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# The creation of cyborgs within a socially constructed understanding of disability and assistive activity technology use

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## ABSTRACT

This article illuminates how understandings of disability is negotiated through use of assistive activity technologies, when people with physical impairment use this kind of technology in their social and physical environment. A qualitative data design was adopted involving interviews with 44 adults with mobility impairments using assistive activity technology. The study was conducted in Mid-Norway. In analysing the findings, this study adopted the stepwise deductive-inductive approach with social constructivism as a theoretical basis. Furthermore, a relational understanding of disability and the cyborg metaphor are used to explain how disability and assistive activity technology are embodied, as well as social and material matters. The article shows how aspects in the social construction of disability are changed when people using assistive activity technology become subjects for new and positive interpretations.

## ARTICLE HISTORY

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## KEYWORDS

Qualitative research;  
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## Points of Interest

- The understanding of disability changes meaning according to the use of different technologies, between different people and in different contexts.
- To understand disability, we need to explore how people ascribe meaning to both the material and the social aspects of disability.
- The use of assistive activity technology led to new opportunities to participate in valued physical activities, and to negotiate new perceptions of disability.
- The understanding of disability and assistive activity technology use is an intertwined interpretation of human bodies, technology, and activity.

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## Introduction

Several researchers have studied the interaction between people with disabilities and assistive technology (AT) for the purpose of generating knowledge of how people experience themselves and additionally how they are perceived by others (Ripat and Woodgate 2011; Ravneberg 2012; Gibson, Carnevale, and King 2012; Pedersen, Soderstrom and Kermit 2019a, 2019b). Various individual, technological, and contextual aspects are affected in the interaction between a person and AT, and knowledge about these aspects are important for a greater understanding of experiences and perceptions of disability. This awareness is especially important to take advantage of the opportunities to counteract disabling conditions that may exist in the use of different types of AT (Scherer and Glueckauf 2005; Hjelle and Vik 2011; Ravneberg 2009; Ravneberg and Söderström 2017; Krantz 2012; Pedersen, Soderstrom, and Kermit 2019a).

The International Classification of Functioning, Disability, and Health (ICF) defines AT as 'any product, instrument, equipment or technology adapted or specifically designed to improve the function of a disabled person' (WHO. 2001). The Norwegian Labour and Welfare Administration (NAV) defines assistive activity technology (AAT) as a subgroup of general AT and is considered AT designed specifically to help individuals with impairments to participate in physical activities. These activities include indoor activities, outdoor activities, exercise, sports, play, and physical education (NAV. 2015). Some examples of AAT are adjusted bikes, alpine equipment, wheelchairs modified for playing tennis or dancing, and hockey sleds. Nevertheless, lack of universal accessibility (Carver et al. 2016; Martin Ginis et al. 2016; Bigonnesse et al. 2018) and of access to technology, and of information and education in physical activity challenge physical activity participation for persons with a disability (Carroll et al. 2014; Martin Ginis et al. 2016; Pedersen, Kermit, and Soderstrom 2021; Pedersen, Soderstrom, and Kermit 2019a; Bergem 2019; Martin Ginis et al. 2017).

In the study of disability and technology use, the indistinct boundaries between the person and the technology he or she uses are recognized (Ness 2011; Ravneberg and Söderström 2017). Moreover, how AT becomes an extension of the body and of people's social selves is also vital (see, for example, Ravneberg 2009; Gibson, Carnevale, and King 2012; Pedersen, Söderström, and Kermit 2019b). This extended understanding of the social self is a result of the social context where the interaction between the person and the AT takes place. However, what takes place in the interaction, such as the specific social negotiations that go on and how meanings are created about technology and disability, is not explored in further detail. Actions and negotiations in the social construction process (Tjora 2017, 2019; Burr 2015), in which an understanding of disability is created, and how technology interferes in this process, is seldomly described. A more detailed knowledge

might give useful insight into the construction processes that lead to positive experiences and understanding of disability and technology use and might contribute to identifying obstacles for positive experiences and understanding.

This study explores the interaction between people with physical impairments and AAT in their social and physical environment, and how a socially constructed understanding of disability is influenced by this interaction. More specifically, we review how aspects in the socially constructed understanding of disability are changed when people with mobility impairment using AAT become the subjects for new interpretations. Following this line of inquiry, the research question posed for this study is this:

What kind of meanings are negotiated in the social construction of disability through AAT use, and how does the use of this technology change the understanding of disability?

This study was conducted in Norway. In Norway, people apply for state-funded AT at the Assistive Technology Centre, a division of the Norwegian Labour and Welfare Administration. The applicant is required to have a permanent illness, injury, or disability that affects his or her daily life at a significant level to meet the requirements for being allocated AT (NAV. 2015). Researchers in the field of disability studies are aware that the use of AT to improve people's functioning is considered part of a normalisation discussion (Grue 2016b, 100). The focus of this article is on the potential, meaning the practical changes, new actions and social negotiations that occur when the AAT is in use in everyday life.

