3Q: Collaborating with users to develop accessible designs

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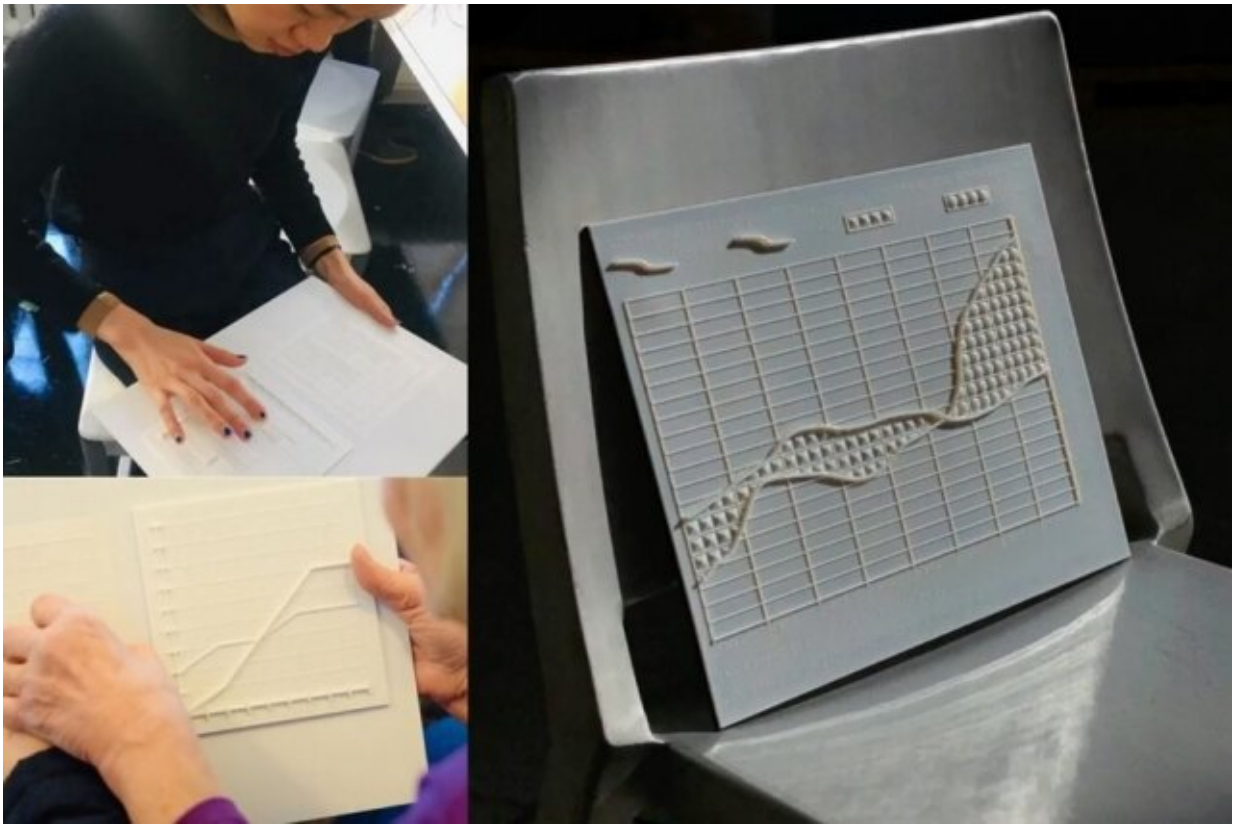

“I’ve recently encountered researchers at a loss for how to describe their visualizations in ways that make them more accessible. When visualizations appear in, say, textbooks, scientific publications, or educational materials, they might appear as braille translations of the image, but more often they appear as textual descriptions. But what is the best way to describe a visualization?,” says graduate student Alan Lundgard. Credit: Massachusetts Institute of Technology

Academic researchers and others have long struggled with making data visualizations accessible to people who are blind. One technological approach has been 3-D printing tactile representations of data, in the form of raised bar graphs and line charts. But, often, the intended users have little say in the actual design process, and the end result isn't as effective as planned.

A team of MIT researchers hopes to fix that. They used a collaborative project with staff and students at the Perkins School for the Blind as a case study of the accessible design process, and generated a list of "sociotechnical" considerations to guide researchers in similar work. A paper detailing the work appears in the journal IEEE Transactions on Visualization and Computer Graphics. Co-authors Alan Lundgard, a graduate student in the Department of Electrical Engineering and Computer Science (EECS); Crystal Lee, a graduate student in the Program in Science, Technology, and Society; and EECS and Computer Science and Artificial Intelligence Laboratory Professor Arvind Satyanarayan spoke with MIT News about the case study and their findings.

Q: How did you land on this idea to record "sociotechnical considerations," and what are some notable examples?

Lundgard: Crystal and I met during an intersession workshop in participatory design, where researchers collaboratively designed products with and for particular communities. We worked with the Perkins School to co-design a 3-D-printed visualization of a time-series chart for people who are blind. Coming from MIT, there was this idea that we'd come up with a high-tech, flashy solution—but, it turns out, that wasn't really the best approach. In that regard, I think a first-order sociotechnical consideration is, what degree of technological

intervention is necessary, if any? Could the intervention take a more social approach without the need for a fancy technological design? Would a low-tech solution meet the needs of the community better than a high-tech solution?

