Designing visibility
A designer’s approach to assistive technology and devices

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ABSTRACT
Research regarding assistive technology has traditionally focused on functionality and usability, and the design approach has been mainly discretion, often trying to hide the device. Abandonment and non-use among people with disabilities is a documented problem. Newer research addresses to a greater extent the emotional aspects related to assistive devices such as stigmatization and dissatisfaction. An approach often embraced is to make the assistive technology more “mainstream”, aiming to make it more socially acceptable.

This paper explores the new design approaches, after first examining assistive technology and stigmatization related to it. Following the introduction section two will define main terms. Section three discusses concepts of AT. Mainstreaming is found to possibly be a good approach in many cases. However, mainstreaming is a relatively vague term and successful mainstreaming depends on many factors as section four elaborates. The paper concludes that the designer should not be bound to making the device “mainstream”, but also be aware of other approaches to the issues of stigma. For example, manipulating the device’s physical visibility of can be of value. The paper also introduces a widened interpretation of the term assistive devices, divided into enhancing assistive devices (EAD) and restorative assistive devices (RAD). It would be interesting to study how the designer can use this in the design process.

KEYWORDS: Assistive technology, assistive devices, design, stigmatization, inclusive and universal design, human factors, visibility

1. INTRODUCTION
Design of assistive technology (AT) is a sensitive field. It provides the developers with complex design challenges as functionality, usability and emotional aspects become so important. However, assistive technology (AT) has traditionally had a functionality and usability focus, as the criteria have been very oriented towards task and problem solving. As seen in the history of hearing aids (Washington University School of Medicine 2012), there has also been an apparent consensus that AT should appear as discreet as possible, trying to hide any impairment or disability.

Unfortunately, many people in need of assistive products or devices (AD) choose to not use them (Mann et al. 2002; Smith & Kent 2006), due to perceived stigma and negative associations and experiences with AD. This makes it clear that other aspects are just as, or in some cases even more, important than functionality. New ways of thinking about these products have appeared, and an increasing, yet today still insufficient,
amount of research has been carried out, suggesting new approaches for design of ADs.

This article explores these new approaches by firstly investigating aspects of what makes an AT product stigmatizing or not, in which context and for which user, and secondly suggesting further approaches.

1.1 Background

The background of this article relates to my interest in the apparently common absence of focus on the aesthetics of assistive devices, giving such products a certain institutional or medical look, even when used in private and public settings. The article by Næss and Øritsland (2009), suggesting a relatively new approach to designing Ads, caught my attention and inspired me to get an overview of the field and to investigate what approaches a designer could use to create ADs that give the user a satisfactory experience.

1.2 Method

This article is based on an integrative literature review, i.e. it summarizes and analyzes literature of a specific field (Torraco 2005). The review is based on literature searches done mainly in the database Scopus and in Google Scholar. Search words used (table 1) have mostly been chosen aiming at newer design approaches to assistive technology products. Emotional aspects related to the design of the ADs, such as stigma related to AT, are important motives for these new approaches, and literature about stigma and AT has also been used. These design approaches are mainly of a relatively newer date, and because of this most of the literature is from the last decade (2000-2012). However, important older sources have been found by looking through citations.

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Table 1: Search words used in various combinations in literature search.

A lot of literature was found on design of AT, usage of AT, stigma related to AT, design of medical devices, robots and smart house technology. I have chosen to focus on articles covering AT design and/or stigma related to AT in general, as my main concern was to investigate how a designer can reduce stigma associated with AT. Medical devices, robots and smart house technology can be seen as types of AT and probably sources to stigmatization as well. However, to narrow my scope and because this was where I imagined the problems of stigma would be the clearest, I focused on the more general AT that is worn and used more or less all the time, also outside the home, and in public spaces. Some articles focusing on more specific topics such as hearing aids were chosen, but I mainly wanted a holistic overview of the field. The field is mainly viewed from a western cultural perspective.

Articles covering AT design and stigma were read in full, while articles outside the main focus, though contributing with what I considered interesting perspectives, were read to get the main points (abstracts and conclusions).

Literature from designers’ perspective and from health workers’ and other perspectives was included, to get a holistic overview. Reviews of the topic and more original articles have been used.