Two theoretical perspectives are used to explore the social and technical processes involved in the use of AAT. Both perspectives use metaphors to describe the human use of technology: (i) the cyborg, as a complex creature of man and machine and (ii) domestication, as a metaphor for the taming of technology. Both metaphors contribute by providing a picture of the complex social construction processes that take place when this technology is acquired and used. The theoretical frame of reference used in the article builds on and connects the two fields of science and technology studies (STS) and disability studies.

### ***Earlier research on the use of technology for adapted physical activity and participation***

The cultural understanding of disabilities and AT affects how both a person and the social environment choose strategies to manage a situation, as well as accepting the help that technological innovations represent (Shinohara and Wobbrock 2016; Seymour 2005; Ravneberg 2009; Häggblom Kronlöf 2007; Ripat and Woodgate 2011; Grue 2016a; Swartz and Watermeyer 2008). Culture refers to the beliefs, values, meanings, and actions that shape the

lives of a collective of people, influencing the ways people think, live and act (Iwama 2003a; Magasi et al. 2015). Values related to gaining mastery, control, independence and autonomy are generally considered hallmarks of individualistic societies (Iwama, Thomson, and Macdonald 2009; Iwama 2003b). In contrast, members of collectivist societies are more likely to value social relationships, community, interdependence and a sense of belonging (Iwama, Thomson, and Macdonald 2009; Hammell 2009). These are the values in society that affect whether people want to use AT, and how people experience its use. Cultural values and actions guided by these values form the basis for whether technology can contribute to a person being a full member of society or not.

Studies have revealed that both disabled and non-disabled people's general awareness of AT use influences social expectations regarding its use (Ravneberg and Söderström 2017; Shinohara and Wobbrock 2016; Grue 2014; Martin Ginis et al. 2017). In addition, people's assumptions, expectations, and responses to using AT in general are also influenced by individual and personal preferences. They are influenced by varying individual needs, opportunities and past experiences with and exposure to such technology, in interaction with the contextual conditions (Scherer et al. 2005; Federici and Borsci 2016; Borg and Östergren 2015) of which culture is a part. For example, people seem to have higher expectations of positive outcomes of AT use when they get information of positive outcomes experienced by others (Pedersen, Kermit, and Soderstrom 2021). AT has been shown to support participation for people with disabilities (Scherer and Glueckauf 2005; Hjelle and Vik 2011; Ravneberg and Söderström 2017; Martin Ginis et al. 2016; Gjessing et al. 2017; Shinohara and Wobbrock 2016; Pedersen, Soderstrom, and Kermit 2019a) but can also prevent it when the technology can be perceived as negative and this may negatively affect a person's self-image (Ravneberg and Söderström 2017; Shinohara and Wobbrock 2016; Scherer, Craddock, and Mackeogh 2011; Pedersen, Söderström, and Kermit 2019b). Negative perceptions are often associated with the fact that AT reinforces the impression of being disabled and as someone different (Hägglblom Kronlöf 2007). AT abandonment (Scherer, Craddock, and Mackeogh 2011) can occur when the technology does not align with the impression an individual with a disability wishes to project about herself or himself (Ravneberg and Söderström 2017; Shinohara and Wobbrock 2016; Scherer, Craddock, and Mackeogh 2011; Ravneberg 2009; Hägglblom Kronlöf 2007; Grue 2014).

Studies have shown that a person with a disability is likely to accept AT if it helps maintain the person's self-image, conveys the impression the person wants to convey, or strengthens the efforts to maintain the user's social role (Shinohara and Wobbrock 2016; Scherer, Craddock, and Mackeogh 2011; Hägglblom Kronlöf 2007; Pape, Kim, and Weiner 2002). AT provides

symbolic signals that affect people with disabilities, and the social environment and interpretation and reactions of these signals influence the individual's identity (Ravneberg and Söderström 2017; Shinohara and Wobbrock 2016; Seymour 2005; Ravneberg 2009; Ripat and Woodgate 2011; Pedersen, Söderström, and Kermit 2019b). Thus, identity creation occurs at an individual and a social level. The cultural understanding of technology affects the identity of people with disabilities and makes it important to understand how culture contributes to the understanding of AT (Seymour 2005).

In adapted physical activity, many people with disabilities are dependent on using AT specially designed for physical activity (Martin Ginis et al. 2016), in this study referred to as AAT. Earlier research on adapted physical activity has demonstrated that it affects participation at both an individual and a social level (Côté-Leclerc et al. 2017; Stenseng, Forest, and Curran 2015; Zelenka, Kudláček, and Wittmannová 2018; Kissow and Singhammer 2012). Participating in an adapted sport has a positive impact on psychological factors, especially behaviour-related abilities, including self-esteem, self-efficacy, and a sense of belonging (Côté-Leclerc et al. 2017; Pedersen, Soderstrom, and Kermit 2019a). Playing an adapted sport also has the potential to influence the individual's quality of life and self-esteem by changing society's attitudes towards those with mobility limitations (Côté-Leclerc et al. 2017; Pedersen, Söderström, and Kermit 2019b). Moreover, a reciprocal relationship between positive emotions and a sense of belonging has been identified in earlier research on recreational sports activities among people with disabilities (Stenseng, Forest, and Curran 2015). Participation in organized physical activity offers individuals opportunities to experience new interpersonal interactions and different social roles (Zelenka, Kudláček, and Wittmannová 2018). Positive associations have been identified between physical activity and employment, educational status, leisure-time schooling, volunteer work and participation in disability organizations (Kissow and Singhammer 2012). The research still needs to identify what it is in our culture and social interaction that creates social barriers, and how this can be changed. More knowledge is needed about how AAT becomes part of the social negotiations of meanings in the social construction of disability and AAT use.