Another big consideration is planning and communicating the extent of the collaboration, which is especially important when collaborating with marginalized communities. That means researchers clearly communicating their intentions and goals. As researchers, are we aiming to produce academic research, or a design solution that is immediately adoptable within the community? What is the duration of the project and what are the available resources? Failing to communicate clearly can leave community collaborators out of the loop in ways that are actively harmful.

Lee: We realized there were tons of intermediate steps before you start to even design a product. What does collaboration actually mean and what does participatory design look like? We got frustrated at certain junctures thinking about what product to make. While we talked to teachers, occupational therapists, and the Perkins School staff, we'd come up with a prototype and realize it was an idea that didn't actually meet the needs of the community. Thinking through these tensions helped us come up with a list of sociotechnical considerations for other researchers and collaborators who may feel these same frustrations when working on co-design projects.

One notable consideration from our case study: As researchers, don't assume that your resources are the same as the community's resources. For example, don't make something for a small school if it requires a $300,000 3-D printer that only MIT can afford. In our 3-D-printed visualization, we at first tried to use a cheap and accessible 3-D printer that's often available in libraries. But, this affordability imposed other constraints. For example, using the inexpensive printer, it was hard to

actually make something legible in braille, because the resolution is too low to be useful. It can't capture the detail you need to accurately represent the data. So, using the affordable printer, our graph failed to meet certain accessibility guidelines. On the other hand, MIT's high-resolution, industrial-grade printer isn't affordable or available to the Perkins School—or most schools, for that matter—which is hugely constraining if the design is supposed to satisfy the students' daily needs.

Satyanarayan: It's also very important to compensate participants fairly, especially with marginalized communities. In participatory design, we don't treat folks we work with as target users. Rather, they are collaborators throughout the process, and with specific skills. For instance, people who are blind have far more experience reading braille. We consider that a highly specialized skill that should be compensated accordingly. A key tenet of participatory design is recognizing that people in the community have lived experience that is valuable and necessary for a design to be successful.

Q: In your paper, you say you hope to avoid pitfalls of "parachute research." What is that and why is it important to address?

Lundgard: "Parachute research" is where researchers—particularly from wealthy universities—drop into a community; take advantage of local infrastructure, expertise, and resources; write an academic paper; and then take off. That is, after publishing a research paper, they completely disengage from the community. That's harmful to community members who engage in the collaboration in good faith and help to facilitate the research, sometimes without reciprocal benefits.

Lee: In accessible design, you often make a prototype based on some abstract knowledge of what a given community may want. Then, the

people in that community evaluate the efficacy of the prototype, instead of being directly involved in the design process. But that can diverge from creating solutions that are beneficial for the communities the designers are purporting to help. In our paper, we didn't just build something, test it, and report on it—we thought it would be more important to contribute guidelines for approaching similar participatory design problems.

Q: What does the future look like for you and for your work?

Lee: I'm starting a collaboration with Massachusetts Association for the Blind and Visually Impaired. They have a large group of senior citizens who are experiencing blindness later in life, and have to learn to interact with technology in different ways. Understanding how people interact with technology ethnographically will be necessary for understanding accessibility—in technology, in the built environment, and in digital infrastructure. That's a big part of my research moving forward.

Lundgard: Really, our paper is not just about data visualization, but also about how to approach accessible design more generally. In that sense, our paper tees up how to do future work, with a concise set of guidelines that researchers—ourselves and others—can apply to different problems. For example, I've recently encountered researchers at a loss for how to describe their visualizations in ways that make them more accessible. When visualizations appear in, say, textbooks, scientific publications, or educational materials, they might appear as braille translations of the image, but more often they appear as textual descriptions. But what is the best way to describe a visualization? Does it make more sense to refer to its visual or statistical properties? Maybe we can collaboratively come up with different encodings that are more intelligible to someone who's not used to interpreting information visually.

Satyanarayan: Along those lines, one thread is captioning online visualizations. There's a lot of work to do in figuring out what's important to caption to present some high-level insight of what the visualization is saying, as well as find a way to automatically generate those captions. That's a deep technological solution. But we still have to make sure our sociotechnical considerations are adhered to.

Looking long-term, we're interested in alternative ways of encoding data that are usable and accessible to people who are blind. Before braille, text was embossed on paper, but that's not really how people who are blind process language. Louis Braille, who was blind himself, came up with something vastly different that became the standard way for blind people to read text. We first need to take a step back and understand the audience for and with whom we are designing, and work directly with them.

To do that, we have to address several things. How do people who are blind think about data? I was introduced to data through line graphs and bar charts. What is the equivalent for people who don't process information visually? Once we answer those questions, we can start thinking about what the best way to encode data, because we're not sure 3-D-printing a line chart is the best solution.

More information: Sociotechnical Considerations for Accessible Visualization Design: vis.csail.mit.edu/pubs/sociotechnical-vis-access