Three axes for expressing disability models and experiences: The cause, the effect, and the ability/disability dichotomy

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In interviews with physics students and early career physicists, we ask about their experiences with having impairments in the physics setting and physics culture. In this paper, we highlight how experiences shared by participants as disabled people in physics represent clusters of models of disability. Specifically, we apply a theoretical framing of a three-dimensional disability model space, with axes defined as medical versus social (i.e., cause); tragedy versus affirmative (i.e., effect); and minority group versus universal (i.e., ability/disability dichotomy). For example, in this framework, providing accommodations is described by a cluster of the social and minority models of disability. By analyzing participants' experiences in physics through this disability framework, we aim to identify the models that underpin supportive experiences and support the development of policies and professional development for the physics community towards benefiting disabled people. Through analysis and comparison of these models and participants' narratives, we offer a discussion and possible guidelines for instructors interacting with students with disabilities, opportunities for those with disabilities to deconstruct their own prior experiences and analyze potential misinterpretations that may arise from the models. .

I. INTRODUCTION

In postsecondary education, disabled students represent approximately 20% of the student population [1,2]. With such a sizeable population, it is important to design curriculum and courses with disabled students in mind. Yet, many physicists are unaware of the life experiences of disabled students [3], which may make it difficult to empathize with current students within their courses. By highlighting students' lived experiences through different models of disability, we hope to increase instructors' capacity to relate to their students, to support instructors to become better mentors, and to implement accessible and inclusive practices in their teaching and research interactions. The culture of the physics community is inherently ableist due to its valuing of ability; overall "academia powerfully mandates able-bodiedness and able-mindedness, as well as other forms of social and communicative hyper-ability" [4] (pg. 7). Interactions in higher education are typically shaped by the medical model of disability, under which disability is construed as biological and individual in nature. The goal of this paper is to present a range of models that can be used to analyze interactions around disability and to use these models to describe disabled students' experiences with physics instructors.

In this study, we use six disability models outlined by Goldiner [5]. Goldiner highlights that the medical and social models vary in where they situate the *cause* of disability. The tragedy and affirmative models vary in the *effect* of disability. Finally, the minority model defines a threshold between those who are disabled and those who are not, while the universal model removes the threshold and posits that everyone exists on a spectrum of disability. We used these models to analyze descriptions of interactions between disabled physics students and physics instructors during interviews conducted with disabled physics students.

II. POSITIONALITY AND LANGUAGE

The identities of the authors change how we conduct our research and interact with the interviewees. The members of the research group experience a variety of impairments, including emotional/ mental health, physical, hearing, and health impairments. Use of person-first (e.g., person with disability) and identity-first (e.g., disabled person) language varies depending on the context and the person within the disability community [5,6]. The first author's preferred identity label is Dis.[1], due to its separation of the concept of ability from the author's identity. However, participants also have their own preferences regarding language about their

identity. Thus, we will use the interviewee's preferred language when discussing their interviews but will use "Dis." elsewhere. We also intentionally distinguish between disability and impairment. Disability will be defined based on the corresponding model, while impairment will describe biological difference from the norm [6].

III. MODELS OF DISABILITY FRAMEWORK

Goldiner positions six models of disability to construct a three-dimensional space, which allows an interaction to be described by a cluster of models. Below, we provide more details about and examples for each of the six models [5].

A. Medical versus Social

The medical and social models revolve around a debate about the cause of disability. Goldiner views impairments as the "cause of their disadvantage in social participation" [6]. The medical model suggests that disability is something to be cured or fixed through engagement with the medical community (e.g., medications or assistive technologies); the burden for change is placed on the Dis. person. An example of the medical model in action are state-sponsored disability benefits where disability is defined as "inability to engage in any substantial gainful activity by reason of any medically determinable physical or mental impairment" [5]. In the medical model, a Dis individual is deemed not able to work because of their impairment, without attention to the interaction between a person with impairments and potential environments.