### ***Using the cyborg metaphor to understand the socio-material processes involved in constructing an understanding of disability***

The Western cultural distinction/dichotomy between machines and organisms, referred to as nature and culture, has been challenged for the past 25 years. A political and feminist-oriented version of Science and Technology Studies (Haraway 2006; Reeve 2006, 2012; Skjølsvold 2015) argues that there is no natural body and no clear understanding of the body. The body is always bonded to cultural understanding, and the truth about the body is

constructed rather than revealed (Haraway 2006; Reeve 2012; Wyer 2001). One of its followers in this version of STS studies, Donna Haraway is most recognized for the essay 'A Cyborg Manifesto: Science, Technology and Socialist-Feminism in the Late Twentieth Century' (2006), where she introduced the cyborg metaphor to challenge the potential underlying distinction between human and machine. The cyborg refers to how the interaction between humans and technology contributes to new interpretation and challenges dichotomous differences between established social categories like human and animals, nature, and culture and the social, and technical. Through the figure of a cyborg, Haraway saw hope for oppressed groups and for a diversity of identities, categories and social arenas. This could further provide new forms of social organization, political action and social analysis (Skjølsvold 2015).

To understand disability and the disabled body from an identity and individual perspective, a phenomenological perspective offers new insights and have had a greater influence in disability as a field of research in recent years (Gibson 2016; Thomas 2004; Grue 2014). From a phenomenological perspective the body is recognised a natural starting point which individuals interpret the world (Hangaard Rasmussen 1996; Merleau-Ponty 1994). Significant bodily and mental dimensions infiltrate one another and interact in the interpretation of situations; thus, the body is always a part of how individuals interpret the world and becomes part of the interpretation of the world (Hangaard Rasmussen 1996; Merleau-Ponty 1994). Feelings, appearances, gestures, sensations and so forth affect the meaning individuals ascribe to the things they experience. Thus, identity and bodily dimensions are involved in experiencing new situations, such as technology use. The technology allows for movements and bodily expressions that may otherwise be difficult for people with disabilities, thereby strengthening the bodily expression, or increasing the chances of expressing themselves. Hence, phenomenology perspectives can also be applied to illuminate the blurred boundaries between human, as bodies, and technology, that Haraway presented through the figure of a cyborg.

The cyborg's interactional perspective blurs the boundaries between technology and humans and might offer alternative understandings and expectations of ability for all people. However, there are differing opinions about the cyborg's advantage in disability studies. Some people argue that the cyborg has limited value in offering new solutions to the material disadvantage that disabled people face (Reeve 2012), an argument that might be interpreted as the existence of low expectations for the potential of the cyborg to contribute to technological and social change. The cyborg might provide an understanding of a fixed boundary between disabled and non-disabled people, and new perspectives on disability (Reeve 2012, 2006). This means that AT provides new opportunities for existence as human

beings, rather than supporting people in need of being 'compensated' for or normalized (Shakespeare 2013).

Donna Reeve (2012) builds on the cyborg metaphor and presents what she terms the ICrip, a representation of people being able to redesign their bodies and challenge who is seen as disabled. The ICrip represents new ways of being and extended perspectives on ability and normality, by focusing on how people incorporate AT into everyday life. To understand the complex interaction and negotiations that goes on between the AAT user, the technology and the environment, the cyborg metaphor and its underlying assumptions (Haraway 2006) might offer useful insight.

### ***Incorporating technology into everyday practice***

Domestication of technology is the process in which technology is 'tamed' by users and becomes normalized in everyday practice (Silverstone, Hirsch, and Morley 1992). Technology users are influenced by temporal and contextual ideas and means that technology use must be interpreted within a complex whole (Lie and Sørensen 1996; Sørensen 2006). Domestication describes phases of acquisition and individual use of technology in the users' physical and social milieu, where interpretation and meaning of technology are central aspects. Domestication takes place within four dimensions: acquisition, objectification, incorporation, and conversion. All these four dimensions contain cognitive, practical and symbolic changes that occur in both the active and domesticating technology-user and the domesticated technology (Lie and Sørensen 1996; Sørensen 2006).

