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Assistive Technologies as Rights Enablers

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Picture Alicia, a child, on a playground. She is engaged in the activity of play, moving across the playground, enjoying her friends, playing games, and having fun. The context for her play is multifaceted. Physically, the playground has many surfaces, from hard dirt to asphalt to sand, and includes various pieces of equipment (e.g. the swing set she uses). Her playmates are part of the social context of her play, together with her teachers and aides. There are rules for playing on the school grounds. These constitute the institutional context. Finally, norms and values influence the cultural context in which the play occurs.

Alicia has one particular characteristic—she is unable to walk or run independently. To participate in the play activity, as well as in the rest of her life, Alicia uses an assistive technology device—a wheelchair. She also has a modified sand tool like a shovel so she can hold it and dig while sitting in her wheelchair. Sometimes she prefers to be helped out of her chair and sit in the sand to play. A special seat belt that fits on the swing allows Alicia to use it. The merry-go-round is wheelchair-accessible so she can enjoy it along with her friends.

This chapter addresses assistive technologies (AT), that is, devices and services like the ones Alicia uses, enabling her to enjoy her right to play in her particular contexts. After defining what assistive technologies are and describing different categories of assistive products, we argue that assistive technologies are enablers for children with disabilities to enjoy their rights. We finally discuss challenges of AT provision for children and ethical issues involved.

What Are Assistive Technologies?

Assistive technology (AT) 'is an umbrella term covering the systems and services related to the delivery of assistive products and services' (World Health Organization 2018). An assistive product is 'any product, instrument, equipment or technology adapted or specially designed for improving the functioning of a person with a disability' (World Health Organization 2002, p. 180). The wheelchair, the modified sand tool, the special seat belt, the adapted merry-go-round, all are assistive products (or assistive technology devices) that Alicia uses to improve her functioning when playing in the playground. An assistive technology service is 'any service that directly assists an individual with a disability in the selection, acquisition or use of an assistive technology device' (US 100th Congress 1988, p. 1046). Training Alicia to transfer from her wheelchair to a swing or developing strategies to go through rough terrains in her wheelchair are examples of assistive technology services.

Assistive technologies help bridge the gap between the requirements of an activity and the functional capabilities of a person who wants to perform that activity in a given context (Azevedo et al. 1994). There are different ways AT may enable an activity: it can change the requirements of the activity (e.g. using a ramp to avoid steps), augment the capabilities of the person (e.g. a hearing aid), or provide a different way of performing the activity (e.g. using speech recognition instead of writing for computer text entry). AT may augment or replace the function being supported. For example, eyeglasses augment the vision capabilities by appropriately modifying the image perceived by the person's eyes, while a speech-generating device that reads aloud written messages replaces the person's speech.

There is a continuum from mainstream technologies that include accessibility features to mass-produced AT devices to custom-designed devices. Mainstream products may be designed according to the principles of universal design (also known as design for all): 'The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design' (Sanford 2012, p. 66). In this approach, features that

make a product more useful to a person with disabilities (e.g. larger knobs, displays in visual and auditory form) are built into the product. Products designed for all are flexible, usually having many features and arrangements of controls, allowing them to be used by a wider range of persons with different needs and desires that may or may not be related to their abilities (Pullin 2009). In many cases, accessibility features were initially designed for persons with disabilities and, when they became more widespread, came to be incorporated into mainstream technologies. An example is predictive text, in which the device predicts what is being entered after a few letters, saving keystrokes for the user. Another example is automatic speech recognition, a system that interprets what a person says and enters it as if it had been typed. These features were developed for persons with disabilities who encounter difficulty entering text using a keyboard, but are now found in almost every mobile phone and many other systems, such as television remote controls. AT devices may therefore be based on mainstream products, such as smart phones and tablets equipped with accessibility features (Emiliani 2006). Customisation of the system to meet AT goals may be provided through software apps. For example, an app may enable expressive communication for a child using a tablet.

Mainstream technologies that include accessibility features reduce the need for some specialised assistive technologies but do not eliminate it completely. For example, Alicia needs a wheelchair with enlarged wheels for navigating sand, or extra power in a powered wheelchair to navigate over the rough surfaces and move faster, allowing Alicia to keep up with her friends. While general-use wheelchairs may be mass-produced, the need for special features may require custom designs.

