WIP: Comparison of Neurodivergent Student Prevalence in Engineering Across Two Institutions

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Abstract— This work-in-progress research paper describes the prevalence of neurodivergent students (ND) in engineering across two institutions. There is growing awareness that engineering students who are neurodivergent bring unique assets and face challenges to their higher education experience. Neurodivergent students may also face additional challenges associated with chronic illness or being marginalized due to their gender or race/ethnicity. This paper provides background on these issues, followed by demographic data from two institutions. The goal of the paper is to raise the awareness of engineering faculty that the variety of differences and medical conditions among engineering students may be more diverse and/or prevalent than many realize. Students may not disclose these conditions or receive formal accommodations but can be successful. With a notable percentage of engineering students identifying as ND, faculty should ensure these students feel supported. Higher education institutions should also prioritize systematic planning and programming to support the retention and success of these neurodivergent students.

Keywords— Neurodivergent; Neurodiversity; Chronic illnesses; Gender.

I. INTRODUCTION

Neurodivergence (ND), encompassing Attention-Deficit/Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), Dyslexia, and Dyspraxia, affects a significant portion of the population [1]. Using a neurodiversity framework embraces the stance that individuals can self-identify. This removes constraints associated with formal medical diagnosis that are tied to the medical model framework. There is a lack of consensus around ND in the medical community, which is readily apparent looking at changes in the Diagnostic and Statistical Manual of Mental Disorders (DSM) over time (e.g., DSM-5-TR in 2022, DSM-5 2013, DSM-IV 1994, etc.) and difference compared to the World Health Organization's International Classification of Diseases (i.e., ICD-11, 2022) [2-5].

Individuals with neurodivergence and chronic physical conditions, especially adolescents and girls, are more prone to experiencing negative mental health outcomes [6]. The diagnostic pathways and support systems for prevalent neurodiversity types (e.g., ADHD, ASD, and Dyslexia) are crucial for efficient support [7]. Embracing a neurodiversity focus can enhance social inclusion and improve health outcomes for many individuals [8]. Understanding the experiences and needs of neurodiverse individuals is crucial for mental health

providers and counselors to adapt their techniques effectively and enhance access to treatment [9-10]. Autistic individuals, in particular, may benefit from a positive autistic self-identity, which can lead to better mental health outcomes [11]. There is also complexity given that some conditions are independent but could also be symptoms resulting from neurodivergent individuals struggling to navigate social systems (e.g., anxiety, and depression).

Bakker et al. [12] found that among over 27,000 first-year college students enrolled at a university in the Netherlands from 2010 to 2016 that: (1) the proportion of students with ASD and other disabilities increased significantly over time (0.2% to 0.45% and 4.76% to 10.22%, respectively); (2) more students with ASD had additional disabilities (24.7%) compared to other disabilities (11.7%); for example, among those with ASD, 7.2% also experienced dyslexia, 6.2% ADHD; (3) a higher proportion of students with ASD were majoring in STEM (55.7%) compared to students with other disabilities (31.3%) and students without disabilities (28.0%); (4) fewer students with ASD were female (28.9%) compared to the percentage of female students with other disabilities (including ADHD; 58.6%) and students without disabilities (55.2%); (5) students with ASD and students with other disabilities were older than students without disabilities.

Employment opportunities for neurodivergent individuals are essential, as they represent an untapped talent pool that can provide a competitive advantage to inclusive employers [13]. Employment opportunities for neurodivergent individuals are increasing as more companies recognize their unique talents and contributions. For instance, the Autism at Work program at SAP (German IT and software firm) has achieved a 90% retention rate by creating a supportive environment for autistic individuals. Similarly, Microsoft's Neurodiversity Hiring Program conducts week-long hiring events to accommodate candidates with ADHD, autism, and dyslexia, showcasing their skills effectively. Goldman Sachs offers an eight-week paid internship under its Neurodiversity Hiring Initiative, which includes comprehensive training and mentoring. EY (Ernst & Young) has established Neuro-Diverse Centers of Excellence globally, focusing on inclusive hiring and work environments. IBM's DiversAbility program hires and supports neurodivergent professionals, emphasizing an inclusive workplace. JPMorgan Chase has adapted its interview process to better suit candidates with ADHD and other neurodiverse conditions by using pymetrics games to match job candidates with roles and providing detailed reports on their strengths. Additionally, Dell's Autism Hiring Program includes a two-week skills assessment to accurately gauge the potential value of neurodiverse applicants. These initiatives not only facilitate the hiring of neurodivergent individuals but also ensure they receive the necessary support and accommodations to thrive, thereby fostering a diverse and innovative workforce [14-15]. In the workplace, implementing neurodiversity-friendly policies and practices can harness the hidden human capital associated with neurodiversity [16]. Moreover, a strengths-based approach, as advocated by the neurodiversity movement, can be beneficial in promoting the well-being and success of neurodivergent individuals in various settings, including work environments [17].