The social model defines disability as caused by societal and physical barriers to access. Goldiner cites The Union of the Physically Impaired Against Segregation, stating "[I]t is society which disables physically impaired people. Disability is something imposed on top of our impairments, by the way we are unnecessarily isolated and excluded from full participation in society." [5, 7] The burden of change in the social model is the physical and social environment. For example, if roads and buildings were designed while accounting for those who use wheelchairs (e.g., curb cuts), those individuals would have the opportunity to operate with less disabling barriers. [5] For example, during the pandemic, those who were unable to leave their house due to their impairment gained more access to work as society shifted towards providing virtual options. [8]

B. Tragedy versus Affirmative

The tragedy and affirmative models are based on the effects of impairments. The tragedy model rests on the claim that disability and impairments generate tragedy and harm. At the extreme end, the tragedy model posits that a disabled

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[1] 1 – Dis. is the author's personal disability identity because of its separation from the idea of ability and identity, and an attempt to reclaim the use of "dis" being negative

life is a life not worth living. For example, the belief by some in the deaf community that being 'deaf is not disabled' [5] is predicated within the tragedy model as some view deafness as a human variation with positive value rather than a loss caused by impairments [9, 10]. This framing positions "positive value" outside of disability.

On the opposite side of the spectrum exists the affirmative model. The affirmative model highlights positive aspects that impairments may allow. At its most general, the affirmative model describes the potential for the effects of impairments to be beneficial. One example of this is how neurodivergent individuals often also identify as queer, possibly because their disability allows them to reject social conventions and gender norms [5, 11].

C. Minority and Universal

The minority model espouses the belief that there is some separation between those who are disabled and those who are not disabled. The threshold for what allows for one to identify as disabled varies on the context and one's own personal beliefs. The existence of what constitutes the threshold varies, ranging from a physical marker of disability, a feeling of weakness, or a sense of belonging in a community. Dis. individuals may have feelings that they may not belong in the community due to their own belief about where the threshold between disabled and not disabled lies. Additionally, similar circumstances may fall under separate sides of the threshold. Bagenstos [12] argues that between two individuals who use wheelchairs, one with paraplegia and one with a broken leg, the individual with paraplegia is more likely to be considered disabled.

Conversely, the universal model is predicated on the belief that anyone can be disabled, and that everyone falls somewhere on the disability spectrum. Rather than a subjective threshold, the universal model does not delineate between disabled or non-disabled, but rather that disability is part of the human condition. Goldiner states that some theorists view disability "on a lifetime spectrum, rather than at a specific point in time. On this view, if almost everyone will experience disability at some point in their lives, then the fact that the risk has not been realized for everyone at a particular point in time does not undermine the universality of disability" [5].

III. METHODS

We recruited volunteers for pilot interviews through personal contacts with the authors (convenience sample). Participants shared demographic information which included their gender identity, race, and personal disabilities that they identified with via an online survey before the interview and indicated their choice of interview format (i.e., a single one-hour interview, two one-hour interviews, or one two-hour interview). Participants were invited to share their access needs for the interviews, such as requesting a sign language interpreter or an asynchronous interview format. All interviews were conducted virtually by the first author via Zoom. Participants were provided a gift card valued at $25 for a one-hour interview and $50 for two-hours of interview.

Three semi-structured interviews were conducted with Dis. students about their experiences in physics learning and research environments. During the interview, we asked participants about the disabilities they identified with, their experiences of those disabilities, and the relationship between disability and their identity. Afterwards, we asked about the supports and barriers they experienced within the physics community in both academic and research settings. Finally, we discussed what an inclusive physics community and classroom would look like, in their opinion, with suggestions for prospective instructors and advisors to make an inclusive and accessible community for Dis. students.

When analyzing the verbatim transcripts of the interview, portions of the interview were identified for their possible similarities with each model by the first author. These portions were then grouped together and labeled to assist in organizing all similar quotes together. Additionally, we focused on identifying excerpts where the participants were discussing their experiences specifically within the physics context. After this first phase of coding, the authors discussed the coding until we reached agreement on all the excerpts presented in this paper.

IV. FINDINGS AND DISCUSSION

We present and analyze several examples from the student interviews to demonstrate the utility of models of disability for creating support for Dis. students in the physics community. We believe these examples are useful for mentors in the physics community to consider during future interactions with Dis. students. The following quotes have pauses, filler words and repetitions (e.g., like, uh) removed for easier reading. This paper differs from previous work by highlighting how different models of disability shape different outcomes in similar scenarios. We present findings related to Dis. students' interactions with physics mentors and Dis. students' suggestions for improving accommodation access.

A. Interacting with physics mentors

All of the participants discussed interactions with physics mentors. Here, we highlight two interactions, selected because they were clear examples of the affirmative and tragedy models, outlined different ways Dis. physics students may interact with physics mentors, and offered contrasted positive and negative experiences.

