

REVIEW

Accessibility, usability and universal design—positioning and definition of concepts describing person-environment relationships

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Abstract

Purpose: The aim of this paper is to position, define and discuss three concepts crucial for research and practice concerning person-environment relationships, viz. accessibility, usability and universal design.

Methods: Literature review, synthesized with the authors' research and practice experiences.

Results: The authors suggest an instrumental, three-step definition to accessibility, highlighting that accessibility comprises a personal as well as an environmental component, and that accessibility must be analysed by an integration of both. Suggesting the introduction of an activity component, accessibility should partly be replaced by the more complex term usability. Universal design is highlighted as a more process-oriented but less stigmatizing concept.

Conclusion: This paper contributes to the positioning and definition of concepts describing person-environment relationships. The definitions suggested challenge current terminology, but can support in developing more efficient research and practice strategies. In order to develop theory for application to societal planning issues, the definition of concepts is a necessary step.

Introduction

During recent years, the attention to accessibility for all people has increased and equal opportunities for all people to participate in society are being emphasized.^{1, 2} Environmental factors as well as viewing accessibility as a relation between a person and the environment are important in determining an individual's degree of independent living and in defining the status of people with

disabilities in society.³ With increasing attention to accessibility issues, empirical research focusing more accessible environments for different user groups as well as practical solutions in different sectors of society are being carried out and new solutions have been implemented. Many actors are involved in these processes, e. g. architects, engineers, planners, user groups, occupational therapists and other health care professionals, politicians, and researchers representing different disciplines. In order to be successful in implementing efficient solutions, knowledge on person-environment relationships is imperative, theoretically as well as in practice. A basic prerequisite, not the least in order to make efficient communication among the actors possible, is the use of a common language, i.e. vocabulary and definitions, within the field. Today however, there often is considerable unconsciousness, ignorance, inconsistency and even disinterestedness among the actors as concerns conceptual definitions to the core constructs being used. The terms used to describe environments that promote human functioning differ between countries⁴ and professional contexts. The differences reflect not only the shift from removal of barriers to a more inclusive design approach, but changing policies as well. The main problem is that words denoting core concepts are frequently being used in everyday communication between actors in planning processes, in legislation and other official documents, in disability movement material, in research reports, etc., without explicit definitions. Still, within each profession the words used often have implicit meanings shared by its representatives, but outside their own professional group the words might have quite different meanings. Besides making communication more efficient, the positioning and definition

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of concepts is a first and necessary step for theory development. The theoretical ideas that guide accessibility research are often revealed only by the beliefs, assumptions, and decisions imbedded in the selection of research methods and the interpretation of findings. In practice, theory is completely hidden while norms and codes of practice take precedence and guide decision making and action.

An analysis and critique of definitions used in accessibility research and practice from the perspective of person-environment theory is necessary in order to provide a more reliable basis for theory development.³ The aim of this paper is to position, define, and discuss three concepts crucial for research and practice concerning person-environment relationships, viz. accessibility, usability, and universal design.

The paper is based on literature studies and the authors' extensive practical and research experiences from planning and implementing accessibility measures in housing and transportation, since the 1980's.⁵⁻⁹ In particular, Iwarsson and Ståhl's research collaboration during the latest five years,¹⁰ involving several other senior researchers, practitioners and a group of doctoral students, have given focus to the different use and interpretation of words and definitions which have nurtured interest and understanding of the complex of problems emanating from conceptual obscurity within the field.

Positions of the concepts to date

ACCESSIBILITY

Out of the three concepts at target for this paper, accessibility is the most well known and used, e.g. in the 5th Standard Rule on the Equalization of Opportunities for Persons with Disabilities as prescribed by the United Nations:² 'States should recognize the overall importance of accessibility in the process of equalization of opportunities in all spheres of society'. Like many other words, accessibility has a common, everyday meaning as well as specific meanings in different contexts.¹¹ According to the Oxford popular dictionary and thesaurus,¹² 'accessible' is an adjective synonymous with 'approachable, at hand, attainable, available, close, convenient, handy, and within reach'. Another everyday language definition is e. g. the definition found in the Swedish National Encyclopaedia:¹³

Possibility to take part in something desirable. For a specific person this possibility depends on e.g. physical mobility and the geographic proximity to the demanded phenomenon. In addition, fac-

tors such as opening hours and admission regulations can be significant.

A definition used in environment and planning architecture is 'the simplicity with which activities in the society can be reached, including needs of citizens, trade, industries and public services', but in this field accessibility is defined primarily in terms of distances and time and not related to human capacity.¹⁴ According to Pirie,¹⁴ the ideas expressed in the publication referred to are borrowed from travel-behaviour modelling and time-geography.