To achieve their academic goals, neurodivergent students need both academic [18-19] and non-academic support [20]. Integrating Universal Design for Learning (UDL) and Personalized Learning Systems (PLS) is crucial for supporting ND students in higher education. Universities often provide additional support through Counseling and Psychiatric Services and/or Student Disability Services. For example, the University of Colorado Boulder offers an Autism Spectrum (ASD) Support Group and Chronic Care Support Group, while the University of Michigan and the University of Iowa provide similar resources [21-23]. Cal Poly, the University of Iowa, and Virginia Commonwealth University also have dedicated support groups for ADHD [24-26]. Additional resources, such as the Neurodiversity Hub, offer support for students and employers. Increasing awareness and resources related to neurodiversity in the workplace is also essential, as highlighted by the World Economic Forum [27].

Little information about the prevalence of ND among engineering students has been published. Among over 1,000 engineering students and a single US institution (a dataset predominated by first-year students), 18% identified as neurodivergent, 19% as maybe ND, and 62% as neurotypical; higher percentages of female compared to male students were ND or maybe ND [28-29]. It is uncertain if ND students persist in engineering at similar rates as their NT peers.

Our research aims to: 1) determine the prevalence of neurodivergent students in engineering across two different institutions, 2) examine the occurrence of chronic illness among engineering students, particularly comparing neurodivergent (ND) and neurotypical (NT) students, and 3) analyze the demographic differences between neurotypical and neurodiverse individuals in engineering at these institutions.

II. METHODS

Two institutions participated in the study. The University of Colorado Boulder (UCB), a large public research-intensive institution (R1) in the US Rocky Mountain region, was included (IRB Protocol 23-0388). Weber State University (WSU), a large, open-enrollment, Master's university in the same region, was also involved (IRB Protocol AY23-24-161) [30]. Institutions and courses represent a convenience sample based on the affiliations of the authors.

At UCB, the ND question (depicted in Table 1) was added to the end of the series of demographic items on surveys being primarily used for other purposes (e.g., innovation self-efficacy, identity) in engineering and environmental engineering courses.

Table 1 - The relevant survey questions used in this study.

With what gender do you self-identify?

Response options: Male, Female, Prefer to self-describe (open text box provided), Prefer not to say.

With which races and ethnicities do you self-identify (select all that apply)?

 Response options: African American / Black, American Indian or Alaskan Native, Asian, Hispanic or Latinx, Native Hawaiian or Other Pacific Islander, White, Other(s): (open text box provided), Prefer not to say.

Do you self-identify as neurodivergent? (based on brain function and/or behavioral traits such as anxiety, ASD, ADHD, dyslexia, dyspraxia, dyscalculia, PTSD, etc.).

- Response options: No, Maybe, Yes [or could elect to skip the question].
- You may add types of neurodiversity you identify with in the text-box if you choose to do so.

Do you have any chronic illnesses? Chronic illnesses are defined broadly as conditions that last 1 year or more and require ongoing medical attention or limit activities of daily living or both. Some examples include asthma, Crohn's, IBS, cancer, autoimmune illnesses, and diabetes

- Response options: No, Maybe, Yes [or could elect to skip the question].
- You may add your illness in the text-box if you choose to do so.

Environmental engineering (EnvE) majors at this institution, similar to the national data [31] are roughly equal in female and male students. The surveys were administered online via Qualtrics and distributed from December 2023 to April 2024. Students could opt not to answer the ND question. Survey incentives ranged from a \$10 e-gift card to participate in the study, entry into a drawing for a \$10 e-gift card, to no incentive. Time was generally provided during class time to complete the survey. Students who consented and completed the ND demographic item are shown in Table 2.

At WSU, the survey was conducted in November 2023 during class time in multiple sophomore-level electrical and computer engineering (ECE) classes. The survey was limited to the four questions listed in Table 1 and a traditional pencil-andpaper format. Students were informed that the survey was optional and anonymous. Students who consented and completed the survey are shown in Table 2. The overwhelming majority of students in the survey self-identified as male and White and/or Hispanic/Latinx. Although intersectionality is an important consideration when examining neurodiversity, the low number of women, gender-minority, and non-Hispanic/Latinx respondents in the sample limits the conclusions that can be drawn without sacrificing anonymity. Most of the students were electrical engineering or computer engineering majors, but a few other majors were present in the sample, namely applied mathematics and computer science.

Table 2 - Demographics and survey response rates of participants in two institutions.

