

**Comparing Perceptions of Disability through a Characterization of Attitudes towards
Assistive Technology**

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On my honor as a University Student, I have neither given nor received unauthorized aid on this
assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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STS Research Paper

1. Introducing the Premise of Differing Perceptions of Disability

The manner in which engineers versus disabled individuals view the role assistive technology plays and how it relates to disability differs. An examination of journals leads to the development of a view that engineers perceive assistive technology as a way to fix people with disabilities (Menon et al., 2015). In stark contrast, those with disabilities view their disabilities as a part of their identity (Mullins, 2009a). They don't view it as a deficiency or something that should be circumvented with technology (Mullins, 2009b). They believe technology should serve to augment a person and expand their potential and as a medium for freedom, independence, and ability (Velkovski, 2021). Mullins identifies the concept of disabled people being considered broken as a societal one in her statement, "There's an important difference and distinction between the objective medical fact of my being an amputee and the subjective societal opinion of whether or not I'm disabled." Through the way they frame problems and write about assistive technology, engineers contribute to the societal perception that assistive technology is meant to "fix" rather than "augment" the range of capabilities associated with a disability. As engineers are responsible for creating assistive technology this means that their work may not fully meet the needs of the individuals they are attempting to help due to a lack of understanding of the role of assistive technology and the ramifications of perpetuating this view.

The engineers mindset of "fixing disability" perpetuates the stereotype that disability is a problem and this is troublesome because that is contradictory to the goal of assistive technology of bridging the gap between an individual's unique abilities and their environment. This is in line with the medical model of disability examined by Thomson and contributes to dehumanizing

those with disabilities and contributing to the societal view of disability as lesser. (Thomson, 1997, p. 37). Views of engineers that are in line with the social construct of “disability” plays a role in shaping these prevalent opinions and the perpetuation of these views further solidifies them (Thomson, 1997, p. 44). The resultant stereotypes single out individuals with physical disabilities as being broken and that can lead to resistance in the adoption of assistive technologies. Despite assistive technologies expanding the range of abilities a person has, they can inadvertently spotlight the disability and a self-conscious person might not want the attention brought with the stigma of having a disability.

In this paper, I will identify how engineers' outlook on disability differs from disabled individuals in an effort to identify how engineers can remedy the way they express their thoughts on disability. These differences will be identified through an analysis comparing perceptions of disability by characterizing attitudes toward assistive technology within sources written by engineers and disability advocates using Kerschner and Ehlers' A framework of attitudes toward technology in theory and practice. According to the authors, “We can only engage in constructive deliberation on the use of technologies if we know on what framings of technology the relevant research rest[s]” (Kerschner & Ehlers, 2016). My motivation for understanding my biases when compared to disabled individuals is my research in developing an alternative motorized wheelchair control system for quadriplegics. While conveying my research in presentations and reports, I would like to know how I can present the information in a way that is conducive to the needs of disabled individuals. In order to do this, I must identify how I as an engineer differ in my thinking about disability.

2. Engineers and Disabled Individuals View Disability Differently

Disabled individuals value assistive technology due to what an expanded range of capabilities enables more so than simply the abilities themselves. Velkovski, a child with spinal muscular atrophy, speaks to how his life changed when he acquired his powered wheelchair. Jake was able to be independent from his parents who previously constantly had to push him around in a manual wheelchair. In Figure 1, Velkovski's smiling face can be seen as he pursues his passion of soccer as enabled through his powered wheelchair.

