Narratives of Identity Coherence and Separation in the Figured Worlds of Undergraduate Engineering Education

Gabriel Van Dyke, Utah State University

Gabriel Van Dyke is a Graduate Student and Research Assistant in the Engineering Education Department at Utah State University. His current research interests are engineering culture and applying cognitive load theory in the engineering classroom. He is currently working on an NSF project attempting to improve dissemination of student narratives using innovative audio approaches. Gabe has a bachelor's degree in Mechanical Engineering from Utah State University (USU).

Dr. Cassandra McCall, Utah State University

Cassandra McCall, Ph.D., is an Assistant Professor in the Engineering Education Department at Utah State University. Her research centers the intersection identity formation, engineering culture, and disability studies. Her work has received several awards including best paper awards from the Journal of Engineering Education and the Australasian Journal of Engineering Education. She holds a Ph.D. in Engineering Education from Virginia Tech as well as M.S. and B.S. degrees in civil engineering from the South Dakota School of Mines and Technology.

Maimuna Begum Kali, Florida International University

Maimuna Begum Kali is a Ph.D. candidate in the Engineering and Computing Education program at the School of Universal Computing, Construction, and Engineering Education (SUCCEED) at Florida International University (FIU). She earned her B.Sc. in Computer Science and Engineering from Bangladesh University of Engineering and Technology (BUET). Kali's research interests center on exploring the experiences of marginalized engineering students, with a particular focus on their hidden identity, mental health, and wellbeing. Her work aims to enhance inclusivity and diversity in engineering education, contributing to the larger body of research in the field.

Dr. Stephen Secules, Florida International University

Stephen is an Assistant Professor Engineering and Computing Education at Florida International University. He has a prior academic and professional background in engineering, having worked professionally as an acoustical engineer. He has taught several courses on design, sociotechnical contexts, and engineering education. He runs the Equity Research Group which incorporates qualitative, ethnographic, participatory, and action-oriented research methods to examine and improve equity in engineering education contexts.

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Introduction

Over the past decade, engineering education has made a shift from a field primarily focused on developing engineering curriculum to considering identity and experience as core aspects of education [1]–[3]. Much of this work has focused on engineering identity, or professional identity, formation and highlighting the interplay between individual identity and engineering culture [4]–[6]. While work in engineering identity has become a prominent area of engineering education research, it can also be somewhat narrow. Implicitly, studies in engineering identity tend to position students' formation of an engineering identity as a positive outcome that promotes retention in the field [7]–[9] and students' lack of engineering identity formation as a problem to solve. Instead, the formation of student professional identities is fundamentally complex as different aspects of students' selves intersect and interact with engineering educational culture.

Each of us express different dimensions or aspects of our identity in different contexts [10]. In some cases, we call this code-switching as a form of identity management in which some aspects of identity are withheld and enacted for building legitimacy for themselves in professional and social settings [11]. Alternatively, we can bring our whole selves to different settings and experience more coherence with how we identify and act in all aspects of our lives. In each context, there may be complex reasons for the choices we make about how we represent ourselves. These include conscious choices for safety and comfort (e.g., choosing not to disclose a non-apparent disability identity to avoid stigmatization and discrimination) as well as unconsciously code-switching during communication. Without presuming that all people can or should bring their whole selves to all settings, generally the more opportunities we have to express our whole selves, the more inclusion we feel for ourselves and create for others.

In this paper, we focus on examining the nuanced ways students identify within engineering contexts and culture, without presuming or narrowing to the importance of an engineering identity exclusively. Specifically, we examine two contrasting student narratives to consider how students' personally meaningful identities are formed and enacted within engineering educational culture. One of our student participants tends to narrate their demographic identities as coherent within engineering education; the other student tends to narrate her demographic identities as separate from engineering education. These narratives highlight a phenomenon that is likely well known to us as individuals, teachers, mentors, and researchers: some students are more open to bringing their whole selves to the engineering classroom while others are not. We present these two students' contrasting narratives to help think about the ways students' identities are developed, limited, and supported in engineering educational culture and how to further develop these cultural spaces to provide more holistic student support.