The domestication perspective focuses on the interpretation and meaning or significance of technology (Lie and Sørensen 1996; Sørensen 2006) and is suitable for showing that both technology and disability are concepts with socially constructed content, depending on the conditions in which meanings are negotiated. There is no absolute definition of such concepts as disability and technology, only the meaning or significance they have for those who use them within a particular context (Gibson 2016, 8). Conversion, the last step in the domestication of technology, seems especially important for the meaning that is bound to the creation of an understanding of disability related to the use of AAT. In this study, domestication is used to keep the focus on the cognitive, practical and symbolic changes that occur with the use of AAT to provide insight into the contextual meanings of disability.

### ***Challenges in defining the category of disability***

There has long been a discussion related to challenges in defining disability in the social sciences, and to how disability as a term is used to describe a group of people. Grönvik (2007) especially problematizes the challenges of



having to describe characteristics of the sample's units, preferably individuals, when these characteristics are attributed rather than being actual characteristics of individuals. This does not mean that one must overlook that disability can be about physical limitation as a material disadvantage (Reeve 2012) but the emphasis on physical or medical conditions in the interpretation of the phenomenon of disability can be described as problematic. An understanding of disability based on physical or medical criteria can be especially problematic when it forms the basis for interpretation of the phenomenon, as it occurs within a social and complex whole, such as in rehabilitation and in the activities of everyday life.

By understanding the use of AAT as an interaction between user, technology and environment, the understanding framework for disability in this article can be said to be close to what in disability research is referred to as a relational understanding of disability (Tøssebro 2010). In a relational understanding of disability, disability is considered as an interplay between the individual's prerequisites and opportunities, on the one hand, and the expectations and demands of the environment, on the other. This includes, of course, both different types of AT and the social environment of humans interacting together. Therefore, we need to explore social negotiations taking place in the interaction between user, AAT and the environment, and what these entail for a relational understanding of disability.

The theoretical frame of reference for this study can be used to study the aspects that disability as a socially constructed phenomenon is made up of. The perspectives that Haraway (1991, 2006) and her followers present, show that both technology and disability are concepts with content that evolves through social negotiations, created in a context and by people who use these concepts. Therefore, the theoretical frame of reference can strengthen our understanding of how meanings ascribed to AAT are understood and interpreted. Further, what it means for the understanding of disability when AAT becomes domesticated as part of everyday life for people with mobility impairments.

## **Method and design**

### ***Study design and sample***

This study employs a qualitative research approach (Tjora 2017, 2019) and aims to contribute additional knowledge about the kind of meanings which are negotiated in the social construction of disability through AAT use, and how these change the understanding of disability. The theoretical frame of reference is in social constructivism, where the understanding of social phenomena is based on social-construction processes where meaning is formed in negotiation within and between individuals (Tjora 2017, 2019;

Burr 2015). These individuals' relations, context, language and history form the basis for how their actions are interpreted.

We used a strategic sampling method (Malterud 2003) to recruit informants. The inclusion criteria were as follows: age 18–67 years, having a mobility impairment, and having received AAT within the last 18 months. The Assistive Technology Centre confidentially recruited the informants by sending written invitations and information to all persons registered in their database who fulfilled the inclusion criteria according to specific case features. Informants had different levels and kinds of mobility impairments, such as spinal cord injury, multiple sclerosis, cerebral palsy, stroke, and other muscular and skeletal diseases. By including only people with mobility impairment, everyday life looks more similar in relation to use of the technology and services involved. The informants represent a strategic sample to give answers of relevance to the use of AAT for people with mobility impairment. Individuals who expressed a desire to participate sent a confirmation SMS message or an email to the first author. A total of 51 people confirmed their wish to participate; of these, 44 people participated in the study (11 women and 33 men). Substantial variations were found in the population regarding age, family situation, occupation, and variations in geographical conditions where they live (e.g. urban vs rural areas). The informants used various AATs, both for summer and winter activities. Most of the informants used only one AAT and others used two or three.

### ***Data collection***

The first author conducted semi-structured, one-to-one, in-depth interviews that aimed to illuminate the informants' own experiences and meanings regarding using AAT. The goal of in-depth interviews is to create a relatively free conversation that addresses specific topics pre-planned by the researcher (Tjora 2019, 114). By asking open-ended questions from an interview guide, the informants had opportunities to talk about their understandings, actions, and experiences with using AAT. The researcher conducted the interviews at the informant's home, in a cafe, or at the informant's or researcher's workplace – wherever the informant felt most comfortable. The duration of each interview was approximately one hour, and all interviews were audio-taped. Each interview began with introductory questions to collect background information about the interviewee, such as age, interests, and earlier experiences with AT.

The researcher then asked open-ended questions on different topics related to the use of AAT and taken from the interview guide, including 'allocation process and user involvement', 'technology and function', 'identity and personal preferences', 'social interaction', and 'physical activity'. Examples of the open-ended questions included What is the significance of this AAT

regarding how you feel? What would have been the consequences if you had not had this AAT? Finally, the researcher asked closing questions (Tjora 2019, 117), which are used to turn the focus towards more practical tasks, such as asking if any part of the study seems unclear and if the informant would be interested in more information before ending the interview. The informants were then referred to using pseudonyms in the findings section.

