BPE Track 2: Capturing the Narratives of Neurodivergent Undergraduate Engineering Students

Dr. Cassandra McCall, Utah State University

Dr. Cassandra McCall is an Assistant Professor in the Engineering Education Department at Utah State University (USU). Her research focuses on the intersections of disability, identity formation, and culture and uses anti-ableist approaches to enhance universal access for students with disabilities in STEM, particularly in engineering. At USU, she serves as the Co-Director of the Institute for Interdisciplinary Transition Services. In 2024, Dr. McCall received a National Science Foundation CAREER grant to identify systemic opportunities for increasing the participation of people with disabilities in engineering. Her award-winning publications have been recognized by leading engineering education research journals at both national and international levels. Dr. McCall has led several workshops promoting the inclusion of people with disabilities and other minoritized groups in STEM. She holds B.S. and M.S. degrees in civil engineering with a structural engineering emphasis.

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.

Vanessa Tran, Utah State University

Bachelor's Degree: Civil Engineering, the University of Architecture, Vietnam. Master's Degree: Global Production Engineering and Management, Vietnamese - German University, Vietnam. Ph.D. Student in Engineering Education, College of Engineering, 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.

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.

BPE Track 2: Capturing the Narratives of Neurodivergent Undergraduate Engineering Students

Introduction

Neurodivergent individuals, including those with attention-deficit/hyperactivity disorder (ADHD), autism, and dyslexia, have long played a critical role in advancing science, technology, engineering, and mathematics (STEM). Over the past decade, research has increasingly highlighted the benefits neurodiverse employees contribute to engineering and scientific innovation such as divergent and creative thinking, pattern recognition, sustained focus on complex problems, and advanced spatial reasoning [1]. These characteristics align closely with the demands of engineering work, which often requires creative problem solving, systems-level thinking, and novel approaches to design. As global challenges grow more complex, the inclusion of neurodivergent thinkers is not only an equity imperative but also a driver of scientific and technological progress.

To support this recognized need, institutions such as the National Science Foundation (NSF), American Institutes for Research (AIR), and the National Academies of Science, Engineering, and Medicine (NASEM) have called for increased participation of neurodivergent people in these fields [2], [3], [4]. More recently, engineering industry has bolstered these calls, with organizations like the Structural Engineers Association of California (SEAOC, event is currently being planned) and the Engineering Change Lab hosting events focused on recruiting, retaining, and supporting neurodivergent engineers, as well as engineers from other underrepresented groups, in the STEM workforce [5]. Despite these efforts, however, neurodivergent people remain underrepresented in engineering education and the STEM workforce. Many neurodivergent students encounter structural and cultural barriers in academic environments, including inflexible instructional practices, limited support systems, and deficit-oriented narratives that frame neurodivergence as a problem to be remediated rather than a difference to be valued [6], [7]. Together, these sociocultural and systemic barriers contribute to higher attrition rates in engineering programs [8], [9], resulting in a loss of talented engineers with diverse perspectives. Addressing these barriers requires shifting from accommodation-based models toward inclusive educational designs that recognize, support, and leverage neurodivergent strengths within engineering career pathways and beyond.

In this paper, we present our research progress and initial findings from an ongoing National Science Foundation project (Award #2306830 and #23068311) to explore how neurodivergent engineering students characterize, describe, and leverage their strengths and challenges while navigating their undergraduate engineering education. Guided by a social constructionist framework, our three-year explanatory sequential mixed methods study consists of two stages. Stage 1 (QUANT), in its final phases of analysis, included a quantitative-based Latent Dirichlet Allocation (LDA) analysis of language used on three social media platforms (X, formerly known as Twitter; Reddit; and TikTok) by the neurodivergent community. To further contextualize and explicate the findings from LDA conducted in Stage 1, Stage 2 (QUAL) consists of longitudinal and cross-sectional semi-structured interviews with neurodivergent engineering undergraduates.

Here, we focus our discussion on the emerging findings from a series of longitudinal interviews conducted with two participants at a four-year university in the western United States. Their

experiences point to strategies for making meaning of themselves and neurodivergence through both online communities and in-person relationships in ways that not only challenge anti-social narratives about neurodivergent people but also reveal the complexities of adapting to oneself and their environments during college. These findings provide insights into how educational systems can be better designed and structured to increase accessibility of engineering career pathways for neurodivergent people as well as identify terminology that can be leveraged to reclaim the neurodivergent narratives though their own language.