Scholarship on Identity and Culture in Engineering Education

Dominant cultural characteristics are inherently communicated to students through a variety of socially-produced and culturally-constructed interactions, activities, and artifacts that constitute engineering educational culture [12], [13]. Such enactments dictate what engineering is, how it is taught and who is allowed to become an engineer [14], [15]. In engineering education, the culture has been described throughout the literature as gendered, raced, heteronormative, ableist, and techno-centric [4], [16]–[23]. This body of work problematizes a variety of embedded, taken-for-granted norms by exposing their marginalizing and harmful impacts on students with non-normative identities. Recent works from Burt et al. (2018) [24] and Blosser (2019) [25] describe Black students' racialized experiences when talking with university professors, forming study groups with peers, and simply being "one of the only ones" [25]. Similar findings have been identified in scholarship exploring the experiences of LGBTQ and disabled students. Cech and Waidzunas (2011) [4] highlight how heteronormativity (i.e., the hypervaluation or privileging of heterosexuality) is embedded in discussions of technical engineering topics, such as describing a plug and an outlet of a mechanical engine as a "man" and a "woman," respectively (p. 10). McCall and colleagues (2020) [26] identified ways in which descriptions of engineering culture, including "work hard, play hard" [19] and "meritocracy of difficulty" [27], contributed to ableist underpinnings that are exclusionary to disabled engineering students. Together, these studies explore individual student experience as a means to critically examine structural -isms and how they perpetuate inequities in engineering education [21], [28], [29].

Identifying and understanding experiences of marginalization within engineering educational culture require that they be told, either by ourselves or by others. The agency to tell our own stories has been identified by scholars as a powerful form of resistance against oppressive structures within and beyond engineering education, [30], [31]. These stories also create spaces for us to identify on our own terms and communicate ourselves in ways that are legible and understandable to others [32]. Several studies have explored students' marginalizing experiences using narrative approaches [1], [33]; however, with the exception of Secules et al. (2018b) [31], few studies have emphasized the role of agency in the telling of those narratives. In the present study, we build on this work and draw from narrative-based methods [34], [35] to underscore the agency of students to tell the stories of their identities through their own lived experiences [31], [36].

Theoretical Framework

We utilized Holland and colleagues' (1998) [13] construct of Identity and Agency in Figured Worlds to inform our understanding of the ways identity becomes non-apparent or hidden in engineering education. Identity and Agency in Figured Worlds serves as a powerful frame for our work because it captures the complex influence of socially- and culturally-produced systems (i.e., figured worlds) on one's capacity (i.e., agency) to purposefully and reflectively act within them. The ways we choose to – or choose not to – represent ourselves as we navigate figured

worlds, and the feedback we receive while interacting with them, serve as indicators of identification with social groups and their privileges [13]. For a system to be considered a figured world, it must have four characteristics: (1) historically developed through the works of participants; (2) include social encounters in which participant positions matter; (3) socially organized and reproduced; and (4) relate individuals to associated activities and familiar social types.

In this paper and the larger project it stems from, we conceptualized the engineering educational landscape and the intersections of various forms of oppression as a figured world in which students with multiply defined, marginalized identities iteratively interact with and within to make meaning of themselves [37]. During their engineering programs, undergraduate students participate in this figured world to make meaning of themselves as they form identities in engineering. At times, identities such as race and gender may be easily observed or experienced, at other times they may be hidden or misunderstood, essentially masking the diverse nature of engineering students and their experiences. As a result, faculty tend to default to dominant cultural norms in the figured world of engineering education that overlook how students make meaning of themselves along their diverse pathways toward becoming engineers.

Methods

To begin our inquiry, we conducted semi-structured interviews as part of a larger study exploring more effective methods for disseminating the experiences of undergraduate students with non-apparent and minoritized identities in engineering education. These interviews, each lasting between 60 and 90 minutes, were conducted with 21 students from 11 universities nationwide. The interview prompts were designed to facilitate researcher-participant discussion of four broad topics: (1) background, identity, and experience, (2) hidden identities in engineering, (3) perceptions and critical awareness of engineering culture, and (4) lessons learned and feedback to professors. Additional details regarding the larger study, including participant recruitment and data collection, may be found in [38]. All interviews were recorded and transcribed for analysis.

We began our analysis with an in-depth review of the transcripts to further familiarize ourselves with participants' stories and lived experiences. Initial narratives were constructed by a member of the research team and written for each participant following the approaches outlined in Kellam et al. (2015) [35]. These approaches include several iterations of listening to interview recordings, reviewing transcripts, and noting key relationships among significant events and experiences. Once an initial narrative was constructed, the entire research team met to conduct a final review of the narrative to eliminate redundancy, improve readability, and articulate key themes and ideas described by the participant.

For this paper, we focus our discussion on a comparative analysis of the constructed narratives of two participants, January and Srihari (pseudonyms), who both identify as having non-apparent disability(ies) but differ based on other minoritized identities in engineering such as international

status and gender identity. These similarities and differences provided a rich sample for us to identify broader narratives of engineering education culture that could be traced through "consistent storylines and thematic content" across participants [39]. These narratives provide deeper insights into the ways students with minoritized identities interpret and interact with engineering education systems and cultures during their undergraduate careers.