The book “Design meets disability” by Pullin (2009) was analyzed, as it is an interesting contribution to this field of design.
2. ASSISTIVE TECHNOLOGY AND DEVICES

In order to know how to design something, it is essential to know the field one is designing for. In this section I will study the nature of AT and ADs. I look at various definitions of the terms, and at some of the aspects that make this an especially challenging design field with regard to human factors.

2.1 Definition of AT and ADs

Assistive technology (AT) has existed as long as human beings have created objects to aid them in various tasks. However, today in the western world AT is mainly associated with software, services and assistive devices (AD), all products that help people with some sort of impairment in the performance of various everyday tasks otherwise made difficult by their disability(ies).

A frequently cited definition of AT is from the 1988 passage of Public Law 10-407 (USA), “The Technology-Related Assistance Act for Individuals with Disabilities”. AT devices are here defined as “any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities”.

This definition relates mainly to the terms ‘impairment’ and ‘disability’, and the differences between them, which are discussed in the following.

Disability is defined by the International Classification of Functioning, Disability and Health as “a negative state when an impairment, activity limitation or participation restriction exists, preventing execution of a specific task or action” (Ripat & Woodgate, 2011, p. 88). Impairment is here interpreted as an individual source of disability. Impairment can further be explained as “an injury, illness, or congenital condition that causes or is likely to cause a loss or difference of physiological or psychological function” (University of Leeds 2012)

This perspective is coherent with Pape, Kim and Weiner (2002, p. 5) who claim that “Impairment and illness can result in functional limitations that, when combined with environmental barriers and personal factors, reduce participation in home and community activities”.

Ripat and Woodgate (2011) present a definition from “a social model of disability perspective”. Here “disability resides outside of an individual and is a result of oppressive societal practices and environments that create disabling conditions” (Ripat and Woodgate, 2011, p. 88). One difference between these definitions is in the source of the disability, respectively both the individual and society, or the society alone.

Within the social perspective the motive of AT can be seen as a part of modifying society and aid the user in overcoming barriers, and thus remove such barriers. The disability is here mostly caused by the situation. This is of course true, as the user may not always perceive himself disabled. A disability related to impairment is also dependent on context. For example, a person with impaired hearing may not experience disability while reading a book, while communicating with others might make him feel disabled. Pullin (2009, p. 91) draws this even further, suggesting that we might all perceive or experience our self as disabled in certain situations: “If we already have our hands full, our ability to carry out a task demanding dexterity is affected”. On the other hand, the international definition opens up for AT also taking on a restorative purpose, where it is not only about removing barriers, but also about reducing the effect of the impairment.

The ideological discussion of these approaches is important in relation to the change of acceptance and attitudes towards disability in society. However, for a designer a holistic approach should always be embraced. This makes it important to acknowledge disability as being caused by both impairment and by barriers created by society.
3. THE EMOTIONAL ASPECTS

As we more or less know what AT is, just as important is it to know which factors and aspects affect its use. As mentioned earlier, functionality and usability are essential aspects that a designer has to consider when developing assistive products. However, this article focuses on the emotions and affections related to AT. This chapter addresses these issues, by first looking at whom we design for and what their expectations are. Then the term of stigma related to AT is analyzed, as one of the main issues that have triggered new design approaches in inclusive design and given birth to Design for social acceptance (Shinohara and Wobbrock 2011).

3.1 Who are the “users”

The terminology in the field of AT is a potential mine field of political correctness and can be a stigmatizing factor in itself. This article does not deal with this issue, and uses the terms most frequently used in the literature related to the field. As Pullin (2009) points out, the word ‘user’ can be a misguiding word, especially for the designer, as it implicates that an AD is only used. He emphasizes that an AD is not necessarily only used, it is also normally owned, worn and carried, with all the various ways in which this affects the person and people around. In a user centered design process one could argue that the term “use” covers all these aspects. However, it becomes especially important to be aware of the many types of use other than its strictly functional sense, when designing an AD, as the emotional aspects are not only related to the function of the AD (Næss and Øritsland 2009). In this article, however, people using, wearing, owning and carrying ADs are all referred to as ‘users’, as this is the term normally used in literature.

