Disabilities and handicaps: Their implications on context and design in HCI

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ABSTRACT
A disability is not a problem in itself. The problem occurs when the context turns the disability into a handicap. There is a UN declaration regarding accessibility for disabled people. In order to achieve a society where everyone can use important artifacts without handicaps – a new awareness of disabilities and their role in context and design has to be achieved.

This paper describes how the use of activity theory and active design strategies can provide us with tools for creating artifacts that can be used by everyone. It discusses two different approaches to disabilities in context and the implications on design. This paper is not a ready-to-use guide for designing artifacts for everyone, it is foremost a definition of the problems that apply.

Author Keywords
Context, disabilities, handicaps, HCI, design, activity theory

INTRODUCTION
Context is a word that is used widely in a lot of different topics. It also has an everyday use, such as the expression "out of context" where it often is interpreted as *scope*. In HCI science, context has a similar meaning, though it is not crystal clear what it actually means. There are several approaches to discussing context and each one of them also bears a definition of the word itself. What most people agree on is that context is not just the scope which is studied right now. It is also where this scope is situated and how it relates to other scopes or other parts of reality (Winograd, 2001).

There are a number of potent theories regarding context. Three of them are discussed by Nardi (1996) in her paper about context and activity theory. These are *activity theory*, *distributed cognition* and *situated action theory*. They all represent quite different views on context. Other researchers discuss other theories. There seem to be no generally accepted theory for context (Winograd, 2001). My aim with this paper is not to find the perfect theory. I am more interested in discussing context in relation to disabilities. Therefore I will use the theories which include my subject or let me discuss it thoroughly. From that point of view, context has to include issues where disabilities may be acknowledged.

At a quick glance, disabilities are much easier to define than context, but when looking at it more closely, it is obvious that this is also hard to state exactly. The meaning of the word disability is a lack of ability to do something and so far most people agree. Where people have different opinions is when deciding what lack of ability should be considered a disability. When asking people, it soon becomes clear that this depends on cultural and ethnological factors as well as technical and psychological (Becker, 2005).

A lack of ability to see clearly hinders you if you are in a situation where vision is important. This could be when dealing with a graphical interface on a computer. How this lack of ability to see is manifested, however, depends on the situation – the context. A person with blurred vision can sometimes be helped by just wearing glasses. This is what a great part of the population is doing today. The blurred vision is a disability but would hardly be considered a handicap. In most situations, tools are available for helping people with common problems such as nearsightedness. These tools might be glasses or contact lenses. Most people take them for granted and contact lenses are not even always observed. This is a non-handicapping disability and its correction is fully accepted by society. But one should bear in mind that in a society where glasses are not available – problems like nearsightedness could really impose a handicap.

On the other hand, if you suffer from a more uncommon problem with vision, for instance partial or complete blindness, then tools for handling this are neither as accepted nor as common as for example correcting nearsightedness. In a situation where a person like this interacts with a graphical interface on a computer – there is very much a problem. If the user has no tool available for coping with the situation, then he or she will be handicapped. What we see here is that it depends on the context whether a disability leads to a handicap or not (Becker, 2005). There are two ways to look at this. One approach is that the situation is causing the problem and problems can be avoided by not getting into such situations. This means the person should choose other situations where possible if the goal is not to be handicapped. The other approach is to say that it is not the situation that is the problem – it is the lack of tools for coping with the

disability that causes the handicap. Both approaches seem to be part of the context but represent different sides and views.

DISABILITIES AS PART OF THE CONTEXT

Most people with disabilities tend to accept the fact that they are not part of the norm. A disability is mostly not considered a tragedy. When people speak of disabilities, the tragedy is based upon arguments of the type: "I cannot do that I am in a wheelchair" or "I cannot take that action – I do not see well enough". The actual problems are expressed as handicaps, focusing on the actions that cannot be taken or senses that cannot be perceived as a result of the disability (Murray-Nyman, 2005). They are not focused on the disabilities themselves. For the same reason a person with a disability to walk upright will not be complaining about his disability causing him distress while watching a movie. A nearsighted person might complain about his vision, but then he is likely to focus on the impracticality of wearing glasses, not on a disability to actually see things in a given situation where he wears his glasses.