Aaron described an encounter with a physics professor that we interpret as aligned with the affirmative model. In response to a prompt about whether there were physics professors who encouraged them, Aaron mentioned that there was one professor that stated that Aaron was a benefit to have in the classroom, and that their autism allowed them

to better succeed. Aaron said. "*I really can only think of one professor in my undergrad who's like 'Yeah, this is great. Like your brain works exactly the way it should in physics. And you're pointing out all the things that you should be noticing. and. You are a benefit to have, because your brain doesn't work in the appropriate way.'*" This excerpt aligns with the affirmative model due to the professor recognizing the positive that Aaron's disability brings to the classroom, rather than only the possible negative effects of their disability. Physics mentors can use the affirmative model to support and encourage Dis. students in physics by highlighting the positive opportunities created by the Dis. students' differences. We encourage instructors to engage with the literature if they are uninformed or unsure about the positive aspects of disability.

On the other hand, Genevieve discussed negative interactions with an instructor when attempting to access accommodations while experiencing generalized anxiety. Genevieve explained that, even after already asking for accommodations (through their local Office of Disability Services), they are forced to remind professors repeatedly while facing possible judgement for asking for their access needs to be met. Genevieve said, *"But I have to email the Professor, and then, you know, ask [for] the extension, and sometimes they will have forgotten that I have this accommodation. So, they think I'm just anormal student asking for the accommodation. So that can be very anxiety inducing. And so, a lot of the time, I don't do it. I just like to submit what I have. And submit it on time."* This instance aligns with the tragedy model due to the negative experience, due to their disability, that Genevieve is working through. For Genevieve, the anxiety that they are viewed as someone not needing the accommodation is paralyzing, causing them to miss out on receiving the supports that they need and turn in work that isn't finished. This quote also is an example of the minority model because of the separation that Genevieve feels between themself and "normal student(s)". Instructors can help Dis. students by supporting and normalizing the use of accommodations, which makes it easier for students to discuss accommodations with their instructors, ultimately by lowering barriers to access and participation in the physics community. Bustamante, Chini, and Scanlon (2021) provide suggestions about how to create a welcoming environment for Dis. students and suggest that instructors "demonstrate understanding that accommodations promote equity within the classroom." [13]

As instructors and mentors, we can use the varying models of disability to consider possibilities for interacting with students, including ways to encourage Dis. students and potentially reduce the stress they experience in the classroom. In Aaron's example, their professor's use of the affirmative model helped encourage Aaron and made them feel included within the classroom. In Genevieve's case, if the professor operated through the universal model, and gave an indication that they wouldn't treat Genevieve differently based on their disability status or possible lack thereof, her anxiety may have decreased, and she may have felt more comfortable.

B. Student suggestions about accommodations

In the interview, we asked participants whether they had suggestions for instructors about what they could do or if there was something they wished that their instructors were aware of related to their disability in the classroom. Two examples, from Banner and Genevieve, show examples of the universal model of disability. These quotes were chosen because they distinctly outlined two different, but valid, perspectives of the universal model. Banner describes accommodations while being unaware of which students are disabled, while Genevieve mentions that accommodations can be used for all students, not just those who are disabled.

Banner described that instructors should be ready to make accommodations at any moment, and if unsure, to ask their students what is necessary for them to succeed within the classroom. Banner said, "*surely just understanding that accommodations are needed, and then just ask the students what accommodations might be needed. I actually that point would be, you know basically I kind of can't think of what the word is. But basically be prepared to take any accommodations ahead of time.*" Banner's suggestion best falls under the universal model because it exists within the implication that anyone in a classroom could be disabled, so instructors should prepare supports ahead of time, and ask students if they are unsure about what to do. Scanlon et al. [14] identified the most requested accommodations for courses that were taught in emergency remote teaching modalities due to the COVID-19 pandemic. We suggest that instructors inform themselves of the common accommodations used in physics courses and plan for the implementation of those accommodations into their teaching. Additionally, when discussing common pathways to access for Dis. students, Chini and Scanlon [15] suggest instructors "create an ecosystem of supports with a specific focus on transparency by explicitly sharing the resources available through each route in a publicly accessible space, such as a course website or shared group document."