### ***Ethical aspects***

The Norwegian Centre for Research Data approved the study (reference no. 45484), which was also approved by the Norwegian Labour and Welfare administration, Unit for Control and Management. Informants were recruited anonymously. Before the interviews, the researcher asked the informants if they could confirm that they understood the purpose of the study and the informed consent. The researcher then advised the informants that their participation was voluntary, and they could withdraw at any time. The researcher removed all personal identifiers from the empirical data.

### ***Analysis***

The stepwise deductive-inductive (SDI) approach (Tjora 2017, 2019) was used. This systematic approach is based on an ongoing movement between an inductive interpretation and theory proximity in the analytical work. Before starting the analysis, the first author transferred electronic transcripts verbatim from the interviews to the software program NVivo, which is suitable for storing and organising data and was appropriate for supporting the analytical work in SDI. Initially, the first author performed detailed inductive coding by reading the text of the interview thoroughly and coding small sections that conveyed meaning about how the informants' experienced using AAT in their social context, using the same words and expressions used in the text. The first author identified striking nouns, action verbs, anecdotes illustrating the informants' experiences using AAT, expressions of irony, and comparisons. Then, the first author coded the text.

The goal in SDI is to generate codes from the data and not from previously planned themes. In this rigorous, bottom-up analysis, it is not possible to establish the codes (a priori) before the analysis (Tjora 2019). This process resulted in approximately 600 codes. For the next step, the first author collected the codes that had inner thematic meanings. This was, for example, shared thematic meanings in the text showing mastery, getting help to support having the same possibilities as non-disabled, and about feeling better physically and mentally. These meanings were collected into code groups (see Table 1) that seemed relevant to the research question. In this step, the authors met for a joint analysis session to discuss data saturation

**Table 1.** Examples of code groups and associated codes.

Code groups:	Codes (examples):
1. To show other people and oneself that you have mastery	<ul style="list-style-type: none"> <li>• other people are not used to see me so quick</li> <li>• I can talk about it and we can have something in common</li> <li>• the bike is well known for non-disabled people, I think they can imagine</li> <li>• it is important that other people don't look at me as very a disabled person</li> </ul>
2. Getting the help you need requires having the same possibilities as others	<ul style="list-style-type: none"> <li>• you end up not applying if the process is to complex</li> <li>• there will be trial and error because users are different</li> <li>• it is important to provide good information to people who come in such situations</li> <li>• emphasis is placed on the social surroundings, people that can assist</li> </ul>
3. To feel better physically and mentally	<ul style="list-style-type: none"> <li>• that is what I had to write to get the AAT</li> <li>• the activity does well for the physical and the mental</li> <li>• just getting out among people and getting moving</li> <li>• in my family, they see that I am a more positive person</li> <li>• I felt old and finished with life</li> </ul>

and the quality of the codes and code groups. The analysis and findings were also presented at seminars and conferences attended by disabled people, researchers, and practitioners in the field of disability.

The analysis resulted in six code groups with inner thematic meanings and represented the potential of the empirical material. Three of the groups (see Table 1) laid the foundation for the themes in the results section: ‘To show other people and oneself that you have mastery’, ‘Getting the help that you need requires having the same possibilities as others’ and ‘To feel better physically and mentally’. The themes fluctuated between these three code-groups and could not clearly be identified from analysed data in one of the groups.

In the final step, theories about how meaning is created (Hangaard Rasmussen 1996; Merleau-Ponty 1994; Blumer 1986; Mead, Vaage, and Thorbjørnsen 1998) and perspectives on technology use (Sørensen 2006, 1996; Haraway 2006, 1991; Reeve 2012) supported the analytical work to gain an understanding of what the codes were about, according to the stepwise deductive-inductive approach (Tjora 2017, 2019).

## Findings

### *Changed actions and social negotiations*

The first theme in the findings is a key discovery based on the code group ‘to show other people and yourself that you have mastery’. The AAT often led to new, practical possibilities for what the users could achieve, and this led to new or changed practical actions through participation in different activities with others or alone. The AAT provided increased access to social experiences with friends, family, and others. Using AAT, the informants also experienced more informal negotiations with other people because they

met other people in the streets, at sports events or during other outdoor arrangements or when doing common daily activities. As informant Gustav said about being out cycling with his adapted bike:

*People are very impressed when they see my bike. I do not know how many times I have been stopped and have talked to people when I have been out cycling. Some people just stand with big eyes and look at me, while others ask me and wonder a bit whether my bike is kind of an aid, and their reactions are very positive.*

This incorporation of the bike into an everyday activity raised positive attention from others and facilitated social interactions. Changed practices through the use of AAT, such as having the opportunity to travel on social trips with family or friends to cycle together, or to stand on the alpine slope together, were essential to participate with others and experience things together. Thus, practical changes led to new forms of social interactions.