Developing AT challenges the designer with aspects that are not necessarily an issue in regular product design. The potential user groups are many and varied, and often consist of heterogeneous populations (Ripat and Woodgate 2011), as an impairment is not necessarily dependent on cultural background. As a result, in a group of people with the same impairment or disability, the users may come from very different cultures, and have different sets of beliefs, values and behaviors regarding disability and AT. “Individuals (...) who identify with a minority or ethnic group may hold differing viewpoints on the meaning of disability, and the value of AT, than those in mainstream society” (Ripat and Woodgate, 2011, p. 5).

3.2 AT and stigma

Stigma
Stigma is something probably all of us have experienced in some degree at some time. Crocker, Major, and Steele (1998, p. 504) define stigma in this way: “the possession of, or belief that one possesses, some attribute or characteristic that conveys a social identity that is devalued in a particular social context”. They further elaborate on this, explaining that “a person who is stigmatized is a person whose social identity, or membership in some social category, calls into question his or her humanity— the person is devalued, spoiled, or flawed in the eyes of others” (Crocker, Major & Steele 1998, p. 504).

Stigma can have various effects on us. Parette and Scherer (2004, p. 217) summarize, referring to various articles, some of the effects that stigmatization of people with developmental disabilities can have: “(a) less than ideal treatment; (b) disrupted social relations; (c) person avoidance, anxiety, and depression; and (d) a distorted self-image and resulting poor self-esteem”. This also goes for people who acquire some sort of disability during life.

Abandonment of AT
The abandonment, non-use or avoiding/postponing acquisition of a beneficial AD is a documented problem (Mann et al., 2002; Pape, Kim & Weiner, 2002). The reasons are many. According to Scherer (2002) the most important
reason is lack of consumer involvement in the selection process of the device, while according to (Mann et al. 2002) the most important reason is the user’s perceived lack of need. These reasons do not necessarily contradict each other, but may be related. Omitting to include the end user in the selection process of the AD might lead to the device given not covering the user’s actual needs. As a person will select AD as any consumer selects a product, according to characteristics that satisfy their preferences (Parette and Scherer 2004), it is important that the person is presented with choices.

In some cases, stigma can be the most important factor leading to product abandonment, non-use or avoiding/postponing acquiring a beneficial AD (Mann et al. 2002). This can happen if negative affections and emotions of stigma and unwanted attention weigh more heavily than the functional benefits provided by the AD. One can imagine that this is particularly the case for people who acquire impairment later in life, as they may already be emotionally affected in the process of trying to accept and adapt to their impairment.

**AT’s effect on stigma**

So in what way may an AT affect a person’s feeling of being stigmatized? Smith and Kent (2006, p. 473) claim that “inherent in stigmatization is a perception of normality and, by implication, the risk of being identified as not normal”. Thus any AT that contributes to the user’s feeling of not being normal may make the user feel stigmatized. Parette and Scherer (2004, p. 219) add to this: “Levels of comfort with use, even around family members, vary widely depending on how “unusual” an AT appears. Feelings of being conspicuous leave many users feeling deviant and stigmatized”.

In ‘AT use and stigma’, Parette and Scherer (2004, pp. 218-219) list some specific areas that may contribute to stigmatization, such as “device aesthetics and cosmesis, gender and age appropriateness, social acceptability”. All these aspects can be related to or reinforced by the use of assistive products.

Shinohara and Wobbrock (2011) explored the question of why persons using AT feel stigmatized, interviewing 20 people with various impairments (hearing, sight, muscular) about their use of AT. The reluctance towards using AT was mainly based on the added negative and unwanted attention it brought to their impairment. Shinohara and Wobbrock (2011) claim that this negative attention mainly takes form in two misperceptions: 1) That the use of an AD means that the user is not able to use an equivalent “normal” or “mainstream” device, and 2) that the user would be helpless without the AD. As we see, these misperceptions both depend on whether the people around notice the AD or not. This does not necessarily mean that it depends on the presence or usage of an AD.

The authors further emphasize that these perspectives describe how the impaired perceive the observers’/peers’ attitudes towards their use of AT. According to Gagné, Southall and Jennings (2011, p. 16), users might “hold (consciously or not) the same prejudicial views about their stigmatizing condition as do the outsiders”. It is also a question of whether the user’s self-stigma actually corresponds with the observers’ perceptions, and so if the user is a realistic judge of the perceptions of the observers.