Velkovski Pursues Soccer



Fig 1. Assistive technologies change lives and expand the capabilities their users

Because of the freedom Jake's powered wheelchair granted him (not having constant parental oversight), he was able to form meaningful relationships with his peers. Jake also suddenly had the ability to move on his own and that let him pursue his passion for football. (Velkovski, 2021) A similar story is Rebecca Knill who lost her hearing as she aged and got a cochlear implant. This implant granted Rebecca the ability to hear and more importantly, meaningfully communicate with others. This is especially true because this was before the advent of texting. In

later years, Rebecca cites texting and closed captions as technologies that improved her quality of life. (Knill, 2020). Notably in both of these examples, disabled individuals cited assistive technologies as transformative because of the impact they had in meeting their emotional needs. The impact, such as forming friendships and communicating, behind the expanded range of capabilities, in this case moving or hearing, serves as the goal that in the eyes of these disabled individuals, assistive technologies are a medium to achieve.

Those with disabilities view their disabilities as a part of their identity rather than a deficiency or something that should be circumvented with technology. Technology should serve to augment a person and expand their potential according to Aimee Mullins, a double amputee and public speaker who shares her experiences with disability. Mullins emphasizes her disability is not a problem. It is a part of her identity and through her prosthetic legs she has been able to be a runner and fashion model. Mullins views her prosthetics as an expression of her individuality and an augmentation of her abilities going as far as to assert that “A prosthetic limb doesn't represent the need to replace loss anymore. It can stand as a symbol that the wearer has the power to create whatever it is that they want to create in that space” (Mullins, 2009a). In her opinion, a life of disability leads to adversity but the phrase overcoming adversity implies it is something that should be sidestepped. She prefers to think of adversity as a part of her life as opposed to an obstacle and views the idea of negative associations to the word disability as a social construct rather than a reflection of her capabilities. Mullins identifies this association by looking up the word disabled and finding synonyms such as “crippled, helpless, useless, [and] wrecked” and antonyms such as “healthy, strong, [and] capable” (Mullins, 2009b). This encapsulates the construct she mentions of society viewing disability as a state of being broken

and is in contrast to Mullins feeling she is capable of doing anything she desires using her willpower and through assistive technology. Those who view being disabled as broken may view Mullins being able to walk again as her disability has been “fixed” regardless of what she claims. However, this idea itself is inherently flawed if the range of capabilities associated with a disability is regarded as distinct from the range of abilities from a “non-disabled” individual as Mullins desires. If those with disabilities are not viewed as having fewer abilities than the norm, but rather having their own unique set of abilities, then assistive technologies serve to simply empower these individuals so that they can live with whatever set of abilities they desire.

In contrast to this view of technology being meant to augment, an examination of journals leads to the development of a view that engineers perceive assistive technology as a way to fix people with disabilities. Two examples can be seen by looking at articles related to tongue-controlled wheelchair control systems for people with quadriplegia. This technology was chosen because it is a relatively novel technology but the disability itself, quadriplegia, has been adequately researched and several alternative types of assistive devices are already in the hands of consumers. In one paper, the definition given for the goal of assistive technology is “to increase, maintain, or improve functional capabilities of individuals with disabilities ... [to] improve their quality of life, contribute economically and socially, and increase their independence.” This is the extent to which the impact of assistive technology is considered in this paper. The rest of the introduction/background identifies the issues associated with prevalent assistive technologies and how tongue-controlled wheelchairs don’t share these limitations (Jain & Joshi, 2014). Another examined paper doesn’t talk about the fundamental issues faced by disabled individuals at all. The background for this paper consisted of finding limitations in existing assistive technologies

and speaks from a solely technical perspective. (Menon et al., 2015). In the case of both papers, to some extent it is recognized that fundamentally assistive technology should expand the abilities of the user. In that respect, the authors of the papers demonstrate that as engineers they have an understanding of part of the problem they are trying to solve.

Despite this, the authors of the academic literature fail to completely demonstrate an understanding of the underlying motivations of the users of assistive technologies. Whether explicit or implicit like in the first and second papers examined respectively, there is a demonstrated understanding that freedom and independence are a corollary to ability. Where the authors fall short is simply viewing assistive technology as a solution to grant ability by circumventing disability as opposed to a medium towards what ability enables; such as freedom, independence or other emotional needs.