While such activities were essential for the informants' participation, the physical activity was not always the main goal of such activities. What seemed important to the informants in this context was that the use of AAT contributed to new activities, and new symbolic interpretations of the technology in use, which in turn led to new opportunities for having common experiences with other people. This also meant new opportunities to negotiate who they were and what their interests were and changed how the informants perceived themselves. These experiences were interconnected with valued cultural activities in the informants' social environment. This was especially illustrated when informant Kasper talked about representing Norway in the European Para Championships:

*Going out to a sports arena when I was playing in the European Para Championships, with a flag on my chest to represent Norway...it did something to me. Although it is a small sport, it was just like other European Championships with opening ceremonies and flag-bearing and national anthems. Feeling that you are mastering something is exactly the same for the disabled as it is for everyone else.*

This quote shows how Kasper's understanding of himself was affected by recognition in this culturally valued activity. Receiving such recognition might affect the individual's personal identity. The participation of disabled people in culturally valued physical activities, might also affect how people in general understand disability. The informants highlighted that use of AAT in physical activity attracted positive attention among other people and thus helped them negotiate a more positive understanding of the informants. The informants experienced how those social negotiations through technology use in common activities contributed to other people gaining new ideas and understanding of disabled people. This type of social negotiation seemed to change negative perceptions of disability and make people who are not disabled become familiar with positive aspects of disability. Informant Jon tells of new expectations as something that motivates the use of the AAT:

*When my colleagues from my old job saw my bike, they said to me, 'you ride to the new job, too?' And in fact, this summer I have cycled twelve trips to my new workplace [more than 21 miles each way].*

This quote shows how Jon found increased motivation through recognition of the activity from his colleagues at his previous workplace. People with mobility impairment might be ascribed a new identity through a social process where the meaning of technology and person are interwoven into daily activities and negotiations. This is what Arne shared about others experiencing him/her playing floorball: 'I think others think it's cool that I do sports. I think the more included disabled people become, the less others think about the person being disabled'. From how we interpret what the informants explained, participating in activities through AAT use made other people change their view of individuals with mobility impairments. The quotation above illustrates a change in focus from the disability to personal characteristics. The findings illustrate how the domestication of AAT in everyday leisure activities involve practical and symbolic changes that open up a new understanding and negotiation about disability and technology.

### ***A struggle with domestication of the technology***

This second theme is based on the code group, 'Getting the help you need requires having the same possibilities as others'. Despite the empirical material showing that new, positive opportunities are gained from using AAT, not all informants experienced a positive relationship between themselves and the AAT. This was especially related to being assigned an AAT that did not fit or which did not work according to the informant's perceived needs or competence. In such cases, there were expressions that the acquisition of technology did not represent a positive opportunity as a tool to negotiate a positive identity. We see this, for example, when one of the female informants, Anne, talked about the importance of being allocated a red bicycle and the challenge of finding an aesthetically fine design when special functional needs are to be met. Anne shared this response to the question of whether the AAT should have been different in any way: 'I think it should have been a little different; it's green! I would rather have it in red, but the Assistive Technology Centre did not have it in red, so I had to take the green one'.

Aesthetic and symbolic conditions play a role in the use of technology. People with disabilities have a higher risk of conflicts in functionality and aesthetic fine design because of a more limited selection compared to people who can buy off-the-shelf items. Thus, sometimes individual needs are not met, forcing the recipient to accept and use technology that does not fit personal preferences. Use of technology that does not fit the users' expectations might lead to negative cognitions of the technology. The

informants sometimes expressed what we interpreted as hampering the domestication of the technology by describing a 'struggle' with technology that seemed to invade their self-image. The informants who explained that the technology did disrupt their personal needs, competence, or self-image needed to clarify the limit between them and the technology. Informant Dina told how she avoided using her lightweight wheelchair that she needed for taekwondo, straight after she had her diagnosis: 'I did not dare to sit down, because it was so painful to think about sitting in that wheelchair. I would rather drag my hands across the floor, instead of using the wheelchair'. As we interpret this, it was not possible for Dina to incorporate the wheelchair into her daily life because it disrupted her self-image, and she perceived the chair as a symbolic expression of her diagnosis.

The clearest example of how the informants objectified the technology as a symbol to communicate barriers in the domestication process was when informant Ole described that he 'drove his electric wheelchair front to death' because he experienced that the wheelchair front he was allocated was not solid enough for the activities he wanted to do: 'I have broken some screens and such, and I have broken a lot of mirrors because I have overturned with it. I'm not afraid to use it; it's my way of demonstrating'. He used the electric wheelchair front so roughly that it broke, and he expressed that the type of AAT he was allocated did not fit him. By explaining that he drove the wheelchair front, we interpret his aim to show the weak bounds between him and the AAT. Ole went on to say:

*When I drive along the river on the rocks there, then I have to give full throttle for me to get over, and it is hard work for the chair. But I intend to continue with that, you know, until I get what I want [a terrain chair with 4-wheel drive]. Then the Assistive Technology Centre must consider whether they should buy me a terrain chair.*

When the Assistive Technology Centre had the worn wheelchair front repaired, they could interpret it as an expression of poor incorporation of the technology. Here, the worn electric wheelchair front became a symbolic expression of Ole's struggle with domesticating the technology. He needed a more solid type of AAT to fit his preferences. He shared that he worked actively to manipulate the technology by how he used it to make it brake faster. With his actions directed against the technology, he negotiated his dissatisfaction with how the allocation system had misunderstood his personal needs. This example shows that technologies can be used as symbols in interactions and negotiations with the Assistive Technology Centre. The quotation also illustrates that domesticating the technology involves the user's engagement in how the technology use will take place. This finding illuminates how AAT has a strong potential to influence users' self-perceptions and behaviour.