Disabled people are part of the context. The context is different in the case where a disabled person is included compared to the case where a person without disabilities is included. In activity theory context is described as a set containing a subject, an object and actions/operations. The subject is the person(s) doing something to reach the object which can be considered as the goal or motive of the process. The action and operations are activities taken to reach the object (Nardi, 1996). In this approach, changing the abilities of the subject inevitably creates a different context. The subject is one of the main pillars of context and from this, it is clear that disabilities produce a different context.

Making the assumption that disabled people have the same motives and goals in life (Magnusson, 2005), this has two implications. Either the activities have to be changed in order for a different subject to reach the same object or the subject has to change to take the form of a subject without handicaps. As I see it this leads to two concrete options. By using the example with a blind person reading a text two different solutions are available for the context to stand with a fulfilled object. The first one is to give the person some kind of device which provides him or her with vision. The other option is to provide the person with a text written in Braille so that he can change his activities and still reach the object. These two options are not as easily separated as this example illustrates, but there is a fundamental difference in the way you perceive the context. In the first case you might not consider the person as handicapped whereas in the second case you probably would.

Other ways of studying context have different impacts on how you view disabilities and handicaps. A few of them will be discussed further down in this text.

There are different methods in determining the width or depth of the context. One way of doing this is to actively separate critical factors from non-critical factors in situations and only let the former be considered part of the context. The latter is part of the setting but not the context (Winograd, 2001). This is a method to narrow down context into a smaller more active framework. An illustration of this is to include only the aspects of a user which are currently important for a certain system interaction. Aspects such as the location and state of the user are part of the context only if these factors are relevant in the process. Although argued as a better way of understanding context by Terry Winograd (2001), I find this method of separating context and setting a relatively meaningless operation. I believe most people perform this separation automatically. However, it is worth keeping in mind that in order to understand and structure context you need to focus on relevant issues.

When applying a strict separation method between setting and context, the question of whether to include disabilities or not in the context once again turns into a question if the disability is important in the situation. If a potential user is wearing glasses or not is seldom a question in computer use. Hence it is never mentioned and out of context. If the user had not had glasses available but needed them to perform the interaction, then that factor would be part of the context. Comparing this to the earlier discussion of disabilities as part of context, when using activity theory, it is obvious that one definition has to be made. Handicaps are definitely part of the context since handicapped subjects require different activities and operations to be made to reach a particular goal. It even turns out that the definition of handicapped, by most people, is derived from the setting and context (Becker, 2005).

Other context theories and disabilities

Situated action theory is a theory for context that is very focused on the setting, the situation and the actions taken. It is very much focused on real activities in real settings (Nardi, 1996). The focus on actions in the setting has one drawback however, when discussing disabilities. Situated action theory fails to see the subtle but important interactions between properties of a subject – for instance disabilities – and their impact on the actions taken, and even more the actions prohibited and the handicaps that may arise. Therefore situated action theory is not a preferred option when dealing with disabilities.

For another different view on context the distributed cognition theory can be used. It has similarities to the system theory in psychology since it is a very system focused approach, but it can also be compared to activity theory by assigning goals to systems and identifying actors inside the system. One major proposition in distributed cognition is that there is no formal difference between people and artifacts – they all have their functions. Properties of one object can never give you understanding

of the system (Nardi, 1996). Nor do the properties themselves direct system behavior. In the case of comparing situations with different actors – disabled or non-disabled people – I find it difficult to see how these differences in properties affect the system.

The focus in distributed cognition is mainly on the functioning of the whole system, not the individuals taking part in it. In that sense the discussion of disabilities and handicaps is related to the entire system. It is not clear how handicaps and disabilities are related to each other and what role they play in the operations being performed in the system. Even though the distributed cognition approach to context acknowledges disabilities and handicaps, I cannot see how to discuss them in relation to operations and goals. There is also the fact that the approach focuses on system goals rather than individuals goals, which makes it harder to relate disabilities and handicaps to objectives.