Stage 1: Latent Dirichlet Allocation (LDA) of Social Media Posts

The first aim of this explanatory sequential mixed methods study was to identify current topics and language salient to the neurodivergent community on a broad scale. To accomplish this, we conducted an LDA of neurodivergent user posts on three social media platforms: X (formerly known as Twitter), Reddit, and TikTok. LDA is a modeling technique used to summarize large sets of textual data by grouping word distributions to identify underlying or hidden thematic structures [10]. The hallmark of LDA is its treatment of each data source (e.g., a TikTok video transcript, etc.) as a decontextualized group of words grounded in the users' language, making this technique particularly useful for gaining a textual foundation of the types of topics discussed and language used by neurodivergent people across these social media platforms. The result of the LDA is a series of topic clusters grouped by word frequency and appearance (shown in Figure 1), thus providing a rich starting point for in-depth topic exploration in Stage 2 (further discussed in the next section). To further explore these clusters, we pulled key words identified in the LDA to be discussed during the interviews conducted in Stage 2. Details regarding the methods and findings associated with Stage 1 are published elsewhere (see [11]).

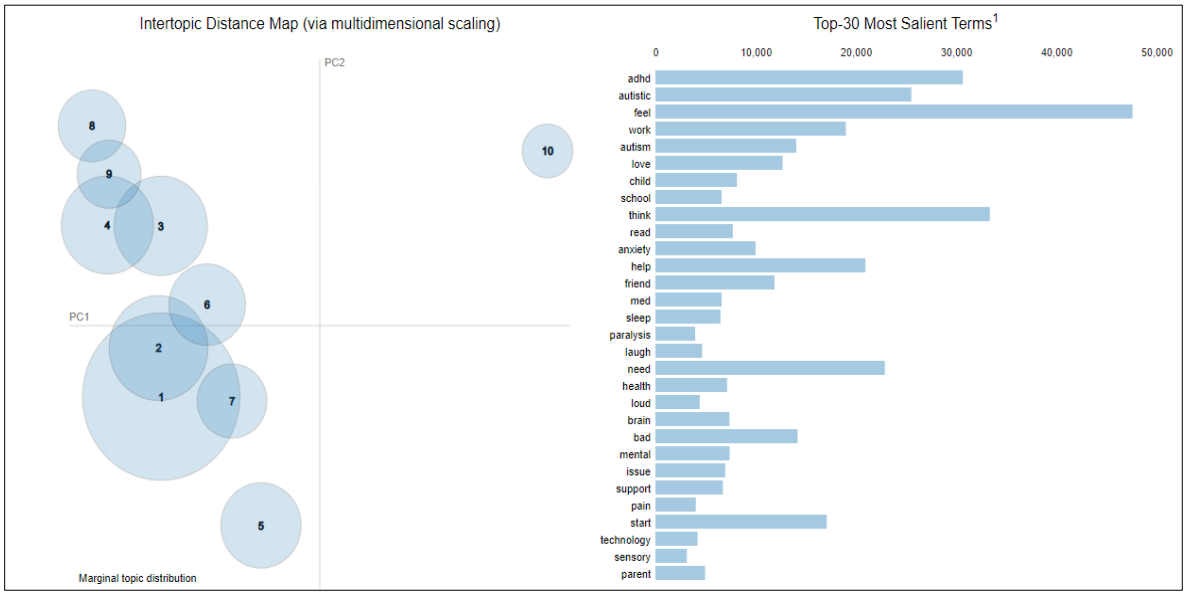

Figure 1: Output from LDA with related topic clusters (left) and list of most salient terms (right)

Stage 2: Semi-Structured Interviews with Neurodivergent Engineering Students

In Stage 2, we leveraged the findings from the LDA to inform the development of the qualitative phases of the study, which consist of longitudinal (n = 5) and cross-sectional (n = 10) semi-

structured interviews with undergraduate engineering students. Recruitment for the cross-sectional interviews to be conducted nationwide has begun, and the longitudinal interviews, conducted at a single university, are still ongoing. To date, we have conducted six interviews, each lasting between one and two hours, with two participants; three interviews were conducted with each participant over the course of a single academic semester from August to December 2025. The narratives resulting from these longitudinal interviews are the focus of this discussion.

Recruitment. For the longitudinal interviews, participants were recruited from a single four-year university in the western United States. Participants must identify as being neurodivergent (a formal diagnosis from a healthcare provider is not required), have been enrolled in an undergraduate program in the College of Engineering, and be at least 18 years of age or older. Participants were recruited by distributing flyers throughout the engineering buildings on campus and through in-person classroom visits. Recruitment materials directed students to scan a QR code from their smartphones to access the recruitment survey hosted in Qualtrics. In this survey, prospective participants can enter their information and volunteer to participate in an interview series. Students selected to participate receive a $50 Amazon gift card for each interview they complete. Due to the low number of students who have volunteered to participate in the study to date, we have not specifically sampled for demographic variability and are eager to talk with any neurodivergent undergraduate engineering student willing to participate in the study.