Through an analysis of anecdotal experiences and engineering journals, the potential disconnect present held by engineers has been identified as the view that that assistive technology is meant to “fix” rather than “augment” disability in pursuit of improving quality of life. First-person accounts and testimonials of users of assistive technologies contain a trove of information including clues to how these people view the technology within the context of their disability and the role the technology plays in their lives. Similarly, academic journal articles written by engineers convey their understanding of the problem and the role they envision their creation playing in the patient’s lives. However, while this claim about perceptions on disability has the potential to be reached using the sources analyzed, ultimately without a structured research

approach to analyze the sources in depth it would be irresponsible to present the claim as a conclusion.

3. Research Approach to Structure Analysis of Attitudes Towards Technology

When discussing technologies within the context of decision-making stakeholders, like engineers developing a product or users giving feedback, being informed during deliberations is important. The perspectives of various stakeholders' opinions can be heard, but without a manner in which the underlying attitudes towards the technology can be understood, it is difficult to fully consider their needs and perspectives. The framework of attitudes toward technology by Kerschner and Ehlers, below in figure 2, provides a methodology to identify these attitudes through a literature review, thus defining a proposed spectrum they can be characterized.

A framework of a spectrum of attitudes towards technology

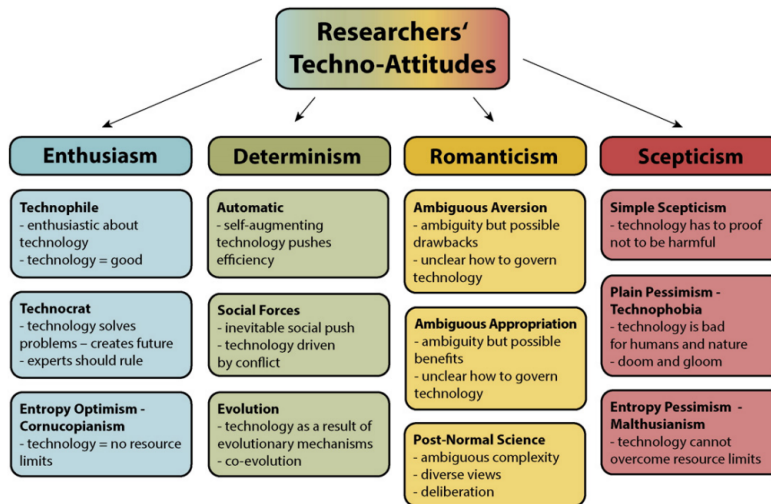


Fig 2. Attitudes towards technology are defined along a spectrum with these four categories (Source: “A framework of attitudes towards technology in theory and practice” Pg. 143)

The methodology applied by the attitude characterization framework consists of the analysis of sentiment within quotes present in a text in isolation. This is done by first identifying sentences

within the text that give insight regarding the author's attitude towards technology. These quotes can then be classified according to where they stand on the spectrum defined by Kerschner and Ehlers. Then using the distribution of sentiments gleaned from the isolated quotes, an overall attitude for the text is identified by determining what the majority sentiments are. Shown in figure 3 below is a visualization of these steps.

