What if technology helped society become more inclusive?

There are already many 'assistive technologies' available, which can help people with disabilities participate more fully in society. More advanced assistive technologies are under development, but is technology the key to a more inclusive society?

Assistive technologies (ATs) are designed to improve the functional capabilities of people with disabilities. While some applications use cutting-edge technologies, and future devices such as robotic mobility aids are keenly anticipated, many others such as reading glasses, crutches and hearing aids are relatively low-tech and familiar to many of us.

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A number of ATs are not specialist devices nor only of interest to people with disabilities. Indeed, many are mainstream technologies, developed for the mass market. For example, standard tablet computers are already used to provide live sign-language interpretation. On the other hand, we also see many examples of ATs being adapted for mainstream use. For example, speech-to-text tools developed for the hearing impaired and text-to-speech tools developed for the visually impaired are used every day by many smartphone users. This is not really surprising, because, when you think about it, *all* technologies are assistive. We all have different levels of ability when it comes to different tasks, and technologies aim to help us do the things that we want to do, whether that be commuting, communicating or cooking.

Drawing upon a recent scientific foresight study, entitled *Assistive technologies for the inclusion of people with disabilities in society, education and jobs*, we will consider how ATs could help us move towards a society that is more inclusive of people with three specific disabilities – autism spectrum disorders (ASDs), blindness and visual impairment, and deafness and hearing impairment. We will introduce some mature, emerging and future technologies, explore their impacts, and consider the role of technology in achieving a more inclusive society.

Potential impacts and developments

ATs for visual impairment are amongst the oldest. Many readers will be reading this paper through lenses, and while they may be more compact, comfortable, effective and affordable than those used a thousand years ago, the basic principles remain unchanged. For more severe visual impairments, including blindness, we are also quite familiar with 'haptic' (touch-based) ATs, such as canes and Braille, which can improve people's reading and mobility skills. We now see emerging ATs under development that build further upon these skills, such as cameras that enable live audio description of texts, or even of the environment, either via human assistance or artificial intelligence. Looking to the future, bionic eyes could restore visual functionality, and might one day even allow vision that is better than is possible with 'normal' eyes.

There are two strands of ATs for hearing impairments. One is hearing aids and cochlear implants, which can reduce the level of hearing impairment, albeit with mixed results. Future developments in this field towards 'curing' deafness are controversial. Another is strand is oriented around translation between spoken language, sign language and text. The quality of these ATs is improving rapidly, and they are increasingly being used by people without hearing impairments in mainstream devices.

EPRS | European Parliamentary Research Service
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June 2017 - PE 603.197

ASDs include a range of disorders related to social behaviour, communication and language, and may be associated with sensory disorders, such as hypersensitivity and difficulties in modulating the range of audio, visual and other stimuli. ATs in this field are more recent, and less advanced than those for vision and hearing impairments. They often offer support in communication and social interactions, for example by providing immersive tutorials or robot companions that help the user to prepare for social interactions. In the future, ATs for ASDs might focus more directly upon the modulation of sensory inputs.

When we consider the range of ATs, we see that they differ in their fundamental understanding of disability. Some adopt a 'medical model', in which the disability is considered a problem to be fixed in order to allow the person to participate more fully in society. This includes, for example, preparing autistic people for common workplace interactions. Here, the user is a patient who has to adapt to fit a workplace that will not change. Other ATs adopt a 'social model', which focuses upon ensuring that society and the environment are inclusive for people with different levels of ability, including hearing and visual impairments and ASDs. From this social perspective, we can see how new ATs or mainstream technologies can also create new disabilities, or exacerbate existing ones. For example, as everyday devices such as cash machines increasingly replace physical buttons with touchscreen displays, they can become harder to access for users with visual impairments.

Many ATs help the user lead a more autonomous and independent life. While this is worth celebrating, there are concerns that it could lead to reduced solidarity and interaction with disabled people. Imagine a future where many disabilities can be 'fixed' or compensated by ATs. Disability would be less visible, which could lead to stricter social definitions of what it means to be 'normal'. People that cannot access appropriate ATs, perhaps because of their specific disabilities or financial situation, may be at risk of increased social isolation.

Advanced ATs might also blur the boundaries between medical recovery and human enhancement. Imagine future bionic eyes that not only offer full vision for blind people, but also enhanced vision for zooming in, night vision or augmented reality. People without visual impairments might also wish to adopt this technology to enhance their 'normal' vision. Taking this further still, 'merely human' eyesight could one day be seen as a disability. While the use of prostheses in athletics has already brought some of this debate to the mainstream, AT development could sharpen our need to reflect upon what human enhancement could mean for society.

Anticipatory policy-making

There are many existing technologies and regulations that could already help us build a more inclusive society. In the regulatory arena, the United Nations Convention on the Rights of Persons with Disabilities, which came into force in 2008, provides a strong framework for a more inclusive society, but its implementation has been uneven among Member States. Meanwhile, work continues on a European Accessibility Act which may improve the situation. Similarly for the technology sphere, many available ATs are under-used because of the higher standards applied to medical devices, financial accessibility, and stigma. ATs that respond to mixed disabilities, for example for people with both hearing and visual impairments, are less advanced, but could be particularly important in the future 'ageing society' where we might expect increasing prevalence of such cases. Perhaps by promoting a new 'AT specialist' professional field, we could make progress in compliance with existing regulations, making effective use of current technologies, overcoming stigma and reflecting upon emerging and future social and ethical issues.

A parallel approach to building an inclusive society could be to shift our focus from technology to society. Instead of developing ATs to eliminate our differences and make everyone 'normal', we could develop a society that accepts the normality of being different. This approach is certainly more challenging, but technology alone can only take us so far. In the meantime, we can work with the ATs that are available to us now, along with regulations and social actions, to try and build a better society.

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