Assistive products are usually classified according to their function. The International Organization for Standardization (ISO) published in 2016 the sixth edition of the widely used ‘ISO 9999:2016 Assistive products for persons with disability—Classification and terminology’ (International Organization for Standardization 2016). In this standard, AT products are classified as in Table 24.1. From this, it is possible to infer the high number and variety of assistive products. The EASTIN information system (EASTIN 2022), a common front-end for

several national assistive technologies databases, contained in November 2021 about 67,400 assistive products.

Table 24.1 ISO 9999:2016 classification of assistive products

ISO class	Description
04	Assistive products for measuring, supporting, training, or replacing body functions
05	Assistive products for education and for training in skills
06	Assistive products attached to the body for supporting neuromusculoskeletal or movement-related functions (orthoses) and replacing anatomical structures (prostheses)
09	Assistive products for self-care activities and participation in self-care
12	Assistive products for activities and participation relating to personal mobility and transportation
15	Assistive products for domestic activities and participation in domestic life
18	Furnishings, fixtures, and other assistive products for supporting activities in indoor and outdoor human-made environments
22	Assistive products for communication and information management
24	Assistive products for controlling, carrying, moving, and handling objects and devices
27	Assistive products for controlling, adapting, or measuring elements of physical environments
28	Assistive products for work activities and participation in employment
30	Assistive products for recreation and leisure

In this chapter, we use the less-granular classification of assistive products proposed by Cook et al. (2020) to briefly describe different categories of assistive products. With the following listing, we want to provide an idea of the breadth of available assistive products and the functions they support. We invite the reader, while going through each of the AT categories, to reflect on the importance of making these technologies available to all children that need them, ensuring they can effectively use them to participate in their desired activities.

Control Interfaces

When interacting with an electronic device, we do it through a control interface. Keyboards, touchscreens, buttons, and switches are typical examples of control interfaces. Through them, we can choose one option from the selection set of the technology (e.g. type a letter, turn on a light, move a powered wheelchair forward). Alicia's control interface for her wheelchair is a joystick, allowing her to move forward or backward or turn left or right. When she texts with her friends,

she uses a keyboard. Her friend Diana uses a switch to play in the sand with a powered excavator that scoops sand when she presses the switch.

When it is possible to choose directly any option from the selection set, we say that we have direct selection. This generally requires one control interface per each of the commands that can be selected (e.g. each letter on a keyboard as a separate key, a powered wheelchair controller may have one button per direction of movement). When we need intermediary steps to make a choice, we have indirect selection (e.g. to choose a command from a group of commands inside a menu, we need first to open that menu). Indirect selection usually requires less control interfaces (the same control interface can be used to choose a group of commands, and then a particular command within that group), but it is more cognitively demanding. It requires memory of the intermediate steps needed to choose the desired option, attention, and sequencing skills, for example. Coded access, in which a person enters a code corresponding to the desired option in the selection set, is an example of indirect selection (e.g. pressing the Control and the C keys simultaneously to copy a text to the computer's temporary memory). Scanning is an indirect selection method that allows the choice of an option using just a few controls. With as little as only one controlled movement, a person can scan through the selection set and make the desired choice. For example, pressing a switch may start the scan through the rows of an on-screen keyboard, another press may select the row and start the scan through the letters in that row, and a third press may select the desired letter.

Control interfaces for direct selection include different types of keyboards (larger, smaller, with different key arrangements), standard and alternative electronic pointing devices (e.g. keypad mouse, trackball), automatic speech recognition, eye-gaze systems (the movement of the user eyes is tracked such that a choice can be made by looking at the desired option in the selection set), brain-computer and body-computer interfaces (physiological signals, such as the electric activity of the brain or of a muscle, are used to make a choice).

The main control interfaces for indirect selection are single switches. Upon sensing a controlled movement, single switches close an electric circuit, thus making a choice. Many

different switches, capable of detecting different movements, exist. An eye blink, the movement of the head, arm, leg, or tongue, inhalation, and/or expiration may be used to activate a switch. With the current technology, it is safe to say that any controlled action may be used to control a technology through an appropriate switch. For example, Alicia's playmate Alex cannot use his hands, so he controls his wheelchair using switches that sense his head movements.