Series of Longitudinal Semi-Structured Interviews. The first interview in the series focuses on building rapport with the participant by getting to know their background, anticipated career trajectory, and past experiences. In addition, we ask the participant to discuss both positive and negative aspects of their experiences during the current semester in their engineering program. The second interview in the series is open-ended and focuses on gathering updates from the participants. These updates can include any aspect of the participant's experience ranging from personal and social developments (e.g., learning more about one's neurodivergence and connecting to others) to academic ones (e.g., implementing new study strategies and techniques). After discussing key updates, the initial findings from the LDA of the examined social media platforms are presented to the participant in the form of key terms from each topic (see Figure 1). Upon review of these terms, participants are invited to choose those that resonate with them and elaborate how those terms connect to their own experiences in engineering. Similar to the second interview, the third (and final) interview is open-ended with prompts focused on reflection across experiences at the beginning, during, and at the end of the semester.

Interview Analysis and Narrative Construction. After each interview, the research team met to construct a narrative for each participant based on the information shared and key themes observed by the research team. Participant narratives were constructed following the storytelling approaches to narrative inquiry [12], [13] that focus on best representing each participant's story using chronology, context, and theme [14]. Participants engaging in longitudinal interviews were also invited to co-construct their narratives by reading through, editing, and updating the initial narrative crafted by the research team. These narrative member checks occurred prior to the start of the consecutive interview; that is, the initial participant narrative generated after the first interview was reviewed and checked by the participant prior to the start of the second interview.

Initial Findings

The initial findings presented here come from two participants, Tom and Via (pseudonyms). Via is an undergraduate in engineering who was drawn to her discipline from the joy she found in science and working in labs. She has a close connection with her family, Vincentian on her mother's side, and enjoys traveling with her family and for engineering experiences (such as Engineers Without Borders). During the semester, she took Calculus II, Organic Chemistry, Biomaterials, and Intercultural Communication courses, including labs. Via experiences chronic health conditions including Attention-Deficit/Hyperactivity Disorder (ADHD), obsessive compulsive disorder (OCD), and postural orthostatic tachycardia syndrome (POTS). Via enjoys studying with friends and tries to make studying a social activity to support her mental health.

Tom recently graduated from an undergraduate computer science program and is currently a graduate student in the same field. He has always been passionate about STEM and was drawn to his field through early experiences in robotics. He has struggled with ADHD symptoms for most of his life and recently obtained a diagnosis for it. Tom places an importance on routine and structure in his daily life, alongside his wife. This semester has been very busy but productive. It is his first semester taking ADHD medication, and he feels it has helped immensely.

Emerging Theme: Making Meaning of Oneself through Community

Both Tom and Via discuss the roles of community in navigating their diagnoses and experiences in engineering. Tom discusses how online sources, such as social media and podcasts, helped him recognize his own experiences as neurodivergent. When he heard stories about experiences through podcasts, he would recognize his own experiences, only to hear the storyteller reveal their own ADHD diagnosis. This except from Tom's narrative highlights the support he found through these sources:

> Since he found out about his conduct (being ADHD), Tom has been more aware and does not just simply label himself as "lazy" or "unreliable." He said he had started reading about neurodivergence and knows his situation better now. He pointed out that online social media outlets like Reddit, discord, YouTube have helped him to connect with similar people, and by reading their stories, he does feel alone. When asked about the role of "sense of belonging" as a neurodivergent individual, he said such a sense of belonging is tremendously helpful. When asked about the awareness of neurotypical peoples about neurodivergent conditions, he responded that having such awareness is extremely helpful for neurodivergent people.

Tom would also seek feedback from therapists, which eventually led to his diagnosis and support through medication. In identifying the diagnoses, he made an unexpected connection with his own father who died when Tom was younger. He hears that his father also had similar experiences to him through other family members. Hearing stories from family members about his father's experiences helped Tom confirm some of his own experiences.

Unlike Tom, Via is not yet engaged with online communities but is aware of them through sources like her therapist. When asked if she considered leveraging online communities for support, she described time conflicts between school and the group's synchronous online

meeting schedule. For Via, community includes the people who have close relationships with her, such as her fiancé, family and friends. The excerpt from her narrative explains how she combines time with members of her support community to complete her engineering coursework:

> To handle the stress of school, Via uses different coping strategies that combine structure and social support. She studies in places where she can be around others like the engineering building or study areas on campus. Being with friends or her fiancé helps her focus and stay motivated. She also tries to connect schoolwork with social time, such as doing homework with roommates during movie nights or studying with friends before exams. These routines make her studying more manageable.

Via's approaches to integrate support community and school are not uncommon; what is less common is that many of her friends, including her fiancé, are not in engineering programs, demonstrating how Via blends non-engineering related aspects of her community to help her navigate her experiences in engineering.

Implications and Future Work: Unpacking Community

Findings from this study underscore the central role of community in supporting neurodivergent engineering students' persistence, identity development, and ability to leverage their strengths within undergraduate engineering environments. Both Tom and Via consistently described aspects of their communities as resources for navigating academic, social, and institutional challenges. These communities provided validation, shared language, and opportunities to reframe neurodivergence as an asset rather than a deficit.