It seems that the use or presence of an AD might lead to increased attention to a person’s impairment or disability. This, however, is given that people around notice it. In many cases the AD might be the only factor revealing a person’s disability, such as with hearing aids. However, for many people the added attention to or awareness of their disability among other people may be experienced as constructive and positive (Smith & Kent, 2006), leading to positive social interactions in forms of discussions, relations and awareness. At the same time, other AD users may experience the added attention as negative and unwanted, in some cases leading to stigmatization and the feeling of being labeled as “not normal”.

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It is highly probable that the person’s perception of this added attention and its nature is affected by a number of factors, such as the appearance and aesthetics of the AD as mentioned by Parette and Scherer (2004), and the context in which it is used. Globalization and the increasing multiculturality of many nations, challenge the designer with users with potentially very different values, beliefs and perceptions of AT and disability.

People may also accept various levels of attention towards their disability depending on the context, and this might call for AD’s with different levels of noticeability.

Summarizing, stigma related to AD is mainly a social issue, and is due to ultimately feeling “unusual” in a negative way or being labeled as “unusual” with negative intentions. Thus an “unusual” AD might contribute to stigmatization. So how can a designer meet these challenges in the light of the multitude of user needs and various emotional aspects?

4. DESIGNING ASSISTIVE DEVICES

Traditionally the design of ADs has been highly focused on functionality and usability. This is natural, as the devices normally are created to aid or help the user to accomplish some kind of task, and it would be meaningless if the device did not function well. However, as it is evident that many people do not use their devices, it is clear that other aspects are just as, or in some cases even more, important than functionality. Newer research addresses the emotional aspects related to AT, and what role the design, including appearance and aesthetics, plays.

Following is a review of the main approaches to AT design which address emotions and satisfaction and avoiding stigma as equally important issues as functionality and usability in the design of AT.

4.1 A tradition of discretion

Together with the traditional focus on functionality and usability, the main approach to the aesthetics and appearance of the ADs (when focus on these aspects has not been totally absent) has been attempting to create discreet products that do not attract attention. This becomes evident in traditional hearing aids, colored in skin tones to become “invisible” in the ear. Despite the intent to hide them, they are often noticeable. As Pullin (2009) points out, this intended hiding may eventually increase the stigma, as it implicates that impairment or disability is something shameful that one should hide. Furthermore it may also “mystify” both the AD and thus the impairment and disability, as it distances the ADs from more familiar products.

4.2 Inclusive and universal design

The most common approaches related to AT design are inclusive and universal design. Inclusive design is said to have its origin in “barrier free design” (Næss and Øritsland, 2009), though this approach is mostly about arranging and facilitating mobility for disabled in both the private and public environment. After WWII it was found that though improved technology and skills in the field of rehabilitation made life easier for many people, the surroundings were not suited for disabled people. The environment was modified with solutions specially adapted for the disabled. However, the alternative solutions excluded the disabled from the “normal” solutions, and thus became a source of stigmatization.

As the design field developed, various guidelines and models were created. The seven principles of universal design from 1997 (by Ronald Mace at the North Carolina State University) are popular guidelines. However, these focus almost exclusively on usability and functionality, except the first: “Equitable use”. This is explained as “avoiding segregating and stigmatizing any users”, as well as making the design “appealing to all users” (College of Design at North Carolina
State University, 2010). However, the principles give no advice as to how this can be achieved. After “inclusive design” was introduced and by many seen as a more fitting and favorable term (Næss & Øritsland, 2009), inclusive and universal design are often used interchangeably. However, this article will continue to use the term inclusive design, as this is the term mainly used in the literature studied.

The overall aim of inclusive design is to target and make the product usable by as many users as possible. Næss and Øritsland (2009) present three different approaches to inclusive design, “one market oriented, one concerning social participation and avoidance of stigma and one that emphasizes the right for disabled to live “normal” lives”. The motive may equally well be a mix of these approaches.