Seating Technologies

Without a physical position that is comfortable and that promotes function, participation in a given activity is not possible. Seating technologies encompass cushions, support systems, and special-purpose chairs. Different materials are used, varying in (a) density (generally, the denser, the more durable); (b) stiffness (how much the material gives under load); (c) sliding resistance (higher sliding resistance prevents the user from sliding, but it also makes transfers more difficult); (d) resilience (or ability to recover its shape after a load is removed or to adjust to a load as it is applied); (e) dampening (ability to soften the impact); (f) envelopment (degree to which the material surrounds the buttocks when the person sinks into it); and (g) recovery (degree to which the material returns to its preloaded state when a load is removed). These properties should be chosen according to the seating objectives: postural control, tissue integrity, comfort, or a combination of these.

Technologies That Enable Mobility

Technologies that enable mobility are those that enable individuals to move within their immediate environments and for short distances between environments. Functional mobility can be augmented with low-tech aids, such as canes, walkers, or crutches, or replaced by wheeled mobility systems, such as wheelchairs or scooters. Different types of wheelchairs exist, matching the person's abilities and the mobility functional purpose. Manual wheelchairs may be propelled by an attendant or by the user. Powered wheelchairs may be used when the person has difficulty

propelling a manual version. These are heavier and bigger when compared to manual wheelchairs, which makes them harder to transport from one place to another. Tilt and recline wheelchair features allow adjustment of the seating position. Different frame materials are available, providing different rigidities and weights, adapting the wheelchair to its use: a heavy wheelchair may be used for short-term use, such as rentals at an airport or shopping mall, but rigid and ultra-lightweight wheelchairs are required for sports practice. Standing wheelchairs, which allow a person to transition from a seated to a standing position, are also available, thus enabling activities that are easier to perform standing (e.g. cooking). Customisation of children's wheelchairs utilising colour and decorations contributes to their autonomy and self-image (Figure 24.1).

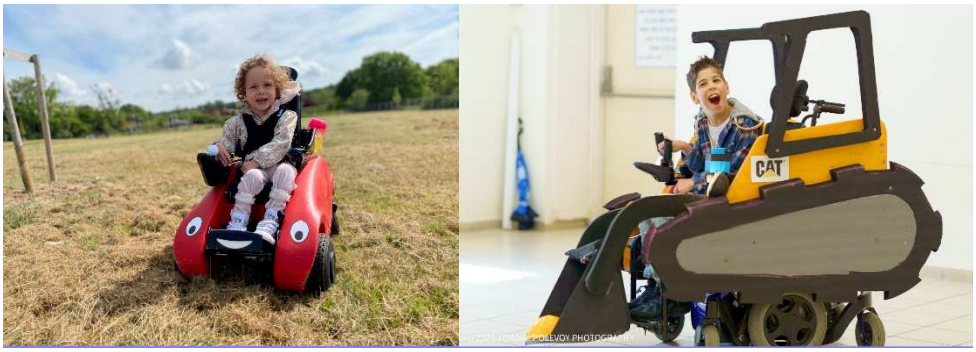

Figure 24.1 Examples of adaptations to children's wheelchairs: (a) the Wizzybug (https://designability.org.uk/) is an electrically powered wheelchair for indoor and outdoor use, intended for pre-school children of minimum age 14 months and a maximum weight of 20 kg (photograph courtesy of Designability); (b) picture taken at Israeli Purim holiday event 'Making Costume Dreams Come True', hosted by Beit Issie Shapiro and Holon Institute of Technology in Israel (designer, Amit Fisher; photographer, Jordan Polevoy; used with permission).

Technologies That Enable Transportation

Technologies that enable transportation are those that enable a person to move between two locations not within walking distance. These include vehicle modifications for driving, technologies for vehicle access, and technologies that provide occupant protection. Of these, the last two are relevant for disabled children.

Assistive technologies for vehicle access include ramps for transfer with wheelchairs into and out of a vehicle, rotating seats to facilitate transfers between a wheelchair and the vehicle seat, and devices to load and store the wheelchair once the user is in the vehicle. Examples of assistive technologies for occupant protection are infant seats or wheelchair tie-down and occupant restraint systems.

Technologies That Enable Manipulation

The American Occupational Therapy Association defines *activities of daily living* (ADLs) as 'those oriented toward taking care of one's own body' (American Occupational Therapy Association 2014, p. S19), such as bathing, toileting, or dressing. *Instrumental activities of daily living* (IADLs) include 'activities to support daily life within the home and community that often require more complex interactions than those used in ADLs' (American Occupational Therapy Association 2014, p. S19), such as care of pets, meal preparation, or home management. Many of these activities require manipulation (e.g. reaching, grasp/release, lifting, carrying, pushing/pulling, throwing/catching, turning, pinch, point).