Steps for Attitude Characterization Framework

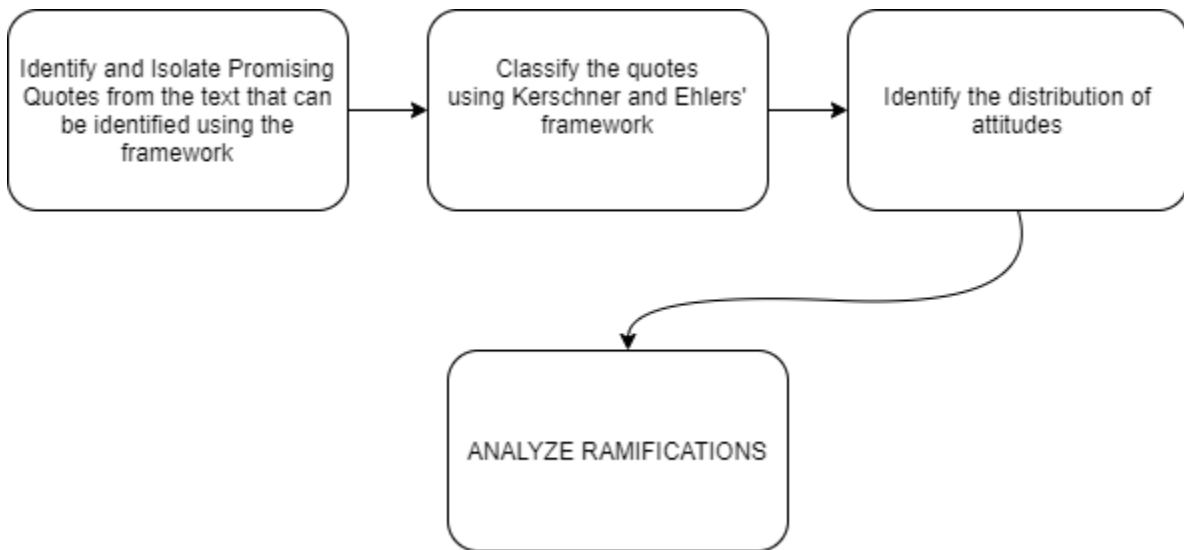


Fig 3. Using a framework allows for the extraction of insights from unstructured data (Source: “A framework of attitudes towards technology in theory and practice” Pg. 141)

The value of knowing the categories of attitude characterization is that when combined with contextual understanding of the texts analyzed, it becomes more feasible to understand the why behind stakeholder opinions, allowing for a more thorough understanding of all parties involved in the decision-making process. For this reason, I will use Kerschner and Ehlers’ framework to analyze first-person accounts on disability and writings by engineers within academic journals. This analysis aims to compare perceptions of assistive technology and identify their respective attitudes towards it.

Through review and analysis of various source materials, the framework by Kerschner and Ehlers defines four primary categories on which attitudes towards technology exist on a spectrum across enthusiasm, determinism, romanticism, and skepticism. The authors define an enthusiast's attitude towards technology as "considered inherently good and its misuses accidental" (Pg. 144) believing that all problems can be solved using technology. Additionally, they further define determinism as viewing the development of technology as inevitable and independent from "social, economic and political forces" while recognizing that "technological change determines social change" (Pg. 146) without taking responsibility for it. In stark contrast to these two categories is skepticism which posits that technology is inherently bad. Serving as a middle ground between these extremes is romanticism. Rather than having strong feelings about technology, this attitude is more equivocal. Furthermore, it is fluid leaning towards either end of the extremes - often highly context-dependent and shaped by external events. Identifying attitudes towards technology using this framework will allow insight to be gleaned regarding implicit assumptions made regarding said technology.

The evidence examined across this analysis are sources that characterize the viewpoint of disabled individuals and sources that encapsulate the views of engineers regarding assistive technology as it pertains to disability. To best identify what views the disabled community holds, sources analyzed are first person accounts namely from Mullins and Velkovski. First person accounts were chosen because they serve to convey the sentiments of disabled individuals directly as opposed to "experts" who may fail to truly understand the feelings of these individuals despite how much they may have analyzed them. The other group of whose views on assistive technologies must be examined are the engineers working on developing these technologies. In

particular, the engineers of a relatively new control system based on tongue localization will be examined. This is because in framing the necessity for their new innovation they provide background on existing technologies which reveals their perception of existing technologies and the role they play. A couple of sources in particular being examined are “Tongue Operated Wheelchair for Physically Disabled People” (Jain & Joshi, 2014) and “Tongue Driven System” (Menon, Nambiar, Pariyarathu, & M, 2015).