The design process is often based on Benktzon’s capability pyramid model (Benktzon, 1993) with “severely disabled people” at the top (figure 1). One either designs for the top of the pyramid, trying to include as many users as possible downwards (top-down), or the other way around. Seeing the pyramid as a representation of the size of the target group, it is not difficult to imagine that with a market oriented approach designing from bottom-up would normally be more profitable. However, with this approach it is difficult to reach the top of the pyramid, resulting in fewer usable products for these users.

4.3 Design against stigma

As the emotional aspects have gotten more attention, new ways of approaching design of AT have appeared. These focus mainly on making the AT more “mainstream” (Pullin, 2009; Næss and Øritsland, 2009;) and “socially acceptable” (Shinohara & Wobbrock, 2011). Shinohara and Wobbrock (2011) suggest a new approach within the design of AT: “Design for social acceptance” (DSA). They explain DSA as an approach “considering not only functionality and usability, but perception, misperception, stigma, affect, and aesthetics to maximize a device’s social acceptability” (Shinohara & Wobbrock, 2011, p. 713). They embrace making AT more mainstream as a good approach to achieve social acceptance for AT.

So what makes a product mainstream? Pullin (2009) refers to glasses as a perfect example of an AD gone mainstream. In the 1930s glasses were prescribed as a medical device and the users were often stigmatized (Pullin, 2009). This has significantly changed, and today glasses are not only socially accepted, but by many regarded as a fashion accessory and bought and worn even without magnification.

Pullin (2009) stresses fashion as an interesting and possibly fruitful way to go to make an AD
more socially accepted. He refers to Aimee Mullins with her prosthetic legs as a good example regarding AD and fashion. Mullins has appeared on the cover of fashion magazines (figure 2) and works as a model, rather “highlighting” her prosthetics than hiding them. In the case of glasses, these have also been “promoted” by various contemporary idols during the process of mainstreaming (for example John Lennon). “Promoting” ADs through celebrities may be one ingredient in trying to mainstream an AD.

![Figure 2: Amy Mullins on the covers of the magazines I.D. and Dazed.](Image)

Correia de Barros, Duarte and Cruz (2011) add to this approach by experimenting with the way the ADs are presented in the selection/decision phase. Based on their findings, they suggest that by presenting the ADs in a mainstream context, such as in a kitchenware catalogue rather than an AT catalogue, the customer perceives the product in a more positive way. It appears that the presentation of a product might contribute to making it more mainstream.

Looking at the user disability pyramid (figure 1), we can surely place most sight impairments in the lower part of the pyramid, as “minor impairments”. As the mainstream market can be located in the bottom of the pyramid (Naess & Øritsland, 2009), glasses as an AD are very close to this field. So is one of the reasons that glasses were possible to “mainstream”, the fact that there is such a potentially big market?

As exemplified with the bottom-up process of inclusive design, one understands that certain ADs are being designed for markets with less spending power, due to both the size of the target group and in some cases the life situation. This can lead to design processes with less resources available, thus resulting in the use of cheaper components, materials and production methods. However, Wang et al. (2009) present a somewhat different view. They claim that today the AD design processes are often highly focused on customization, resulting in expensive products that are available to only a small group of people. To make the process more efficient in terms of money, time and size of target group, they suggest a more standardization-focused process. This goes against the DSA approach as it deemphasizes the human factor perspective. At the same time it supports it by aiming to include more users for each product, presuming these are “mainstream” users.

Few literature sources address the content of the design process regarding emotional aspects for AT. Naess and Øritsland (2009) do this by presenting a design approach focusing on affordances (possibilities of use) and analogies. By finding existing mainstream products with affordances equivalent to the ones needed for the AD, one could use this instead of a specialized AD. This is exemplified with the use of walking poles instead of a regular cane for old people, changing the peers’ perception of the user from “old and fragile” with the cane, to “old and sporty” with the poles. If a fitting analogy is not found for the AD in question, a “styling approach” is suggested. The intention is to “design for life style rather than disability”, as this may be more satisfactory for the user.