For many people, especially when applying a technical perspective, accessibility is an umbrella term for all parameters that influence human functioning in the environment, thus defining accessibility as an environmental quantity.^{4, 14} In this way, the individual interacting with the environment is more or less disregarded. In most countries, at least in the Western world, there are laws that to some extent define accessibility. For example, since many years in Swedish building and planning legislation accessibility is a core concept, interpreted and defined as follows: 'To allow any individual, in spite of impairments, to get into and out of any building independently'.¹⁵ In the field of traffic planning, accessibility is often defined as 'the time needed or the distance to different activities or destinations in society for a population in question'.^{14, 16}

In the disability context, applying the International Classification of Functioning and Disability's (ICF)¹⁷ definition of disability as an umbrella term denoting the negative aspects of the interaction between an individual and that individual's contextual factors, the word accessibility becomes far more complex. In this perspective, a first assumption is that an accessible environment is an environment in which an individual with any impairment can 'function independently'. Another assumption is that there is some level of function that can be called 'minimally acceptable'.³ The lines of thought underlying the latter, although fairly diffuse, kind of definition are based on the concept of person-environment fit (P-E fit), proposed e.g. by Alexander.¹⁸ Applying this, an accessible environment must match the abilities of an individual or a group.

Most theoretical models on person-environment relationships within psychology are at least partially based upon Lewin's concept of 'Life Space',¹⁹ stating that behaviour is a function of the interaction of personality and individual factors and the subjectively perceived environment of the individual. The most well-known example is the environmental docility hypothesis and the ecological model²⁰ which has been used as the main

theoretical foundation in accessibility research. The ecological model focuses the transaction between individual competence and environmental press. Individual competence refers to basic domains such as biological health, sensory-motor functioning, cognitive skills and ego strength and there may be differences between objective competence and perceived competence. When it comes to environmental press, it refers to the fact that some environments pose great demands on people while others do not. The environmental docility hypothesis is 'the less competent the individual, the greater the impact of environmental factors on that individual', acknowledging the fact that more frail individuals are more vulnerable to environmental demand. To date, most accessibility research has been based on Lawton and Nahemow's model.^{3, 5, 10}

DIMENSIONS OF ACCESSIBILITY

In exploring the word accessibility, it can be divided into different dimensions. One way is to distinguish between accessibility to the physical environment, to information,² or to societal activities and services. Again, the most common and obvious dimension when discussing disability issues is accessibility to the physical environment, while the other two still are neglected. However, they are now gaining increasing interest and importance. Another way of describing different dimensions reflects different levels such as home, neighbourhood, community,²¹ or in sociological terms; micro, meso and macro levels. At the micro level, accessibility concerns our immediate environment, in physical terms e.g. housing and its close surroundings. Meso level accessibility concerns our neighbourhood such as public outdoor environment and public facilities in the local municipality or city, e.g. public transport,¹⁴ while accessibility issues at macro level encompasses society as a whole, nation- or world-wide.^{5, 22} Micro, meso and macro levels can be applied to accessibility to the physical environment, to information, as well as to societal activities and services.

PERSPECTIVES OF ACCESSIBILITY

Accessibility can also be considered from different perspectives, reflecting different viewpoints or outlooks. First, accessibility might be viewed from objective versus subjective perspectives. Lately, several authors have suggested that accessibility should be defined as the extent to which norms and guidelines in legislation and other official documents are met,¹ thus rendering the concept of accessibility a more explicit objective

character. In other words, accessibility concerns fulfillment of measurable requirements. For example, the American Disabilities Act (ADA) only provides information on compliance with technical norms and standards,²³ while it states nothing about performance, i.e. how a building or setting actually works for a range of users.²⁴ When it comes to methodology, in objective terms accessibility problems can be analysed only after reliable and valid professional environmental assessment, in relation to existing norms and guidelines, and related to functional capacity in individuals or groups of individuals.^{6, 25} In contrast to this, actors in the disability movement argue that the only experts on accessibility issues are users themselves, i.e. they stress the very subjective character of the word.

Second, accessibility can be viewed from the individual or from the group/population perspective. In individual cases, accessibility is often viewed from a rehabilitation perspective, characterized by the patient–therapist relationship.⁵ This perspective must be explicitly client centred, i.e. more subjective than objective, since the specific person's needs and special requirements must be taken into account, e.g. in planning for an individual housing adaptation. In contrast, from the group or population perspective suggestions and decisions furthering accessibility must be based on valid knowledge about human diversity, i.e. on the prevalence of functional limitations in different groups.²⁶ From a planning perspective, suggestions for interventions should not be based on individual assumptions but on data aggregated to the population level. Consequently, this perspective is based on epidemiological knowledge, characterized of the population–health agent relationship as described in public health literature.²⁷ To sum up, there are many dimensions and perspectives to accessibility. Even if the word is well-known and in common use, no unambiguous definition is available.