Choosing platform of discussion

There are numerous ways of studying context, but as it turns out they are of different value when dealing with the issue of disabilities and handicaps. Both disabilities and handicaps are properties of an object. Since the aim of this paper is to discuss the relation between these properties and the context in which they appear it is quite obvious that activity theory is the best available option in this case. The advantage of activity theory here is that it allows us to compare different contexts where only the actor's properties have been altered. It also allows us to recognize the whole picture of what is happening, not just the produced activities and environment as in situated action theory (Nardi, 1996). When dealing with subtle issues such as disabilities we need a theory that can handle both changes in situations and in subjects and also permits the use of *sub contexts*.

DIFFERENT ABILITIES – DIFFERENT CONTEXTS

There are a number of situations or cases where the same type of actors – humans – has the same objectives in a given setting. That is because most of us have roughly the same needs independent of abilities and disabilities (Magnusson, 2005). The difference in these cases is that some people will have to change their activities or operations due to disabilities. Others have to change themselves or extend their abilities with tools. As mentioned earlier there is a difference between those options. To many of us it is important to fit in society, and feel accepted for who we are. For disabled people this might be even more important as they already feel that they are left out in some way (Umb-Carlsson, 1996).

When designing for interaction understanding of context is vital. Since context was introduced in the 80's, it has become an increasingly important part of design (Löwgren et al, 2004). When designing computer systems for disabled people the context is different from designing for non-disabled people. There are levels of awareness in design for disabled people. The highest one is when the design is solely focused on people with specific disabilities. I will call that *specific design*. A touch-screen with sections made up of Braille letters is clearly a design for people without eyesight. The context is clearly defined from scenarios involving only people with little or no vision interacting with the screen in order to reach some objective. In this case the context does not allow people without the knowledge of Braille.

One other way of looking at it is that the design is made for a sub context. By that I mean that a design revolves around a context with the primary function of allowing the actual super context to be operable. To illustrate this I would like to present the following example. Suppose a gravely nearsighted person wants to read the paper on the internet. This case can be thought of as a context consisting of the person (subject) looking at the screen and interpreting text (activity) in order to read the news (object). This context however is not possible due to the person's lack of eyesight. Therefore a design process is initiated which results in a device that increases the person's eyesight. This comes from a sub context which is made up of the person (subject) wearing the device (activity) in order to be able to interpret text on a screen (object). That way the original design process is solved using a sub-process and the designers of the online paper need not worry about people with a partial lack of vision. This is a sort of extendable design which can cope with some problems (Becker, 2005).

The next level of design is when designing something for everybody – both disabled and non-disabled people. I will call that *general design*. The context of use is then built from assumptions that everybody should manage the system. In such a context the possible activities have to be designed in a way that a subject could have almost any state of properties but still be able to perform the activities. Although one always has to make some limitations, the intention should be that the context includes a very generic individual. An example of this is a navigation tool that can be controlled by people lacking vision, hearing, partial loss of movement etcetera.

The level below general design I will call *broad design*. This is when the context is though of to include people with some disabilities or one type of disability as well as non-disabled people. Broad design is something between general design and *normative design* described below. Designers with this ambition often have included some disability property in their perceived contexts but for reasons left out others.

The lowest level of awareness I will call *normative design*. This does not necessarily be negative in a disabled point of view. If there are device solutions available the subjects will all have equal abilities anyway regardless of original disabilities. If the context is made up of activities that are all included in sub contexts where devices are available, then this option is preferable. Disabled people ultimately

want to participate in society under the same conditions as non-disabled people (Becker, 2005). However if this low level of awareness is caused by lack of understanding and by disregarding disabled people, then this is the worst possible case. Sadly though, this is norm in a lot of situations, thus making disabled people really feel left out (Becker, 2005).

Eliminating handicaps from a context

The most important issue for disabled people is not to be handicapped – especially when there are solutions available. To prevent this from happening, the first step is knowledge and understanding. When designing with awareness of context and a goal to allow wide use of the desired artifact, disabilities have to be taken into account in the context. For a lot of disabilities there are tools available that allow the disabilities to be disregarded in perceiving a context or constructing cases. Even if disabilities are disregarded in the actual context the designer should be aware of them.

When analyzing the contexts produced by different cases and scenarios the designer should focus on the activities and operations. Which of these activities are potential handicaps and whom do they concern. This is where the sub contexts play a vital role. Some of the activities might be part of other contexts where the subject is disabled. Those activities could then be checked as non-handicapping if the disabilities in question have been included in the sub contexts. If there are always sub contexts available – where there are artifacts included which permit the execution of the desired activities – then the normative design approach could generate artifacts in contexts where everybody is perceived as equal and nobody is handicapped.