Low-tech assistive devices may enable ADLs and IADLs, such as modified cutlery (e.g. cutlery with enlarged grips or angled handles), adapted cuisine implements (e.g. implements with non-slipping bases or modified handles), pen/pencil holders, or simply Velcro attachments to facilitate manipulation of a doll. A reacher (long-handled gripper) may be used for manipulation of different objects.

Electronic aids to daily living (EADLs) encompass those technologies that enable the control of appliances, electronic devices, or features in the home environment (e.g. lights, doors, window coverings). EADLs have some kind of user interface providing a way for the person to control a powered device. For example, a centralised accessible console may control the TV, the home lights, the heating/cooling system, and the door.

Robotic assistive technologies that aid manipulation are also available. These can take the form of a general-purpose robotic arm, fixed to a workstation or to a wheelchair, or of special-purpose robotic tools, such as a small robotic vehicle with a gripper that is controlled by a child to manipulate educational items or toys within the workspace.

Sensory Aids

Sensory aids may amplify the visual and/or auditory input or convert the input into another form and convey the information to the person through another pathway. Glasses and hearing aids are common assistive technologies that amplify the input. Mainstream sound amplification systems are another example. A wide range of magnifiers, optical and electronic, is available to amplify a visual input. Captioning systems convert an auditory signal into a visual one. Braille printing, Braille displays, or a long cane provide tactile substitution. Current operating systems, present in computers, tablets, or mobile phones, offer screen reading features, enabling visual-to-auditory conversion.

Technologies for Cognitive Augmentation

Technologies for cognitive augmentation encompass those that support skills, such as perception, attention, memory, orientation, knowledge representation and organisation, problem-solving, language, and learning. Information may be easier to perceive, and language barriers may be overcome if simple graphical language is used. The use of headphones may help a person focus on a sound source (e.g. the television or the voice of a professor in a classroom). Daily

schedulers and reminder alarms are precious memory aids available in any mobile phone. An electronic navigation system supports orientation. There is software that allows for the development of ideas in a graphical format and automatically converts it to text. Listing the subtasks that compose an activity, including possible decision points, be it on paper or on an electronic device, may help problem-solving. A text-to-speech reading aid may help in detecting errors in written words by hearing them.

Technologies That Enable Communication

Augmentative and alternative communication (AAC) 'is a set of tools and strategies that an individual uses to solve everyday communicative challenges' (International Society for Augmentative and Alternative Communication, n.d.). Unaided communication refers to communication using 'only the person's own body, such as pointing and other gestures, pantomime, facial expressions, eye-gaze and manual signing, or finger spelling' (Cook et al. 2020, p. 395). Aided AAC makes use of devices like letters, picture communication boards, computers/tablets/mobile phones with appropriate software, or dedicated speech-generated devices. Common to these devices is the need of having a way to select messages. Different symbol sets exist, from the alphabet to picture-based systems, to represent the different messages. Either direct or indirect selection may be used. Given the amount of the possible communication messages, many times the different vocabulary choices are grouped by theme in communication boards offering several direct-access options within the theme. The user needs to navigate between the different communication boards to build the desired message.

Some of the ATs described in the preceding text are used together, and others stand alone. The choice of a configuration of an AT system should be guided by the specific needs of the child. Considering the particular child, with their physical and cognitive characteristics, as well as their preferences, the activity the child wants to engage in, the physical, social, cultural, and institutional contexts, a choice of possible AT solutions should be sought. The process

should be centred on the child, aiming at empowering and enabling the child to independently participate in the activities of their choice.

Assistive Products as Rights Enablers

Upon going through the description in the previous section, it should be clear that assistive technologies can support many of the functional areas that are instrumental for a child to enjoy their rights. From this perspective, assistive technologies are rights enablers.

General principles that shape the Convention on the Rights of Persons with Disabilities (2006) (CRPD) include respect for inherent dignity, individual autonomy, including the freedom to make one's own choices, and independence of persons; full and effective participation and inclusion in society; equality of opportunity; and accessibility. Particularly for children with disabilities, its Article 7 obliges states parties to take all necessary measures to ensure children with disabilities can enjoy all human rights as any other children. This means that the rights enshrined in the Convention on the Rights of the Child (1989) (CRC) also hold for children with disabilities. Both CRPD (Article 7) and CRC (Articles 3 and 12) emphasise that the best interests of the child should always be considered and that the voice of children should be heard in all matters affecting them. In many cases, this can only be achieved through assistive technology. Table 24.2 associates some of the rights in CRPD and CRC and the assistive technologies that may be needed for a child to be able to enjoy those rights.