Another example of how AATs may affect a user's self-identity negatively and how they may experience resistance is when Berit talked about first using her massive terrain chair: 'When I started using my chair four years ago, I was very opposed to it at first, because I felt I had become too handicapped'.

The examples above illustrate a disruption in the domestication process of the technology because the AAT was thought to be a negative symbol affecting the informants' expression of identity. Still, the informants generally experienced a transformation of meaning related to the use over time. For some of the informants in the study the domestication process was troublesome. They perceived starting to use the AAT as challenging because using adapted technology could reveal their disability. This was because the disability initially was not visible before the AAT was put to use. At the same time, the AAT could be associated with positive values in society related to exercise, which made it easier to show oneself as disabled. Several of the informants talked about taking the technology in use as overcoming an obstacle where, as we interpret it, they risked assuming a discredited position. In the design of AAT, aesthetic and functional factors play a role in what the technology expresses, how people have the opportunity to act and express themselves and how they are interpreted. All social interactions and negotiations together with the material elements, like the AAT, play a role in how disabled people are understood.

### ***Individual experiences of the body and identity transformation***

This last theme is based on the code group: 'To feel better physically and mentally'. Another pattern of the experience of being disabled found in the data was linked to individual bodily experiences and a changed identity based on new possibilities. When the AAT was domesticated, the informants highlighted how they felt getting into a different position in relation to other people through how others perceived them. The change in position was also an individual cognitive process, in how the informants perceived themselves and reflected on themselves. New things became possible with their physical starting point, and often in close interaction with the AAT. This made the informants perceive their own body in a new and more positive way, through positive feelings, experiencing themselves as stronger and healthier and through inner explorations of sensations. With successful domestication of the AAT, the technology became an incorporated element in how people perceive themselves, acted, and thereby negotiated with other people in their surroundings. This was a transformation process, where the AAT converted bodily achievements and became part of a positive identity, providing motivation for new actions and experiences. An example of this was when informant Janne shared how she experienced using her



Tetra bike: 'The activity gives a feeling of mastery, absolutely. Knowing that I'm going to run again. And that I do not have to think so much. On that Tetra bike, I kind of forget that I have bad balance.'

Several informants experienced that over time they achieved more, their body functioned better, and they became stronger physically. The informants experienced this as positive and in turn it motivated them toward other activities. The perception of bodily change and a more positive identity is illustrated when Ellinor talked about how using an adapted bike provided motivation for other activities:

*I feel so tough with the adjusted bike, so now I have only gotten even tougher. I have started doing the kayak activity again as well. It is not certain I would have done it if I had not started cycling and felt that I can be strong. I do not have to be weak.*

This quotation illustrates the last step in a domestication process, the conversion of the technology, providing experience of bodily strength and mastery. Physical and cognitive changes through domestication of AAT stretches out from one situation and activity to another. This also illuminates how learning to know the body in a new way is a feature of using AAT and that learning by using AAT is about the development of physical strength and physical skills. For the use of AAT, this lesson was about getting to know the body in a new way, in terms of what the body can tolerate and what physical activity entails.

By changing how the informants experienced themselves—when it came to mastering physical skills and how they acted out in their social surroundings—they noticed that it changed how other people perceived them. Furthermore, this also changed the feedback the informants got from other people. Through this circular process of change in the interaction between the AAT, the informants and other people, the findings address the liberating potential of AAT to alter the understanding of disabled people and their bodies. AAT interacts with physical and social conditions. The informants made negotiations through the domestication of the technology to match their individual needs in relation to the social context they were a part of.

## Discussion

This study illuminates how the participants experienced a change in the social interaction with other people when the AAT was domesticated in their everyday life. This domestication of the AAT led to new opportunities to display their preferred individual identity, to participate in valued physical activities, and to negotiate new perceptions of disability. However, when the domestication of the AAT was disrupted, these opportunities were also disrupted. Nevertheless, a successful domestication initiated a transformation

process into an ICript where the participants redesigned and extended their bodies. Thus, they created a cyborg where the boundaries between their bodies and the technology become blurred. The creation of the cyborg provided our participants opportunities to display ability and negotiate a valued perception of disability as one part of ability.

### ***Domesticating assistive activity technology***

Our findings illuminate how the AAT is intertwined in the lives of those who use them, and how using AAT affect both how the users experience themselves and how they experience being perceived by others. When the domestication of AAT is successful the technology provides new or different opportunities for with whom, where and how the users can participate. Using AAT provide our participants with opportunities to participate in socially valued activities and negotiate positive aspects of disability, such as ablement, interests, strength, preferences, and individual style. This is examples of how use of contemporary AAT is not only a personal matter but also a social matter counteracting previous perceptions of AT use as a marker of disability and difference.