Results: Identifying Narratives of Coherence and Separation in Engineering

Our analysis revealed two types of narratives: (1) Narratives of Coherence that highlight the ways participants reconfigure normative identity roles in figured worlds to make space for their minoritized identities within engineering education, and (2) Narratives of Separation where participants maintain normative identity roles by either intentionally or unintentionally separating their minoritized identities from engineering activities. In the following sections, we introduce January and Srihari through portions of their constructed narratives and demonstrate how they constitute broader narratives of coherence and separation in engineering.

Narrative of Coherence with Separation based on January's Disability Identities

January is a first year mechanical engineering student who identifies as gender fluid and as having autism, anxiety, and chronic migraines. When asked about aspects of their identity, they identified autism as the most salient and, throughout the interview, described their evolving relationship with it. Despite being diagnosed in early childhood, January did not disclose their disability to their friends until they specifically asked January about testing accommodations in high school.

> [...] I decided to tell a couple of friends about it. I mean, they asked why I had been doing a standardized test in a different space for extended time. And I decided to not make up a story and just say what it was. And I discovered that they had not realized [that I had autism], and they were not just friends with me out of pity, like I was a little bit afraid [of]. So that helped a lot.

As indicated in their use of the word "afraid", January initially anticipated a negative reaction from their friends to their disclosure. Rather, this experience ameliorated their fears of stigma and pity because of their friends' positive and supportive response to their disclosure. As a result, January developed a strong sense of connection to their disability identity that has continued from high school and into college.

> And then when I got to college, I decided to just be very open about it and I'm very happy with that. I can't remember if I've mentioned it to all my teachers, but it's something I'm very comfortable being open about. Just saying like, okay, my mind works different[ly]. I need to be told very clearly what you expect from me.

In this instance, January's description also suggests that they began to develop as a self-advocate by explicitly telling their engineering instructors their needs to be academically successful (e.g., articulating that they need clear expectations). Their advocacy was further highlighted in their comments where they described autism as a basic difference that is omitted in the design of society.

> Autism is a disability mostly just because the world isn't built for someone with autism to function easily in it. So [I'm happy to] use all the support I can get to make that work, like I'm running a different operating system from most people, so [I just need to get] all the extra patches and third party software to help communicate better. [...] And with migraines, as long as I tell instructors what's going on, they [won't] be upset with me and [they'll] let me know what I need to make up [in class] and often give me a little more time if I need.

Because they described their disability as a difference, January removed the stigma that often surrounds students who use accommodations in college and positioned them as necessary tools for navigating an academic structure not built for them. They demonstrated a narrative of coherence by making space for their autism disability identity in an engineering educational culture where not having a disability is a norm. However, this narrative of coherence did not hold for all aspects of January's disability identity. This became apparent when January described their experiences of disclosure (or non-disclosure) of their mental health disability.

> The anxiety is no fun, and I've had a couple of panic attacks over the last year, [but] the good thing is because I have [migraines that are] registered with disability [services. And] because people are still weird about mental health, when I need to miss class because of anxiety, I can just say I have a migraine. So [...] I haven't been able to get a sense of whether teachers are understanding of mental health or not, because I've managed to find a way to say I need to miss class without specifically citing anxiety. [...] For all I know, they might be fine with it [...] and just be like, "Yeah, fine, no problem." I understand that that's a real thing too, but I haven't, like, taken that risk or tried to see how they would react to that.

January describes disclosure of their mental health disability as a "risk" and will utilize the accommodations granted to them for their migraines, a non-apparent physical disability, to avoid disclosure of their mental health disability to their instructors. The broader engineering educational social norms and cues have indicated to them that "people are still weird about mental health" and they do not want to risk having a negative experience of mental health disability disclosure. We identified a narrative of separation for this dimension of January's disability identity because they maintain a separation between their mental health disability and engineering educational experience. While it is known that engineering students' mental health has been significantly decreasing over the past few years [5], [40], [41], enough stigma remains

associated with mental health disabilities that many students, like January, choose not to or feel that they cannot make space for this identity in normative engineering educational culture.

Narrative of Separation with Coherence based on Srihari's Disability, International, and Leadership Identities

Srihari is an international, third year, computer science student who has epilepsy and anxiety. When discussing her identities, she describes how her epilepsy disability identity was not a salient part of her life until she moved from her home country to the US for college.

> I have epilepsy, seizures. I've had them since I was six years old and. It didn't really affect me when I was in my working space or anything before I came to college. But my seizures get triggered by stress, [so] after coming to college, [it's been really bad].