Table 24.2 Children' rights and assistive technologies that may be needed to be able to enjoy those rights

Right	**CRPD article**	**CRC article**	**Assistive technologies**
Accessibility	9		AT that enables mobility and transportation; seating technologies; control interfaces (providing access to information and communication technologies)
Liberty and security of person	14	37	AT that enables mobility, transportation, and communication; seating technologies
Freedom of torture or cruel, inhuman, or degrading treatment or punishment	15	37	AT that enables communication
Freedom from exploitation, violence, and abuse	16	19	AT that enables communication
Liberty of movement and nationality	18	7	AT that enables mobility and transportation; seating technologies
Living independently and being included in the community	19		Control interfaces; seating technologies; AT that enables mobility, transportation, manipulation, cognitive augmentation, and communication; sensory aids
Personal mobility	20		AT that enables mobility and transportation; seating technologies
Freedom of expression and opinion and access to information	21	13	AT that enables communication; control interfaces; seating technologies
Education	24	28	AT that enables mobility, transportation, manipulation, cognitive augmentation, communication; seating technologies; control interfaces; sensory aids
Participation in cultural life, recreation, leisure, and sport	30	31	AT that enables mobility, transportation, manipulation, cognitive augmentation, and communication; seating technologies; control interfaces; sensory aids

Table 2 shows that the achievement of children with disabilities' rights also depends on the availability of AT to enable the underlying functional areas. The need for AT is recognised in CRPD's Article 4, in which states parties commit themselves to undertake or promote research and development of, to make available, and to provide information on assistive technologies. References to assistive technologies that may be needed to enjoy the corresponding rights are also included in Articles 9, 20, 21, 24, 26, and 29 of the CRPD. Article 32 commits states parties to technical and economic cooperation on AT. One can thus infer that CRPD also (indirectly) establishes the right to AT (de Witte et al. 2018).

Assistive technologies may have a mediator or a moderator role in the enjoyment of human rights (Tebbutt et al. 2016). They play a mediator role when there is a direct relationship between AT and the enjoyment of the right. Without an appropriate AT that enables mobility, a child may not be able to enjoy the right to personal mobility (CRPD Article 20). AT has a moderator role when it acts as a facilitator of the achievement of a given right. For example, addition and subtraction may be easier to understand if students have access to manipulatives, physical objects they can put together or apart to simulate the corresponding algebraic operation. Providing a child with AT that enables manipulation may facilitate the learning process, but it is not a condition for learning, since the child can try to understand the concepts from their description or from seeing others using the manipulatives.

In the case of Alicia, she would not be able to enjoy her right to play without access to an AT that enables mobility (the wheelchair, which also incorporates seating technologies) and without the necessary environment adaptations (playground equipment modifications). These technologies have a mediator role in Alicia's right to play. If we enlarge the scope of the analysis, it is also necessary to ensure that Alicia is able to express her will of going to the playground and that she is able to get to the playground. That may require AT that enables communication and AT that enables transportation. These technologies moderate Alicia's enjoyment of her right to play. The same assistive technologies are also necessary for Alicia to fully enjoy her right to education. AT that enables communication may also be instrumental in achieving the rights of liberty and security of person, of freedom of torture or cruel, inhuman, or degrading treatment or punishment, and of freedom from exploitation, violence, and abuse. In fact, only by enabling Alicia's communication do we give her the power to denounce breaches to those rights.

At this point, we need to stress again that assistive technologies include not only the devices/products but also the services assisting an individual in the selection, acquisition, or use of an AT device. When in the last paragraph we say, for example, that AT that enables communication may be instrumental in enjoying the right of freedom from abuse, we mean not

only that the child should have an AAC device but also that they must be knowledgeable of the techniques to use it, while the device should have incorporated the vocabulary needed to communicate about those themes. In the case of Alicia, the wheelchair will be of no use in a playground if she is not able to negotiate uneven terrains or is not able to use the adapted playground equipment. For Noah, Alicia's friend who has a mild intellectual disability, having a tablet in class will make no difference unless his teacher takes advantage of it to present the curriculum in an accessible language and provides Noah the opportunity to participate in class using the tablet.