Similarly, Genevieve states that more generic accommodations would be beneficial to have, not just for themselves, but for students not normally considered Dis. These accommodations wouldn't be mainly focused on impairment but would also be focused on those who may not be as good in certain academic areas, or those who are first-generation college students. Genevieve said, "*I feel like there's resources that could be good for everybody that I could think of. But, I, there's not anything specific to my disabilities that I wish that I would have.*" When asked what specific resources they were considering for everybody, Genevieve continued, "*I think it would be good for grad students to have, I guess, for this for the department to have certain types of workshops, like a technical writing workshop, or how to make a presentation for a conference*

like some workshops like this to help students who have, So a lot of people in physics come from families who were in physics, at least that's what I've noticed. And so just kind of some accommodations, I guess, for students." Genevieve's suggestion also aligns with the universal model because of the implication that even those who may not be conventionally viewed as disabled (e.g., first-generation students) would benefit from accommodations.

While the final subject between the two was different, as Banner was specific about impairments, while Genevieve had a more general look on accommodations, both describe solutions that we interpret as aligned with the social and universal models. By focusing on accommodations as a solution, both participants imply that changing the social structure of the university would help those with disabilities, which aligns these excerpts with the social model. However, both use the universal model in unique, but equally valid methods. Banner's statement that the instructor is unaware of which student might need accommodations, and which supports will be necessary ahead of time implies that any student within the classroom could be disabled, and that, for the start of the class, no threshold exists between the disabled and non-disabled within the classroom. Genevieve's statement goes further by including first-generation college students or graduate students unfamiliar with academia as being able to benefit from accommodations. Just as the universal model states that everyone can be disabled, it also holds that the idea of disability itself is a spectrum, one not just limited to biological differences.

C. Potential model tensions

While we examine the utility of these models of disability for the physics community, it is also imperative that we discuss misinterpretations that may arise through the usage of these models. We want to avoid giving the indication that one model is better than the other and should always be used. Each model has a benefit to its use, and each model can cause harm to Dis. individuals and students if over-relied on. Supported through quotes in our interviews, here we highlight how the affirmative model can be harmful for students, and how the medical model is used by Dis. students to situate their identity.

An example of how the affirmative model can be harmful was demonstrated through Aaron's experience with one physics professor. This professor ascribed to a belief that if someone was autistic, that they were a genius in math and science. The assumption that all autistic people have extraordinary specific abilities is known in disability fields as 'savant syndrome' [16]. Aaron said, "*He subscribed to an idea of everyone who's autistic is, like, they're either Sheldon Cooper [autistic character from Big Bang Theory], or they're just not worth it, I guess is the best way to say it. ... it's one of the terrible cultural effects of the Big Bang theory that, uh, if you are labeled as high functioning, which I don't*

believe in those labels [functioning labels are terms used by some medical practitioners and carers to describe the level of support an autistic individual needs to participate in society] but you must clearly be already a genius. And, everything must come easy to you in terms of math and science."[17] Even though the professor was working through the affirmative model (i.e., through describing their perception that autistic individuals are naturally good at math and science), they shaped the model through ableist stereotypes, comparable to the model minority myth within Asian communities [18], creating an "ideal" disabled individual while denying or discouraging those that don't fit the savant model. This diminished and discouraged Aaron's ability as a disabled person, rather than supporting them. Similarly, when using the affirmative model, we must take care not to ignore negative effects that disability can have, such as pain or weakness.

Just as with the affirmative model, the social model does not fully describe Dis. experiences in some situations [5, 19]. In the interview, Banner mentions how they see themselves differently because they lack hearing and this lack is something that sets them apart from others who are not disabled. When asked whether they would view themselves as disabled in a world where "accommodations are natural," Banner said: "*It [disability] actually comes from the practical perspective. I'm still lacking hearing compared to everyone else. So still, there is still something that sets me apart from everyone else.*"

This viewpoint is grounded within the critique of the social model because of Banner's belief that his lack of hearing creates the distinction between himself and those who are not disabled. The social model has its uses in helping provide accommodations for students, but it fails at individual attempts at understanding how disability is grounded within some individuals' identities. This grounding can also be beneficial for Dis. individuals because it allows for a clear distinction of who might be considered disabled when viewed through the minority model, helping some avoid feelings of impostor syndrome.

V. TAKEAWAYS AND NEXT STEPS

As educators and advisors, we should strive to do our best for our students. We have presented these models as a way for us as mentors to improve our teaching methods, our interactions with our students, and the physics community. This is still a preliminary look at using these models to help represent the interactions that Dis. Students experience as they exist within our community. Our next steps are to continue doing the interviews to allow for a broader range of participant experiences.

ACKNOWLEDGMENTS

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