However, more work is needed to unpack these communities, the people who constitute them, and the roles they play in understanding the experiences of neurodivergent undergraduate engineering students. Aligning with prior research associated with group identities [15], interactions with these communities help people decipher who they are and who they are not [16]. As data collection for Stage 2 continues both longitudinally and cross-sectionally, we will continue to examine how different communities shape and contribute to neurodivergent students' experiences in engineering. Gaining this understanding can help further inform strategies for engineering educators for reducing isolation and encouraging collaboration and social activity in the engineering curriculum. Overall, our findings suggest that fostering community is not a peripheral support strategy but a core component of inclusive engineering education. By designing learning environments that prioritize connection, belonging, and shared meaning-making, engineering educators can help cultivate sustainable pathways that support neurodivergent students' success and, in turn, strengthen the engineering profession as a whole.

Acknowledgements

This material is based upon work supported by the National Science Foundation under EEC Award #2306830 and #2306831. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

References

[1] T. Armstrong, "The Myth of the Normal Brain: Embracing Neurodiversity," *AMA J. Ethics*, vol. 17, no. 4, pp. 348–352, 2015, doi: 10.1001/journalofethics.2015.17.4.msoc1-1504.

[2] NSF, "Dear colleague letter: Persons with disabilities - STEM engagement and access (PWD-SEA)." National Science Foundation, Aug. 15, 2021. [Online]. Available: https://www.nsf.gov/pubs/2021/nsf21110/nsf21110.jsp

[3] NSF, "Workplace Equity for Persons with Disabilities in STEM and STEM Education." [Online]. Available: https://www.nsf.gov/pubs/2023/nsf23593/nsf23593.htm

[4] AIR, "Broadening participation in STEM (science, technology, engineering, and mathematics)," American Institutes for Research. Accessed: Jul. 21, 2022. [Online]. Available: https://www.air.org/project/broadening-participation-stem-science-technology-engineering-and-mathematics

[5] Engineering Change Lab, *Focused Initiatives*, 2026. [Online]. Available: https://ecl-usa.org/?s=initiatives

[6] C. G. Kingsbury, E. C. Sibert, Z. Killingback, and C. L. Atchison, "'Nothing about us without us:' The perspectives of autistic geoscientists on inclusive instructional practices in geoscience education," *J. Geosci. Educ.*, vol. 68, no. 4, pp. 302–310, Oct. 2020, doi: 10.1080/10899995.2020.1768017.

[7] T. Shakespeare, "The social model of disability," in *The Disability Studies Reader*, Routledge, 2006, pp. 197–204.

[8] 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," presented at the IEEE Frontiers in Education Conference (FIE), Covington, KY, USA: IEEE, Oct. 2019, pp. 1–5. doi: 10.1109/FIE43999.2019.9028416.

[9] 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, doi: 10.1177/1362361320918750.

[10] D. M. Blei, A. Y. Ng, and M. I. Jordan, "Latent Dirichlet Allocation," *J. Mach. Learn. Res.*, vol. 3, no. 2003, pp. 993–1022, 2003.

[11] K. Thakkar, L. E. Feri, A. Cuellar, V. Tran, C. M. Spence, C. McCall, & H. Karimi, "Hidden in plain text: social media mining of neurodivergent discourse at scale on X and Reddit," presented at the ASEE Annual Conference, Charlotte, NC, USA: ASEE, Jun. 2026, pp.1-22.

[12] T. Moen, "Reflections on the Narrative Research Approach," *Int. J. Qual. Methods*, vol. 5, no. 4, pp. 56–69, Dec. 2006, doi: 10.1177/160940690600500405.

[13] D. E. Polkinghorne, "Narrative configuration in qualitative analysis," *Int. J. Qual. Stud. Educ.*, vol. 8, no. 1, pp. 5–23, Jan. 1995, doi: 10.1080/0951839950080103.

[14] M. Bearman, J. Greenhill, and D. Nestel, "The power of simulation: a large-scale narrative analysis of learners' experiences," *Med. Educ.*, vol. 53, no. 4, pp. 369–379, Apr. 2019, doi: 10.1111/medu.13747.

[15] H. Tajfel, "Social identity and intergroup behaviour," *Soc. Sci. Inf.*, vol. 13, no. 2, pp. 65–93, Apr. 1974, doi: 10.1177/053901847401300204.

[16] C. McCall, L. D. McNair, and D. R. Simmons, "Advancing from outsider to insider: A grounded theory of professional identity negotiation in undergraduate engineering," *J. Eng. Educ.*, vol. 110, no. 2, pp. 393–413, Apr. 2021, doi: 10.1002/jee.20383.