Another aspect that needs to be stressed is that AT can only be a rights enabler if the child is at the centre of the process. Not only should the physical and cognitive abilities need to be considered, but also must the child's subjective preferences be taken into account. It is the child who should have the ultimate word on which activity they want to participate in, in what contexts, and using which assistive technology(ies). The meaning attributed by the child to the activity (e.g. is it a school or leisure activity?) and the role within which the child will be performing the activity (e.g. as a student or as a playmate) need to be clarified with the child and not assumed based on any cultural norms. For example, playing an instrument may mean much more to a child than only getting musical training; it may be an opportunity for participating in a group activity, in this case the school band. The physical, social, cultural, and institutional contexts should all be discussed with the child when assessing different AT solutions. Ideally, different hypotheses should be considered and trialled with the child, and the one preferred by the child should be the one adopted. In any case, follow-up is critical to ensure that the AT solutions do, in fact, meet the child needs. AT providers, caregivers, family members should all contribute to the process, making sure that the best interests of the child are a primary consideration and that children have the opportunity to express their views freely (CRC, Articles 3 and 12; CRPD, Article 7). Such a human-centred perspective on AT is provided by the Human Activity Assistive (HAAT) model (Cook and Hussey 1995). The most recent description of this model is in Cook et al. (2020), and a summary is provided in the following text box.

The HAAT Model

The HAAT model was developed to portray the interplay between a person doing an activity in contexts using assistive technology. The starting point in applying the HAAT model is to clearly describe the activity the child wants to pursue. This will be within specific contexts: physical, social, institutional (e.g., rules and policies) and cultural. The child will bring certain skills to the activity, but she may also have characteristics that might limit her participation. Assistive Technology device(s) may be available to help her overcome the limiting characteristics. The HAAT model considers how the four components (Human, Activity, Context and Assistive Technologies) interact to provide an assistive technology system. The emphasis of the model is on the person engaged in an activity within chosen contexts. As we saw with Alicia, each component part plays an important role that can affect her opportunity, but it is the combination of all four that results in success. The HAAT model provides a formal way of evaluating this total system for a particular situation.

We argued so far that assistive technology can enable children to enjoy their rights. Naturally, those rights should also be respected during the AT service delivery process. Challenges of a child-centred AT service delivery are discussed in the next section.

Challenges of a Child-Centred AT Service Delivery

A human-centred approach to AT for children is particularly challenging. First, how to ensure that the best interests of the child are a primary consideration? Are technologies being provided to meet the children's needs and not the needs perceived by parents/caregivers? For example, one concern sometimes voiced by parents is that providing AAC or mobility aids may delay or prevent the development of autonomous speech or ambulation. Research data puts all such fears to rest. Blackstone (2006) summarised the evidence from several studies addressing myths and misconceptions about AAC. For example, based on a research review of the impact of AAC

intervention on the speech production of individuals with developmental disabilities conducted by Millar et al. (2006), Blackstone shows that there is evidence that AAC intervention in fact contributes to gains in speech. Bottos et al. (2001) assessed the effect of early provision of a powered wheelchair to 29 children aged 3 to 8 years with spastic or dystonic tetraplegia. They observed that even those with severe learning disability or motor deficit were able to achieve a good-enough driving competence, enabling independence and socialisation. While 21 out of 25 parents were not in favour of the powered wheelchair when the study started, 23 expressed positive feelings about it after the study. Jones et al. (2012) conducted a pilot randomised controlled study involving 28 children with various diagnoses, aged 14 to 30 months, showing that the group of children that received a powered wheelchair improved significantly more in several development and function scores compared to the control group.

The CRPD, in Article 7, sets that states parties shall ensure that children have the right to express their views freely on all matters affecting them, their views being given due weight in accordance with their age and maturity. How can children's voice be heard? Disability adds another dimension based on non-typical understanding or expressive ability. It is necessary to make sure children with disabilities have opportunities to express themselves and have both the expressive communication ability and vocabulary to adequately discuss their needs and desires.