Kerschner and Ehlers’s framework of attitude toward technology is an ideal foundational source while examining the differences in perceptions of assistive wheelchair control technologies due to the potential for reflection on the “why” behind an identified stakeholder’s attitude. Knowing how decision-making or research outcomes are shaped by an attitude provides an additional layer of depth to understanding a particular perspective. Another way of thinking about the value of this framework is that asking the right questions generally leads to more useful insights. A good example of this is in “Toward an Integrated View of Technology”. After characterizing the mindset of engineers the author, Neeley, proposes the concept of encouraging engineers to ask whether something should be done as opposed to what could be done. I endeavor to use the insights gained from analyzing attitudes in order to answer the right questions in order to determine in what specific ways can engineers improve their problem framing and communication about disability to match the viewpoints expressed by disabled individuals.

4. Results of Analyzing Attitudes Towards Assistive Technology between Engineers and Disabled Individuals

Attitudes towards assistive technologies for both engineers and disabled individuals were categorized as majority enthusiastic but had differing minority attitudes. Below in Figure 4 are the results of analyzing two sources by engineers.

Results of Analyzing Attitudes of Engineers towards Assistive Technology

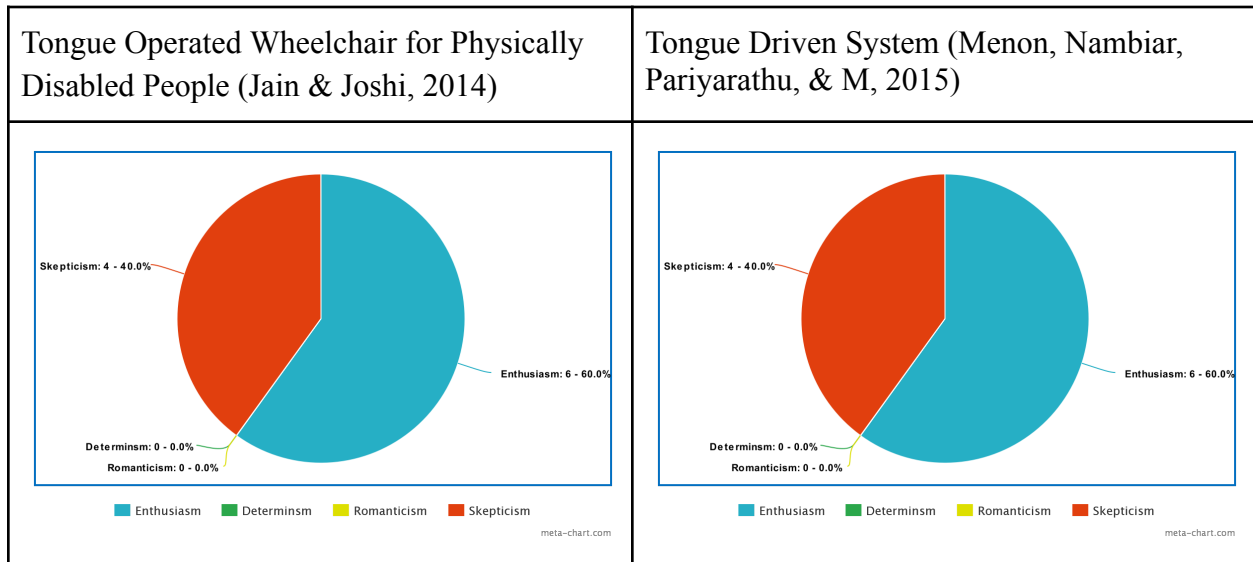


Figure 4. Engineers hold a majority enthusiastic and minority skeptic attitude

The characterization of attitudes towards assistive technologies for engineers fell into the extremes of enthusiasm and skepticism with the majority expressed opinion being enthusiasm. Among the sources by engineers analyzed, 0 quotes fell into the category of determinism and romanticism. They overwhelmingly conveyed enthusiasm for the technology they were developing, a good example being "[The] Tongue Drive System is another step toward bringing power wheelchairs into the next century." (Menon, Nambiar, Pariyarathu, & M, 2015). However engineers also seemed to recognize barriers to adoption, limitations of the technology, and faults in previous technologies that fell under the characterization of skepticism; a notable quote being "Till date, very few assistive technologies have made a successful transition outside research

laboratories and [have become] widely utilized by [the] severely disabled in their routine life." (Jain & Joshi, 2014). Below in Figure 5 are the results of analyzing two sources by engineers.