Inst.	Course Info.	Enrollment	Response	Response	Female	Accommodation
		(n)	(n)	Rate (%)	(%)	(%)
UCB	First-Year Design	31	12	39	16	23
UCB	EnvE Junior	45	39	87	~49	5
UCB	EnvE Senior	29	25	86	48	14
UCB	EnvE Capstone	54	30	56	~57	7
WSU	ECE Sophomore	36	34	94	9	0
Total		195	140	72		

Note that due to limited racial/ethnic diversity and a low number of non-binary students at UCB, results from individual courses will not be reported. Instead, these data have been combined across the four courses. Intersectional sex and race/ethnicity are not discussed. The intent was not to erase these students or neglect their experiences but rather to help ensure the anonymity of the responses.

III. AUTHORS' POSITIONALITY

The authors bring a unique perspective to this study, drawing from personal experiences with neurodivergence. Their understanding is informed by parenting neurodivergent children and, in the case of one author, a late diagnosis of ASD. This lived experience provides a deep and nuanced understanding of neurodivergence that informs their research and analysis.

IV. LIMITATIONS

Students may choose whether or not to disclose ND on the survey, and if they feel that a stigma accompanies ND could elect not to answer the question truthfully. The level of perceived comfort with disclosure or stigma is likely to vary among individuals based on cultural norms and other factors. There is a lack of consensus on the conditions that are included under the umbrella of ND. Formal diagnosis is not a requirement to self-identify, understanding that diagnosis has limitations. This research used a convenience sample of students enrolled in the courses of the authors which may limit the generalizability of the findings.

V. RESULTS

In the first-year design course at UCB, 11 students identified as NT and one maybe ND. Note the unusual demographics in the course among the survey respondents: 2 female (1 maybe ND) and 10 male (all NT). The prevalence of neurodiverse students (8% maybe) is lower than was previously found among first-year engineering students [28] and first-year college students [32], perhaps due in part to the somewhat low response rate which is perhaps not representative of all students in the course. The two students who might be ND did not have accommodations. There was one more student with accommodations who did not complete the survey to indicate their neurodiversity status.

Within the fall junior-level environmental engineering course post survey at UCB, 72% of the students identified as NT, 10% maybe ND, and 18% as ND. Among the 18 male students, 89% were NT and 11% were ND. Among the 20 female students, 60% were NT, 15% were maybe ND, and 25% were ND. Among the 7 ND students in the course, 5 opted to identify their type of ND, which included: ADHD (n=4) and anxiety (n=1). Only 1 student identified as experiencing a chronic illness; this student was also ND; they did not describe either their type of chronic illness or neurodivergence. Among the nine ND students, only one had accommodations, while the other eight did not. The four students who might be ND also did not have accommodations. None of the other 28 NT students had accommodations. Additionally, there was one more student with accommodations who did not complete the survey to indicate their neurodiversity status.

Within the fall senior-level environmental engineering course post survey at UCB, 75% of the students identified as NT, 4% were maybe ND, and 24% identified as ND. Among the 13 male students, 1 identified as maybe ND (8%); all other male

students reported being NT. Among the 12 female students, 50% were NT and 50% were ND. Among the 6 ND students, 4 wrote in their types of ND, including ADHD (n=4), anxiety (n=2), PTSD (n=1), and depression (n=1). Two students reportedly experienced chronic illness; 1 female NT student and 1 female ND student. The identified chronic illnesses by the ND student included POTS, chronic migraines, and arthritis. Among the eight ND students, four had accommodations while the other four did not. The two students who might be ND also did not have accommodations. None of the other 15 NT students had accommodations.

Within the senior capstone EnvE design course at UCB, 60% of the students were not neurodivergent (therefore NT), 7% were maybe ND, and 33% identified as ND. The two maybe ND students did not elect to write in their type of ND. Among the 10 ND students, 5 wrote in types of ND which included: ADHD (n=1), anxiety (n=4), and depression (n=1). Only 1 of the 13 male students was ND (8%); all other male students reported being NT. Among the 16 female students, only 38% were NT. Only 2 students indicated that they experienced chronic illness. These students were both also ND (1 male, 1 female); they identified neither their type of ND nor their type of chronic illness. Among the nine ND students, only two had accommodations. The two students who might be ND did not have accommodations. Of the three other students with accommodations in this course, one was NT, and the other two did not complete the survey to indicate their neurodiversity status.

The results at UCB for gender and race/ethnicity were compiled across the four courses due to low numbers and to provide an additional layer of anonymity. There were two non-binary students and both identified as ND (yes and maybe). The percentage of ND and maybe ND students among those identifying with racial/ethnic groups was: 28% white (n=97), 20% Hispanic/Latinx (n=20), and 36% Asian (n=14). Fewer than 5 students identified as other racial/ethnic groups and therefore results are not reported. These data do not indicate significant differences in the prevalence of neurodivergence among racial/ethnic groups.