As stressed by Desmond et al., '[p]eople's preferences, perspectives and goals are fundamental to defining and determining the success of AT' (Desmond et al. 2018, p. 437). While many assistive technologies have been designed for children, not many have involved children in the design process. When children are involved in the design process, the resulting systems have often differed dramatically from the designs of non-disabled adults. As an example, children designed AAC systems for them (Light et al. 2007). In contrast to existing commercial AAC systems, the child-designed systems integrated multiple functions, including communication, social interaction, companionship, play, artistic expression, and telecommunications. Their designs also focused more on features designed to engage children, such as colours, naming the devices and lights, transformable shapes, popular themes, and

humour. In order to reflect the user's age, personality, attitude, interests, and preferences, the systems were designed to be easily personalised. This result underscores the need for children to be given every opportunity to advocate for themselves and for their AT to be appropriate to their specific needs if their rights are to be assured. Examples of ideas on how to involve children with and without disabilities in co-design of new technologies are:

a) Having children working in groups, moderated by adults, using blocks with various shapes and sizes which can be easily attached and detached to design a device (Vaajakallio et al. 2009; Hansen 2017).

b) Taking children to a comfortable, creative, and imaginative space and having familiar objects with an 'electronic layer' added such that children can modify the environment (e.g. lighting, interactive graphics, or music) through the tangible objects, thus simultaneously designing and using the space (Cappelen and Andersson 2021).

c) Providing diverse methods of collecting children's views, such as brainstorming, sketching, collecting art supplies and crafting, story-writing, animation-making, and brief interviews (Sanoubari and Dautenhahn 2021).

Providing AT to children has the additional challenge that the AT needs of children often change fast. For example, physical growth can change the required size of a wheelchair. The capabilities of an AT device can become more complex and functional as a child develops more understanding of the technology and the task. An example is the use of word completion while typing that may not be understood by younger children but is very useful to older children as they work to keep up with more advanced writing requirements. AT should be provided in a timely manner; otherwise, it may already be obsolete when made available to the child. To maintain functioning and independence, the child's AT must be flexible and adaptable. If the AT is based on mainstream devices, this flexibility may 'only' require new software.

Success of AT systems depends heavily on the expertise of the personnel assisting the user in understanding the use of the system and developing skill in its use. These areas of practice differ significantly between adults and children. Personnel serving children must be capable of a child-centred approach to training and system development while simultaneously involving significant adults who can support the child on a day-to-day basis.

As discussed earlier, the AT service delivery process needs to consider children rights. Children rights are often related to ethical principles, and several ethical challenges arise in the provision of AT to children. These are described in the next section.

Ethical Issues, Children's Rights, and AT for Children

Principles advocated by the CRC (Article 12) and by the CRPD (Article 7) call for children to be able to express their needs and wants independently and to be free of undue influence from parents or caregivers. This is an expression of the ethical principle of autonomy, meaning, the right to self-determination and freedom from unnecessary constraints, interference, or loss of privacy. A related ethical challenge is paternalism, which is 'the interference of a state or individual in relation to another person, either against his will or when the interference is justified by a claim of better protection for the individual' (Martin et al. 2010, p. 71). Because paternalism assumes that safety is more important than freedom of choice and that it is important to protect people from themselves, it is a factor in the ethical consideration of the rights of children. This has implications for the child's voice being heard. The opposing perspectives of autonomy and paternalism can lead to conflict when considering the rights of both children and their parents and caregivers. The rights of parents to control their child's behaviour for safety or other principles (religious beliefs, conformance to cultural norms, etc.) can easily be in conflict with a child's right to autonomy in their daily life.

Another important principle is that of fidelity, which requires faithful, loyal, honest, and trustworthy behaviour by the clinician (Kitchener and Anderson 2011). Addressing fidelity can

lead to ethical conflict. These conflicts can be exacerbated when considering the rights of children enabled by AT. The available AT may be inappropriate to the needs of the child, with options limited by the resources of the particular state. Providing inadequate AT may be done on the basis of 'something is better than nothing' accepting the decreased fidelity of the intervention. AT personnel can also find themselves at odds between what they believe is right and what the child and parent want. Other sources of conflict include varying expectations of members of the healthcare team, dictates of organisational policy, or what the profession or the law requires.

Stigma is a sign of social unacceptability associated with shame or disgrace (Perry et al. 2009). Assistive technology can be stigmatising or can help to counter stigmatisation. A stigma associated with the use of the AT is that its use implies weakness or less ability. Conversely, AT that is based on mainstream technologies implies competence and can decrease stigma. Stigma can also be related to cultural differences and can be exacerbated by use across different cultures with varying social domains, rules, and norms.