Here, Srihari also introduces the complex relationship between mental health and epilepsy. The more stress she experiences, the more seizures she is likely to have. This relationship also impacts Srihari's course productivity and progress, particularly when having to manage large course projects in engineering with an unreliable partner.

> [There has been] more than one instance where I would have to ask for a [homework deadline] extension because I had an unreliable partner. I can't work if that other person is not working with me. [And then] it really mess[es] with my mental health, [which in turn really messes with my] physical health. So I have to ask for extensions, and I just felt guilty, [but] I [would] do it. I knew I was on top of my work, it was just because the other person wasn't and they didn't want to go ask for an extension or anything. So I would have to do it. They'd be like, "Oh, you have accommodations, you should do it." And then I would have to do it. It's not my fault, [but it just] made me feel guilty.

Her repetitive use of the phrase "I have to" and the term "guilty" indicate that she feels obligated to inauthentically request a deadline accommodation to account for poor peer support (e.g., her partner suggesting that because she has accommodations, she should be the one to request an extension). Despite not needing a deadline extension due to her disabilities, Srihari must take the path of least resistance to protect her mental and physical health by requesting accommodations for her and her group. This is not a choice she would make on her own volition, which is also a theme she experiences when making decisions regarding her engineering career path as an international student.

> And another big part with the international status is I started off as an aerospace major. And when I was trying to make connections, talking about how I would, you know, go get a co-op or an internship, I was told I probably wouldn't because most aerospace engineering jobs are defense based. And since I don't have like, a

> green card or something like that in the country, it would be very difficult. And I spoke to a Ph.D. student, and he was like, “I think computer science would be a better area for you”.

Because of her international status, Srihari was discouraged from and, in most instances, restricted from getting an internship or co-op in the aerospace industry. After consulting with a more knowledgeable and experienced graduate student, she chooses to go into computer science. However, this was not a decision that Srihari would have necessarily made on her own; like requesting the accommodations for her group’s course project, she must make a decision based on factors that pressure her into that decision. For these reasons, we identified the relationship between Srihari’s disability and international identities as a narrative of separation. In these instances, she cannot make space for her identities as an international aerospace engineer, nor can she authentically make space for her disability identities as an engineering college student.

While Srihari often describes instances that contribute to a narrative of separation among her disability and international identities, she also experiences instances that contribute to a narrative of coherence based on her involvement with extra-curricular activities.

> I'm one of the directors for the [event planning team at my school]. So we do the concerts and like the large scale events. And my professors always ask me, “How does that relate? How is that related to programming? It just doesn't add up.” But knowing that I want to focus in [human computer interaction], I understand, because [in] programming I work a lot with people [through] user experience, [which relates perfectly to] the people who are coming to the events [and] if they're enjoying it. I like talking to them [and hearing their feedback]. And that comes absolutely hand-in-hand with user experience and UI, UX and human computer interaction.

While her professors do not connect her involvement with the event planning team to her career goals, Srihari views this involvement as a meaningful connection to her work with human-computer interaction (HCI) that aligns with her passion and interests. This is an activity that Srihari chooses to participate in, and despite objections from her professors, she demonstrates a narrative of coherence by making space for this part of her identity as a legitimate professional development opportunity.

Discussion: Variations of Narrative Agency

January and Srihari’s experiences highlight the complex relationship between the various dimensions of one’s identity and the culture of engineering education. Rather than experiencing narratives that were entirely coherent or separate, participants exhibited characteristics of both throughout each of their constructed narratives. Our analyses indicate that students can move fluidly between narratives of coherence and separation as they iteratively interact with the norms, practices, and expectations of those around them. This kept us from “binning” or categorizing

students based on a monolithic narrative of coherence or separation. This finding contributes to engineering education research that resists generalizations across different identity groups and highlights the importance of diving deep into individual experience [1], [42].

Our findings also highlighted differences in agency, or one's capacity to purposefully and reflectively act within the figured world of engineering education [13]. These variations in agency are demonstrated when comparing narratives across and within participants. For example, both participants described disability as a salient part of their identities. However, January exhibits agency as an engineer with autism by freely disclosing their autistic identity and clearly communicating their needs to be academically successful. They further exhibit this agency by placing the ownness of access barriers on the systems in which they interact but were not built for them. This aligns with advocacy-based perspectives of disability, namely the social and social-relational models that describe disability as being constructed through inherent constraints of social norms, environments, and systems that shape our daily lives [43], [44]. In contrast, Srihari tended to keep her disability identities undisclosed. When she did disclose them, she encountered instances where she was obligated to inauthentically request accommodations from her partners, thus removing her agency to determine when and how her accommodations should be utilized. Her experience reflects findings from prior work suggesting that students with disabilities spend a significant amount of emotional energy to manage accommodations in ways that reduce stigma and counteract broad assumptions of accommodations as "extra" help that makes engineering easier [26], [45].