As stigma is highly related to the unusualness of an AD, making the AD “mainstream” would seem to be a good approach. However, many factors contribute to making an AD appear unusual. As mentioned earlier, one of these is age appropriateness. This relates to both the impairment itself (impaired sight is more common among older people), and the related
AD (glasses are more common among older people). It is possible that many of the issues that make an AD stigmatizing, are the same issues that must be addressed to make an AD mainstream. Based on the findings in this chapter, some of these include:

- Age appropriateness.
- What product category it is presented as to the consumers.
- The size of the potential market.
- Available resources in the developing process.
- “Promotion” of the AD.
- Cultural aspects.

It is also tempting to add “functional similarity to existing mainstream products” to this list, based on the suggestions from Næss and Øritsland (2009). However, this is also a question of context and appearance, as will be addressed in the following chapter.

5. DISCUSSION

5.1 Why mainstreaming?

‘Mainstream’ is in many dictionaries synonymous to ‘normal’. Thus a mainstream AD will not contribute to making the user seem “not normal”, and this will prevent stigma. Making the ADs more like “normal” consumer products may also contribute to making the disability more socially accepted (Shinohara & Wobbrock, 2011).

As many ADs higher up in the pyramid are used by a small number of people, people around will not be familiar with the ADs unless it is a product that is also available in already existing mainstream markets. This may make it difficult to ‘mainstream’. Even though an existing mainstream product is found, the context of use may nevertheless make it seem not normal. For example, an old person can use walking poles outside and thus seem sporty instead of frail. However, using walking poles inside a house is not ‘normal’, and it is a question what will be more stigmatizing; using a cane inside or the walking poles?

It is also interesting to note that though glasses have become a fashion accessory many people do prefer eye lenses, or do not want glasses at all. Furthermore, not everyone necessarily considers ‘mainstream’ positively. Various subcultures, for example hipsters and punkers, dislike mainstream, and want to distinguish themselves from ‘normal society’.

In the mainstream market the consumer can normally choose whatever product suits his or her lifestyle and needs. Maybe this is a characteristic of mainstream products that should be adopted and emphasized in design of AD. Findings in this article do show that AD consumers have many different needs, and to be able to find an AD that suits one’s individual needs is important. This can be achieved by user customizable products, or through offering a range of different products.

5.2 Widening the term of AD (sensory AT)

As with universal and inclusive design, a goal might be to make an AD valuable also to people without any disability. The more people who use the product, the more “normal” it becomes. To give the product value for users without a disability, it should also hold attributes/characteristics that are valuable to a person without a disability. For example, if a hearing aid makes you hear better than normal, or makes it possible to listen to music and at the same time hear people around you, this might make it interesting also for people without impaired hearing.

A common definition of AT such as the one in “The Technology-Related Assistance Act for Individuals with Disabilities” (section 2.1) is beneficial in a social and public perspective as it makes relatively clear what we are talking about. However, from a designer’s perspective, generally embracing a more holistic approach, it is tempting to widen the term AT to account for all devices that in some way aid human beings in performing some kind of task, regardless of whether they are disabled or not.
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With this somewhat extended definition, a substantial part of the products we create become assistive devices. However, a difference can then be found in the goal of the device and the way it aids us in performing an activity or task. The ADs covered by the official definition can be said to have a restorative (or compensating) function, as they generally are aimed to aid the user in coping with disabilities related to impairment, physical or mental. This article suggests that these devices be addressed as ‘restorative assistive devices’ (RAD).

On the other hand, the article will name as ‘enhancing assistive devices’ (EAD) devices that in some way further enhance a human body function and/or the performance of an activity, physical or mental, compared to a “normally functioning” state.

In table 2, this is exemplified with various products affecting the function of sight. If someone has poor eyesight, glasses or lenses are used in an attempt to compensate or restore the function of sight. Thus glasses and lenses are examples of RADs. Microscopes and binoculars on the other hand, are designed to enhance our eyesight, so they are examples of EADs. Sunglasses are basically EADs, as they have a protective function that enhances the eyes’ tolerance of strong light. However, sunglasses with magnification will both have a restorative and an enhancing function, thus making them both an EAD and an RAD.