If there are no sub contexts recognizable then the disabilities are in danger of producing handicaps. In this case the designer should preferably choose a general or broad design to meet most of the intended users' demands. However, this might not always be possible. It is hard to develop computer interaction tools that everybody can use and also benefit from (Becker, 2005). A tool for people with limited finger control could be useful to them but considered inefficient to others.

The classic design problem is that you should regard an infinite number of aspects in you design and that is simply not possible. The designer has to choose some requirements and follow them (Arvola, 2005). The last decades have put even more pressure on designers by adding more and more requirements. The implication of choosing only a few aspects for the design is that you will likely fail to meet some requirements. The competition on a global market is furthermore tough. A successful design has to be efficient as well. In this case it could mean that disabilities cannot be considered to the extent desired while also producing maximum efficiency. Normative design might prove to be the best approach in producing useful artifacts that survive the competition. If this turns out to be true, then a lot of sub contexts have to be considered when listing the activities for a given context. In order to make functions in society available to everybody aiding tools have to be produced.

CONCLUSION

It turns out that in discussing disabilities and handicaps in relation to context, activity theory is the best option. Disabilities and handicaps are related but very different. Disabilities are properties of the subject whereas handicaps are properties of the context. This neat distinction was harder to achieve with the other two discussed models for context.

Two different approaches were discussed in order to avoid handicaps to arise. The first approach was to work according to a general design principle where the artifact produced should be usable to everybody. The advantage is that nobody is left out and that all subjects have sufficient properties to meet the activities needed in order to reach the object. However, I also pointed out that this design method is hard to use since there is always a tradeoff between the number of people who can use it and its efficiency. The hard competition on the market may not allow such artifacts to be produced.

The other design approach was the normative design. As opposed to the name it can be a design method that recognizes disabilities. The essential part is that the normative design should still consider disabilities and only be used where other products are included in sub contexts which allow the activities needed for the artifact. This implies that normative design requires a broad understanding of disabilities. The obvious drawback of this design method is that it could maintain an environment where everything is still designed for the norm and providing an excuse for keeping it this way. However, I believe this is the only way to create competitive products on the market today. This ideally puts a lot of pressure on people building specific tools used in sub contexts to allow disabled people to perform all activities in the normative design context.

An example of how normative design could be successful is again the analogy with nearsightedness and glasses. Instead of developing glasses (and being able to disregard all problems with nearsightedness), society could have taken the other approach by designing every other artifact so that it can be used anyway. An example would be designing big screens instead of giving people glasses. Even though this example clearly shows the advantage of specific design in sub contexts and normative design everywhere else, there are problems with the approach. The major one was mentioned above. Somebody always has to design the specific aiding artifacts – "the glasses". If those artifacts are not designed yet, then the normative design only promotes further discrimination.

I have described two completely different approaches to preventing disabilities from turning into handicaps. Today I

see a lot of normative design – but without the necessary understanding and without the assisting tools needed. Personally I should be happy that my biggest disability is nearsightedness. There are a number of disabilities that have not been provided with a solution. As shown in my paper there is a huge problem to be solved.

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REFERENCES

1. Nardi, (1996) *Context and Consciousness. Activity theory and Human-Computer Interaction*. The MIT Press: Cambridge
2. Becker, S., (2005) Lecture at KTH 2005-11-21
3. Murray-Nyman, M., (2005) *Dubbelt utanförskap*. Sveriges kristna råd (SKR): Stockholm.
4. Umb-Carlsson, Ö., (1996) *Brukarstyrd utvärdering och utveckling*. http://www.umea.fub.se/kunskapsmappar/mapp2961.shtml
5. Magnusson, C., (2005) *Handikappforskning pågår nr 1 2005*. Centrum för handikappforskning: Uppsala.
6. Löwgren, J., Stolterman, E., (2004) *Design av informationsteknik*. Studentlitteratur: Lund.
7. Arvola, M., (2005) Lecture at KTH 2005-11-14
8. Winograd, T., (2001) http://hci.stanford.edu/~winograd/papers/context/context.pdf