Results of Analyzing Attitudes of Disabled Individuals towards Assistive Technology

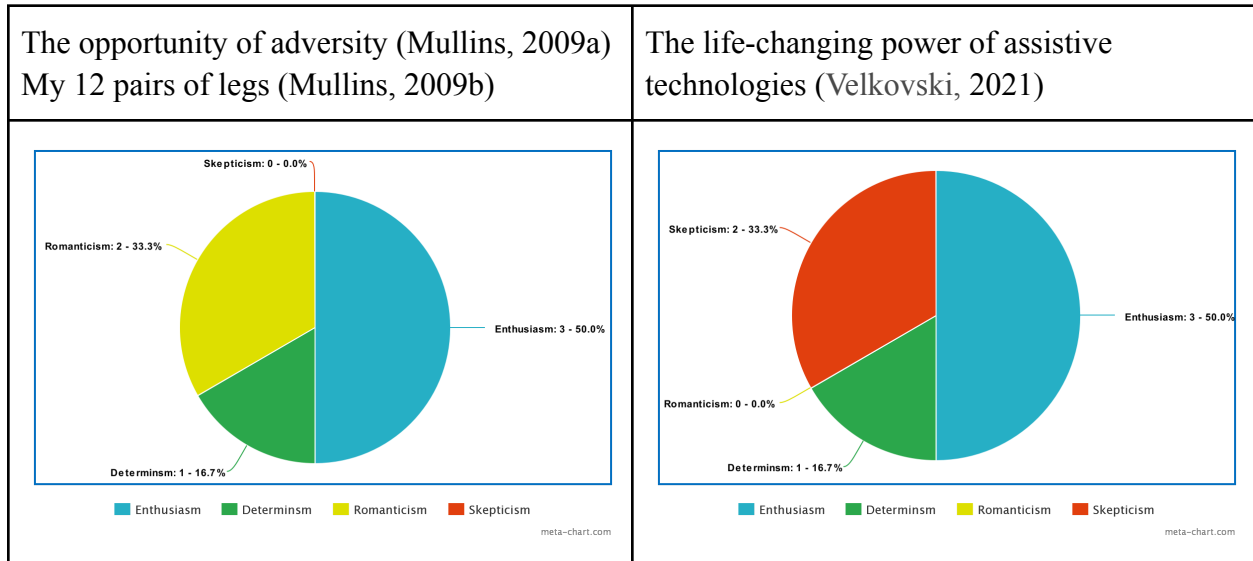


Figure 5. Disabled Individuals hold a majority enthusiastic and a nuanced minority attitude that excludes skepticism

The characterization of attitudes towards assistive technologies for disabled individuals was also majority enthusiastic but was more nuanced in that it was not overwhelmingly so and at least two other minority attitudes were expressed. For example, Mullins was an enthusiast which lines up with her identity of a self proclaimed disability advocate. However, she also held the deterministic view that technological change led to social change and the romantic view by viewing technology through the additional lens of aesthetics and whimsy. While examining these results it is important to consider the shortcomings of the framework used for analysis; analyzing quotes in isolation this framework has the potential to exaggerate the presence of certain opinions if the author chooses to be repetitive in stating them. Furthermore, the sentiment analysis for each isolated quote may be slightly off without considering the context of the

surrounding text. That said, the synthesis the framework has provided is generally useful as a starting point for understanding the attitudes expressed.