Table 2: Widening the term “assistive devices” to count for RADs and EADs.
I have not seen this distinction addressed in any literature I have found so far. I found the distinction quite helpful in analyzing the various aspects of AD design. A simple product like a potato peeler may serve as an example of this distinction. The OXO peeler (figure 3) was given a handle specifically designed with motorically impaired people in mind. However, the peeler also became popular among people without impairments as it turned out that the new handle was an improvement for all users. This potato peeler has restorative as well as enhancing attributes. Its enhancing attribute lies in its value as a tool for peeling vegetables more effectively than with just using the hand. This “enhancement” of the hand’s “normal” function, makes the peeler a valuable device for all people who need to peel something. However, this particular peeler distinguishes itself from other peelers in its good ergonomics, providing motorically impaired people with an improved grip that makes it easier to handle the peeler. Thus, the peeler’s restorative attributes lie in its good ergonomics. The OXO peeler is a good example of inclusive bottom-up design, making a mainstream product available to users higher in the user-disability-pyramid.

The transition from a product being solely an RAD to also have enhancing attributes is very interesting. Prosthetic products show this very well. A prosthetic leg may aim solely at restoring the functions of the leg, making the wearer able to move around just as before. However, many prosthetics also provide the wearer with new or enhanced functions. This becomes especially apparent in sports, where the prosthetics can improve performance, for example by making a sprinter run faster than a sprinter without the prosthetics, or a basketball player jump higher than what is possible on normal human legs due to suspension in the prosthetics.

Can one approach to inclusive design be that the product should hold both restorative and enhancing attributes, thus making it valuable also to people who are not disabled? If this leads to more people using the product, it might reduce the stigma associated with it. Of course, this might be difficult to achieve in many cases. The restorative attributes may be annoying if one does not need them, and it might also be difficult to combine enhancing and restorative attributes in a comprehensive way.

5.3 Hidden or not

It seems that an important aspect regarding AD and stigma is visibility. Not necessarily the physical visibility of the AD itself, but the attention it draws to the impairment or disability. As we have seen, “mainstreaming” may be a way of reducing the noticeability of the AD and thus of the disability. However, mainstreaming is not the only way to make a product less noticeable. Also, it might not always lead to the best solution, and the designer should keep this in mind. Findings earlier in this article show that it is important for the designer to know for whom she/he is designing and have good insights in contextual, social and cultural aspects of the intended use, as in any regular user-centered or human centered design process.

Mainstreaming a product can thus be a way of more or less “hiding” a product in plain sight. Other ways of making an AT product less noticeable is making it invisible in use or camouflaging it as, or in, another product. These approaches are rarely mentioned in the literature studied in this article, maybe because this is
more in accordance with the traditional discreet approach towards AT design. However, although these are approaches similar to the traditional approaches of discretion, they should not be dismissed. Based on the findings earlier in this article, some reasons for this can be:

- A multicultural society might bring other cultures with a more tense relationship towards disability and AT.
- Not everyone is as strong mentally as Aimee Mullins, for example adolescents. People acquiring impairments later in life might need time to get used to it.
- “Out of sight, out of mind”. Invisibility might move the thought away from the disability/impairment.

As the goal often seems to be to reduce the noticeability of the AD, it might prove useful to know how the physical visibility of the product affects this. Considering the physical visibility of a product, this article divides visibility into four different levels, as presented in table 3.

The following examples illustrate how these levels of visibility may apply to ADs:

**Signaling: white cane**
In some contexts it might be advantageous to make people aware of one’s disability, thus avoiding potential misunderstandings and barriers. The AD might contribute to this, either through appearance or use, by having signaling characteristics that communicate and are clearly noticed by people around. The white cane does this, both through use and appearance, as people quickly understand that the user is blind, and can take precautions if necessary.

**Visible: traditional asthma inhaler**
If the user does not have any problems with stigmatizing, there is not necessarily any reason to make it less or more visible. A traditional asthma inhaler is normally only present when used. It is also difficult to hide, due to the nature of its use, and thus the best option might be to neither hide it nor making it signaling.

<table>
<thead>
<tr>
<th>SHOWING</th>
<th>HIDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Signaling</strong></td>
<td>3. <strong>Camouflage</strong></td>
</tr>
<tr>
<td>A product that is supposed to draw attention, as the user wants to communicate something with people around.</td>
<td>The product is either designed to look like another product, or it is integrated in another product.</td>
</tr>
<tr>
<td>2. <strong>Visible</strong></td>
<td>4. <strong>Invisible</strong></td>
</tr>
<tr>
<td>The product does not try to stand out, but neither tries to hide.</td>
<td>The product is not noticeable at all by people around.</td>
</tr>
</tbody>
</table>

Table 3: Four levels of visibility.