Our illumination of how this process of negotiation takes place provide new insights to the discussion of AT as a normalization tool (Grue 2016a), elaborating on how an altered perception of ability and disability takes place. Keeping in mind how cultural understanding of technology affects the perceptions of users of AT and AAT (Seymour 2005; Häggblom Kronlöf 2007) we find it plausible to assume that the technological development in society in general, and particularly contemporary AT and AAT development, plays a vital role in altering society's perceptions of AAT users.

By providing access to physical activities, different arenas, and social interaction, the domestication of AAT has a positive potential for exploring and communicating personal identity and extended bodily abilities. Thus, social interactions change when AAT is successfully domesticated. This change leads to new negotiations and new understandings of disability. Our findings shows that this exceed previous limits for understanding disability, such as disabled people being in a position as ill or weak, or without the same interests as non-disabled people. This change in interaction and negotiation illustrates the dynamic aspect in the understanding of disability, and how the understanding of disability is constructed depending on what opportunities people with disabilities are given to express themselves through social interaction. By providing access to physical activities at different arenas the domestication of AAT provides a break with traditional ways of understanding disability.

However, when this domestication of AAT is hampered, our findings turned out somewhat different. A hampered domestication occurs when the

technology does not fit the user. The mismatch may be due to aesthesis, to function or to solidity. The study illuminates how this may lead to users showing agency through technology avoidance, manipulation or even deliberately wear out technology that does not match their personal needs and preferences. This rejection of unsuitable technology is in line with previous research (Ravneberg and Söderström 2017; Shinohara and Wobbrock 2016; Scherer, Craddock, and Mackeogh 2011; Pedersen, Söderström, and Kermit 2019b).

### *Are we humans or are we cyborgs?*

All humans exist as bodies in some kind of action, and our actions are guided by meaning (Merleau-Ponty 1994). Meaning creation occurs in our social environment and through our social negotiations. Through the domestication of AAT people with disabilities get the possibility to act differently than without this technology. They get the possibility to participate in vigorous activities where the limits between the actions of the body and the actions of the technology are blurred. In these settings disability displays itself in a blurred landscape of acting bodies, technology and social interactions. Thus, disability becomes a feature of a complex cyborg, created through the interconnectedness between humans, technology and negotiated meanings of disability. This interconnectedness extends how disability is understood.

Nevertheless, our findings also reveal experiences through use of AAT that are body-specific (Hangaard Rasmussen 1996; Merleau-Ponty 1994). These are experiences about extending bodily capabilities. They are about bodily extension, strengths and possibilities, which provides new experiences as human beings, and goes far beyond merely compensation for bodily impairments. The human body is the starting point and the edge of humans' sensations and explorations of the world (Merleau-Ponty 1994; Hangaard Rasmussen 1996). Domesticating AAT involves a close interaction between technology and the body, making the users of AAT cyborgs with blurred distinctions between body, technology and activity. Being a cyborg provides people with impairments access to bodily extension, engagement, participation, and to express and unfold themselves.

Using this cyborg metaphor in understanding and disability is an intertwined interpretation of human bodies, technology and activity as a total gestalt that cannot be separated into different parts or separate meanings or experiences. This complex gestalt is also what makes ability and disability. We find that the cyborg provides an important input in disability research. A relational understanding of disability inevitably involves negotiations of bodies, materials, and social aspects, where technology plays an increasingly important part in contemporary social interactions.

### ***Implications of the findings***

The findings illustrate that the understanding of disability is constructed, and that the interaction between humans, environments and technology contribute to a construction of a cyborg. This has implications for the field of practice, for policy makers and for the field of disability studies. To really grasp this construction, it requires striving for an insider-perspective. This means that we need to listen to disabled people's experiences of function, interaction and disability when being allocated and using technology. This implies an exploratory attitude from both researchers and practitioners in the disability field.

For the practice field, such a constructionist understanding implies developing criteria with an increased focus on individual preferences and social factors when assessing needs and evaluating use of AAT. For policy makers the support of such an individual tailored allocation service will provide new opportunities for positive social interactions and constructions that enable disabled people.

Implications for the field of disability studies is that the interaction between people, technology and environment should be in the researchers' lens when function and/or disability is studied. A constructed understanding of disability involves a radical break from a medical focus to studies of dynamic and contextual interactions that contributes to the construction of disability.

### **Strengths and limitations**

The study was conducted in central Norway and may therefore be related to local variation at the Assistive Technology Centres and in the users' experiences. The study consisted of significantly more men than women, which is a challenge in transferring the findings to both sexes. Furthermore, it is a challenge that findings concerning the views of non-disabled people are based only on disabled people's experiences of changing feedback from non-disabled people. Cultural conditions can also affect the transferability of the findings, and a study conducted in Norway cannot without reservation be said to be relevant in other countries. At the same time, the findings do not differ from the research on the use of AAT, or AT in general. This gives reason to assume that the findings have transferability and value to other conditions in practice and within the field of research on disability and the use of AT.

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