The similarity of the majority views gives insight into the intent behind the attitude of the groups - that assistive technologies are a force for good meant to improve the quality of life for the people who use them. This is supported by the actions of engineers in building these devices in the first place to suit the physical needs of those with physical disabilities. This is also supported by how the disabled community testifies to the impact these devices have had on their lives. In the words of Velkovski - "I'm independent with my chair. I'm free to go wherever I want to. I'm able to do things I couldn't otherwise. My motorized wheelchair gives me three incredibly important things: freedom, independence and ability" (Velkovski, 2021). While the end result may appear to be a harmonious understanding if only the majority attitudes are examined - the truth is anything but.

The differing minority views between disabled individuals and engineers suggests a differing perception of disability that could interfere with the intention of engineers to improve lives through assistive technology. The minority attitude of skepticism on the behalf of engineers confirms the idea that engineers view disability as a problem since the skepticism towards assistive technology was often with the perspective that existing technologies weren't meeting the physical needs of the patients or directed towards various technical aspects of their devices. This fixation on the physical requirements of assistive technology fails to recognize disabled individuals as people with nuanced emotional needs. Statements towards the disabled tended to be harsh and neglected to recognize these needs as something that assistive technology is a

medium towards meeting as opposed to a way to give a person an ability. Below in Figure 6 are some examples of quotes written by engineers and how they should be modified to accommodate the aforementioned criteria.

Examples of Modifying Text to Reflect Understanding of Disability from the Preferred Perspective of the Disabled

Original Quote	Revised Quote	What Changed?
"Joy stick controlled wheelchair proves to be useless to those who can't even move their hands or fingers" (Menon, Nambiar, Pariyarathu, & M, 2015).	Joystick controlled wheelchairs fail to suit the needs of individuals who are unable to move their hands or fingers.	<ul style="list-style-type: none"> ● Shifts responsibility of accommodation to technology rather than emphasize deficiencies of the individual ● Sentence demonstrates reflection on the needs of disabled individuals.
"The speech recognition controlled wheelchair recognises the speech of the person but it has a disadvantage it can hinder with the speech of the person in the day to day activities" (Menon, Nambiar, Pariyarathu, & M, 2015).	Speech recognition fails to be a viable method of wheelchair control because while it is able to recognize the speech of the person, it interferes with the ability to have normal communication with others.	<ul style="list-style-type: none"> ● Recognizes that a flaw that is contradictory to the purpose of the assistive technology is not a disadvantage but a disqualification in terms of viability. ● Recognizes the end goal of the specific AT is not simply the ability to move but also to facilitate social interaction and formation of meaningful relationships

Figure 6. Changing how disability is framed presents the disabled as people with nuanced emotional needs that can be supported through the use of assistive technology

While intuitively it would make sense that the mindset of engineers and stereotypes perpetuated by engineers would breed skepticism regarding assistive technology, the minority deterministic and romantic views (and lack of skepticism) indicate that is not the case. This suggests that the engineers are contributing to a culture of stigma against disability that people with disabilities

already face and overcome as opposed to directly impacting the stakeholder's they are attempting to help.

5. Conclusion on the significance of differing attitudes towards assistive technology

Engineers working on assistive technologies have been found to represent their thoughts on disability in a manner that is not conducive to the needs of disabled individuals. This was determined through an analysis of attitudes towards assistive technology that confirmed that engineers held the view that they were "fixing" disability in contrast with the view of disabled individuals who believe assistive technology serves to augment their existing capabilities. More importantly however is that disabled people believe that they are not inherently "broken".

Engineers should change the way they communicate about disability to convey an understanding that assistive technology fundamentally serves as a medium to meet the emotional needs of disabled individuals such as freedom and independence. Considering disability from this perspective enables engineers to better fulfill the purpose of assistive technologies by truly meeting the needs of disabled individuals. It also allows engineers to no longer contribute to the stigma of disability being associated with brokenness which in turn may help reduce barriers to adoption for assistive technologies.

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