**Camouflage: safety alarm**
A person who is starting to develop dementia may need a safety alarm. Because the person does not want other people to know that she/he has dementia (especially for middle-aged or young persons), a camouflaged safety alarm, for example designed as a necklace or integrated in a watch, could solve this issue.

**Invisible: hearing aids**
Some people with impaired hearing, for example adolescents, might be afraid of being stigmatized. Having the option to choose hearing aids that are truly invisible in use might be a valuable opportunity.

These are only examples of the various levels of visibility. Letting the user customize the level of visibility through different “visibility modes” for various contexts may be useful.

6. **CONCLUSIONS**

Through literature study of AT and AD definitions and stigma related to its use, it seems that an AD contributing to stigmatizing is an AD that attracts unwanted and negative attention to a person’s impairment or disability, thus leading to stigmatization.

The new approaches within design of AT mainly embrace the idea of making AT and AD more mainstream. This can be a means to either
reduce the noticeability of the AD, or to create positive attention, thus counteracting stigmatization and increasing social acceptance. However, few suggestions and guidelines for how to make AT and ADs more mainstream have been found in the literature studied for this article. There is also a lack of research as to what characterizes, and how design can contribute to, “mainstream AT and AD”.

Moreover, some aspects found in literature regarding stigma and cultural aspects of AT, indicate that the designer should not wholly exclude other approaches than mainstreaming to reduce the noticeability of the AD. These aspects include

- Multiculturalism
- Consumers’ need of choices
- Different needs and wants
- Contextual aspects
- “Out of sight, out of mind”
- Available resources

Other approaches to reducing the noticeability might be to hide the device through camouflage, integration in other products or make it truly invisible in use. This paper divides the visibility of the product into four levels:

1. Signaling
2. Visible
3. Camouflaged
4. Invisible

Furthermore, this paper also suggests that an extended interpretation of ADs can be beneficial to the designer. By widening the definition of AD to count for “all devices that in some way aid human beings in various tasks”, this, in combination with the four levels of visibility, could broaden the solution space and hopefully add to the creativity of the designer. Following from this interpretation, the paper suggests dividing ADs into two categories, “restorative assistive devices (RAD)” and “enhancing assistive devices (EAD)”. Most of the devices traditionally defined as ADs can be labeled “restorative assistive devices” (RAD), as the purpose of these are to compensate for or restore some kind of impairment, physically or mentally. “Enhancing assistive devices” (EAD) are devices that improve or enhance some kind of physical or mental body function from a “normal functioning” state.

Incorporating both restorative and enhancing attributes in an AD might give it value to people without impairment. Thus it might be a means to include more users, and eventually also to “mainstream” the AD.

<table>
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<tr>
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<tr>
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<td>RAD</td>
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<td>EAD</td>
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Table 4: Combination of RAD/EAD and the visibility levels.

### 7. FURTHER WORK

Literature provides many arguments for mainstreaming AT as a good approach to attain social acceptance and thus reducing stigma related to use of AT. However, several questions arise that have yet to be addressed properly. What characterizes a “mainstream product” and how can this label apply to an AD?

According to the aspects above and the visibility categories, designers should choose an appropriate strategy rather than limit themselves to a (mainstream) dogma. The widened interpretation of ADs, including RADs and EADs, and the levels of visibility, are first suggestions from this paper. Ongoing research further explores these aspects and looks at how they can be applied in design practice. A combination of the aspects, for example as suggested in table 4,
might be a beneficial way to go. Just as important as exploring these aspects, is acquiring more knowledge about them and preferably a method for how to choose the appropriate strategy. A starting point for this could be the list of aspects regarding stigma and cultural aspects of AT.

There is much work to be done, in design research as well as in design practice and last but not least in societies, understanding and recognizing what impairment is and what role it plays in the lives of the people who are confronted with it, which we all might be sooner or later.
REFERENCES