At WSU, 41% of the students self-identified as neurodivergent, while 18% responded that they may be neurodiverse. Among students who self-identified as white, 50% also self-identified as neurodivergent, compared to the students who self-identified with other races/ethnicities, where only 29% of them identified as neurodivergent. At WSU, it is difficult to make conclusions about the intersectionality of gender and neurodiversity because of the very small number of women and gender minorities present in the sample. More data are required, both to obtain statistically significant numbers and to preserve students' anonymity. None of the students requested formal accommodations.

VI. DISCUSSION

Within the small dataset at UCB, only a small percentage of male students (9%) indicated that they were neurodivergent (4 out of 44 yes or maybe), compared to half of the female students (25 ND or maybe ND among 50). Only 2 students identified a non-binary gender; both were ND. There may be different comfort levels with disclosure among male and female students,

and genders. Given the small number of students of different races and ethnicities, no conclusions can be made about the relative prevalence of ND (or comfort disclosing ND).

In contrast, at WSU a very high percentage of electrical and computer engineering students self-identified as ND (41%) or maybe ND (18%). These high percentages are surprising, because neurodivergence, by its very definition, occurs in a minority of the general population. It is possible that ND students self-select for engineering in general, and/or for electrical and computer engineering in particular. Additionally, it might be possible that ND students tend to self-select for open-enrollment universities, such as WSU. Another factor may be the commuter-university culture of WSU, where a large percentage of students live with their parents instead of in dorms or apartment housing. This may provide additional family support and familiar, sensory-friendly housing environments that might be appealing to ND students, leading them to self-select that type of university. Given the high percentages of self-identified ND individuals in the sample, it is very surprising that none of the students at WSU had any formal accommodations for disability. The reasons why students may not seek accommodation are unclear. It is uncertain whether they find the accommodation process daunting, are uninterested in accommodation, do not believe it would be helpful, or are unaware of its availability.

At WSU, there was a marked difference in the response of students who identified as white compared to the students who identified with other races/ethnicities. Among the students who identified as white, 50% also identified as neurodivergent. For comparison, only 29% of non-white and mixed race/ethnicity students self-identified as neurodivergent. This disparity may reflect the systematic biases in health care that prevent diagnosis and support for minoritized youth [33]. Additionally, the higher percentage of white students self-identifying as neurodivergent compared to non-white and mixed race/ethnicity students suggests a potential difference in how different racial or ethnic groups perceive or disclose their neurodivergence.

At both institutions, a low percentage of the students indicated that they experienced chronic illnesses (5% at UCB and 21% at WSU). At UCB, 4 of the 5 students who reported experiencing chronic illness were ND / maybe ND, which seems notable while acknowledging the small numbers limit a conclusion. At WSU, all the students who reported chronic illness also reported ND. However, the sample size was small, with only five students reporting chronic illness. Nevertheless, our data is in line with the literature indicating that ND individuals are more likely to experience chronic health conditions than the general population [34] and those chronic health conditions may further impact the ability of ND individuals to access and advance in higher education. This relationship may indicate a higher prevalence of chronic illness among neurodivergent students, but further research with larger sample sizes is needed to confirm this relationship.

The high percentage of neurodivergent (ND) females in the senior capstone course is a significant observation that underscores the ability of ND students to persist and succeed in

engineering. This finding challenges stereotypes and misconceptions about the capabilities of neurodivergent individuals, particularly females, in STEM fields. It suggests that with the right support and accommodations, ND students can excel in challenging academic environments and contribute meaningfully to their field of study. This insight is not only encouraging for current ND students but also highlights the importance of inclusive practices in education to ensure that all students, regardless of neurodivergence, have the opportunity to thrive.

In summary, embracing neurodiversity within the field of engineering and adapting support systems to meet diverse needs has the potential to enhance outcomes and well-being for neurodivergent students. Supporting neurodivergent (ND) students involves both institutional and individual professor remedies. Institutions can create sensory-friendly dorms, allow early move-ins, provide peer mentors, establish sensory spaces, and offer comprehensive advising. Life skills and study skills support are essential, along with peer support groups and extra assistance with job searches and transitions, such as from high school to college or college to the workplace. Professors can aid ND students by recognizing that ND is not a disorder of motivation and that ND students deserve their place in class. It is recommended to be tolerant, assume good intentions, and provide course materials in multiple formats. Flexibility with exam time limits and clear, predictable class structures are beneficial. Professors are advised to break large assignments into smaller tasks, allow regular breaks and fidgets, and foster supportive group work environments. Understanding and accommodating ND communication styles, using direct language, and setting clear expectations are key to effective support.

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