Agency varied not only across participants, but also within the same identity dimension for a single participant. While January highly identified with their autistic identity and intentionally made space for that identity in their engineering educational experiences, they did not have the same experience with mental health. For example, when describing disclosure of their mental health disability, January used the term "risk," indicating an inherent fear of or hesitancy toward others' reactions. Because January felt the need to keep this identity hidden, they demonstrated little agency in making space for their mental health disability in engineering education. We propose that this theme could be explained by prior work describing a pervasive and persistent stigma surrounding mental health disabilities in engineering, in higher education, and in the US broadly [41], [46].

Future Work

In our completed analysis to-date, we identified narratives of coherence and separation in our data, which led us to ask further questions about the outcomes of each narrative type. While it may be assumed that narratives of cohesion may be more beneficial for students and narratives of separation may be more detrimental to students, these narratives do not dichotomously exist in a value-laden hierarchy. This nuance is highlighted when Srihari decided to change her major. Initially, this instance could be considered a narrative of separation since she is discouraged from pursuing a career in aerospace engineering based on a lack of internship opportunities due to her

international status. Even though Srihari experienced a narrative of separation, she still remains in an engineering-related field; her narrative of separation did not necessarily result in a deidentification with engineering or attrition. This observation in Srihari's narrative also prompted questions regarding the nuance of agency inherent to each narrative type. We define narratives of separation as either intentionally or unintentionally separating their minoritized identities from engineering activities. For other participants interviewed in the larger study, we observed that, even when further questioned or encouraged, many students simply did not identify connections between their minoritized identities to their experiences in engineering education; they often read such inquiry as a separate line of questioning. In conducting analyses associated with the larger study from which the present work is derived, we will continue examining the nuance and variation of outcome and agency within and across narrative types.

Conclusions and Implications

In this paper, we utilized constructed narrative analysis to identify Narratives of Coherence and Narratives of Separation that capture the various ways students identify within engineering contexts and culture. While other studies in engineering education tend to center engineering identity formation [47]–[49], this study examined how a students' agency to make meaning of themselves was influenced by their interactions with engineering identity and culture. In some instances, normative engineering identity and culture, as they currently exist, became so salient that students either maintained their agency by choosing not to "bring their whole selves" into the classroom or were inherently discouraged to keep other aspects of themselves separated from engineering-related contexts. Such findings reveal that while we are making progress toward creating more inclusive environments for all students in engineering, the identification of these narratives indicate that there is still significant work to be done to overcome the cultural inertia that communicates who engineers are and who can be one.

As educators, we play a critical role in encouraging a culture of inclusion in engineering education. One way to achieve this is through perspective building. That is, gaining a greater awareness and understanding of why students may choose or choose not to bring aspects of their minoritized identities into the classroom. Regardless of this decision, it is important for educators to also recognize that these identities may directly or indirectly influence the ways a student engages and performs in the classroom and interacts with their peers and instructors. We hope that highlighting these students' experiences will prompt faculty to further engage in perspective building by taking time to listen to students' needs as well as providing opportunities for students to connect their identities to course content, if they so choose. Such actions create the necessary, flexible space that encourages students to enact their agency through approaches that are more coherent with or more separate from an engineering identity on their own volition.

For researchers, this work contributes to a broader understanding of the ways students form identities as they interact in and engage with engineering culture. In this study, we explored identity formation in a way that was student-centered (i.e., emphasizing the various aspects of

identities held by students in engineering contexts) rather than engineering-centered (i.e., emphasizing the formation of an engineering identity in engineering contexts). While subtle, this change in research lens can lead to a more critical examination of engineering education culture that challenges assumptions surrounding the formation of students not only as engineers, but as contributors to broader society. This study also contributes to an emerging body of research that utilizes constructed narrative analysis. Such approaches enable researchers to gain more abstract yet nuanced insights that contribute to a more holistic and contextual understanding of the topic being studied (e.g., examining the nuance in January and Srihari's disability identities when considering engineering and US cultural stigma regarding mental health disabilities). By developing a greater understanding of the ways student narratives intersect with their cultural formation as engineers, we can contribute to an engineering education culture that not only accepts, but invites students to freely and simultaneously construct their personal and professional identities.

Acknowledgments

This material is based upon work supported by the National Science Foundation under Award Numbers 2114241 and 2114242. 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.

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