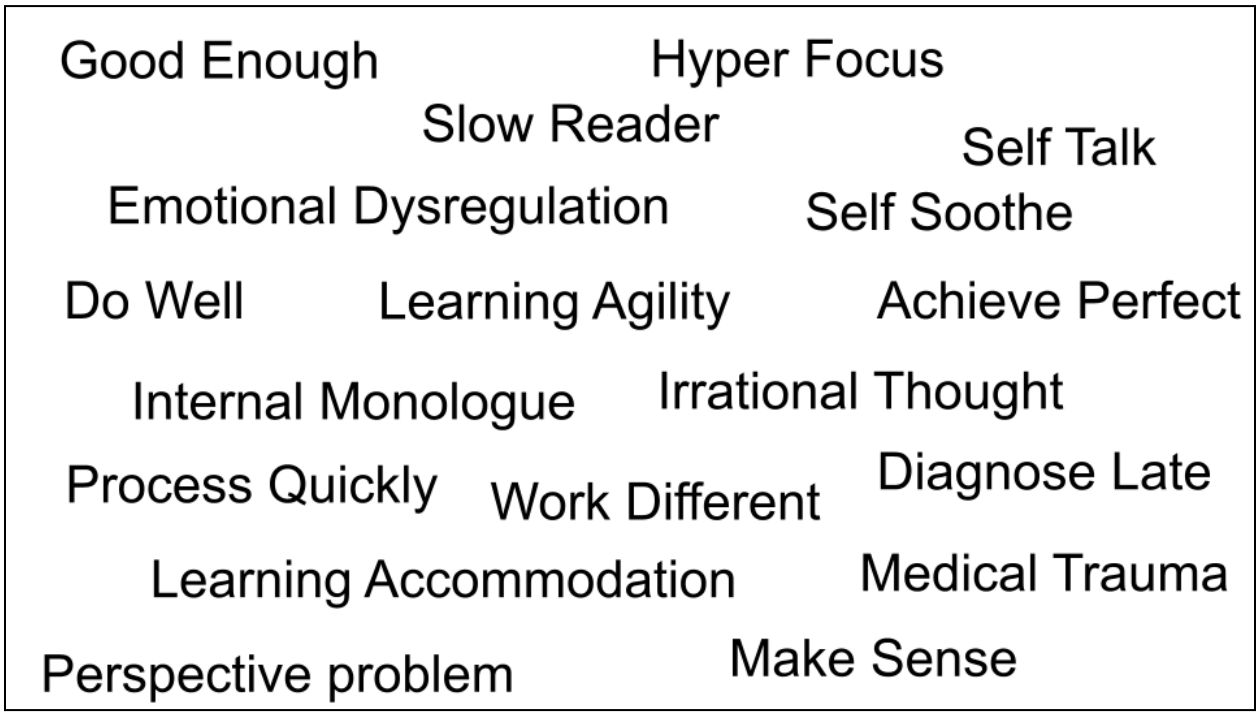
Third Interview Questions:

1. Looking back at the whole semester, how has your engineering experience been?

2. What would you identify as your greatest strengths and your greatest challenges from the semester?

3. Last time you discussed [review summary with the student]. Is there anything you want to clarify or update about your semester?

Example Key Words to Present in the Second Interview



Potential follow-up interview questions, *if* any of the bolded experiences are brought up.

How has **masking** impacted your engineering experience?
What does your **self-talk** look like for school?
How would you describe your experiences working with **learning accommodations**?

Can you explain what you mean by feeling **strong enough**?
Can you give an example from one of your engineering classes to explain what you mean by **work differently**?
How has **processing** the **world differently** impacted your engineering experience?
What does your goal of **achieving perfect** look like for you in your engineering experience?
How has the process for an **official diagnosis** affected your engineering experience?