Conclusions

The CRPD establishes the rights of children with disabilities and commits states parties to ensure that children with disabilities can fully enjoy all human rights on an equal basis with other children. For many children with disabilities, that is only possible using assistive technology, that is, products adapted or designed for improving the functioning of disabled people and all services inherent to the selection, acquisition, and use of assistive products. From this perspective, we argue that AT is a rights enabler. CRPD also recognises the critical role AT may have in enabling the rights of persons with disabilities, referring in several articles to the need of promoting research and development in AT, and making AT effectively available for all those that may benefit from it. From that perspective, AT is also a right.

There is a wide breadth of assistive technology products supporting virtually all possible occupations. It is critical to understand that just providing an AT product to a child is not sufficient. It is necessary to ensure that the product is properly fitted to the child, that training is provided teaching the child and their significant ones the best strategies to use the product, and follow-up must be conducted. AT services are as important as AT devices.

AT service delivery for children with disabilities faces several implementation and ethical challenges. An effective AT service delivery process must be centred on the child. Often, imaginative solutions need to be found to ensure that the children's voice is heard. For example, when assessing a child for an AAC system, to collect the child's inputs, one needs to find a channel for communication. Deliberate attention should be paid to the perspective of the child. A timely service should be in place guaranteeing that the child has access to the AT when they need it. Delays in AT delivery may compromise child development and may lead to the delivery of AT that is already obsolete when it finally reaches the child. Ideally, the selected AT would have some degree of adaptability such that it can meet the changing needs of the child as they grows. All steps in the AT service delivery process, from assessment to finding a device, to delivery and fitting, to follow-up, should be child-friendly and performed by personnel trained in serving children.

Ethical challenges in AT provision to children with disabilities encompass the respect for children's autonomy, avoiding paternalism; ensuring fidelity in the AT interventions when the clinician faces a conflict between the child needs and the AT resources available; and considering the impact of a particular AT on stigma.

In 2014, the World Health Organisation launched the GATE (Global Cooperation on Assistive Technology) initiative to address CRPD's Article 32 obligations on technical and economic international cooperation on assistive technology (World Health Organization 2018). It also supports the realisation of the Sustainable Development Goals (United Nations, n.d.) and the implementation of the resolution WHA71.8—improving access to assistive technology (World Health Organization 2018c). The mission of GATE is 'to assist Member States to improve access

to assistive technology as a part of Universal Health Coverage', and its vision is '[a] world where everyone in need has access to high-quality, affordable assistive products to lead a healthy, productive and dignified life' (World Health Organization 2018). GATE revolves about 5 Ps: people, products, provision, personnel, and policy. It is a rights-based approach to AT, recognizing that the AT user should be at the centre of the entire process. The focus has been in under-resourced areas of the world, but one needs to keep in mind that, when it comes to AT, many people in developing countries also don't have access to it. It is expected that GATE will have a big impact all over the world.

The GATE initiative aims at improving access to high-quality, affordable assistive technology products in all countries, for all those who need them, across their entire lifespan. As such, the GATE initiative also caters to the interests of disabled children. However, challenges in AT provision for children, like the ones singled out in this chapter, cannot be overlooked. Only through a child-centred AT provision can we enable children's rights, empowering children with disabilities to develop to the maximum of their potential.

Key takeaways

Assistive Technology encompasses products adapted or designed for improving the functioning of disabled people and all services inherent to the selection, acquisition and use of assistive products.

There is a wide breadth of assistive technology products supporting virtually all possible occupations.

Since the enjoyment of a particular right by a particular person may depend on or be facilitated by assistive technology, assistive technologies are rights enablers.

AT services are critical! While making available an assistive product may be a condition for someone to be able to engage in a given activity, it is far from being enough. The use of an assistive product requires efficient strategies and the best possible matching between the person's needs and the technology.

Assistive technology provision for children entails particular challenges, including ensuring that the best interests of the child guide the process and that the children's voices are heard; involving children in AT design; time pressure so that all required AT is available when needed for the child to develop to the maximum of his/her potential; the need for products that 'grow with the child'; having trained personnel serving children.

Ethical challenges of respecting children's autonomy, avoiding paternalism, ensuring fidelity of AT providers, and considering the effect of AT on stigma must be addressed when providing AT for children and enabling their rights.

Global initiatives in AT are based on a rights-approach, but specific needs of children cannot be overlooked to ensure that AT provision is respecting and enabling children's rights.

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