USABILITY

A word often used in parallel with accessibility is usability. For example, since many years Swedish building and planning legislation requires that all housing, work premises, or other premises open to the public 'must be accessible and usable for persons with restricted mobility or restricted sense of locality'. In this legal framework, usability was interpreted and defined as follows: 'The built environment has to allow any individual, in spite of impairments, to be able to perform daily activities within it'.¹⁵ In the same way, Swedish law also requires that vehicles used in public transport

must be usable for elderly people and people with disabilities. When it comes to the word in itself, 'usable' is an adjective synonymous with 'fit to use, functioning, operational, serviceable, valid, and working',¹² i.e. it is not synonymous with accessibility. In other words, usability concerns fulfillment of functional requirements.

Even if the two words accessibility and usability have different definitions, Steinfeld and Danford³ use them in parallel, stating that they both usually are defined in terms of observed task performance. Defined in this way, accessibility as well as usability represent the concept of person-environment fit, but the distinction Steinfeld and Danford make is that usability is based on individual interpretations. That is, psychosocial factors impinge on the definition of fit, e.g. self-image, motivation, social pressure and expectations. In other words, individuals interpret and evaluate the degree to which the environment restricts and supports the satisfaction of their goals and desires, often without any reflections on compliance with norms and official guidelines. Daring to make a free interpretation, such factors seem to be included in 'personal factors', i.e. in one of two components making up the part 'contextual factors' as defined in the ICF.¹⁷ Another way of defining usability is that it embraces perceptions of how well the design of the environment enables functioning, performance, and well-being, mainly from the user's perspective.^{3, 28} This kind of definition is much in line with current ISO definitions,²⁹ often referred to in the field of Human Factors Research. According to ISO 9241-11, usability is a measure of the effectiveness, efficiency, and satisfaction with which specified users can achieve specified goals in a particular environment. In this definition, effectiveness is about goal achievement, efficiency denotes evaluation of effort required, while satisfaction is about whether the product/system is suitable for the task and whether the act of use was pleasant or unpleasant.

When it comes to usability, Lawton's introduction of the importance of being aware of personal needs and environmental challenges and their influence on functional and task performance levels must be regarded as most relevant.³⁰ He stated that there is more to functionality than just bodily access, and in order to be able to design environments supporting behaviour, information on person-environment fit is not enough. Competent behaviour is the favourable outcome of any person acting in an environmental context.

Obviously, even if not yet explicitly stated and defined by any author, it seems as if a definition of usability involving human activity is on its way. There is a close

link between behaviour and activity, but behaviour represents a more comprehensive construct. Behaviour is a function of the person and the environment, based on a consideration and a strong need for performing an activity.¹⁹ Activity represents the individual perspective of functioning, and performance describes what an individual does in her or his current environment, bringing in the aspect of a person's involvement in life situations.¹⁷ Activity in terms of functioning and performance is a crucial aspect of human behaviour.

One model focusing the outcome of person-environment relationships explicitly including the performance of daily activities¹¹ is the Canadian Model of Occupational Performance (CMOP).²¹ In this transactional model people, their activities and roles, and the environments in which they live, work and play over their life-span are in dynamic interaction. This model does neither focus usability nor accessibility per se, but it elucidates activity or occupation as a basic human need and an important health determinant. The main components of the model are person, environment and occupation. A core concept of the CMOP is occupational performance, representing the actual execution of an activity and the personal experience of engagement in activity within an environment. Since occupational performance as described in the CMOP represents the transaction between person, environment, and activity, it seems closely connected to usability.

In ongoing research on housing accessibility and usability, preliminary results indicate that the two words represent different constructs, since they do not co-vary consistently.³¹ On the contrary, there are differences in to what extent subjective ratings of usability co-vary with objective accessibility assessments between different sub-samples of subjects, presumably depending on varying personal experiences when it comes to really performing activities in different sections of the housing environment. In another study, focusing public environment accessibility, similar tendencies were identified.³²

Venturing a conclusion on this review of the word usability, it must be stated that the word seems to be relevant for explaining aspects of person-environment relationships, but it is not synonymous with accessibility. However, there is no explicit definition at hand.

UNIVERSAL DESIGN

Traditional design adds accessibility to otherwise inaccessible buildings and products. The underlying principle of accessible design is the fact that there are two different kinds of populations; the normal population and the population diverging from normality, i.e. people with

disabilities.^{33, 34} The ultimate result is segregation and stigmatization. In contrast, ‘universal design’ is based on the principle that there is only one population, comprised of individuals representing diverse characteristics and abilities. Uttermost, the difference between accessibility and universal design concerns democracy and equity among citizens. The term universal design was first used in the US by Mace,³⁵ defining it as follows: ‘Universal design is an approach to design that incorporates products as well as building features which, to the greatest extent possible, can be used by everyone’. Another definition is: ‘Universal design may be defined as the best approximation of an environmental facet to the needs of the maximum possible number of users’.³⁰

During the past 15 years, the universal design approach has successively emerged. This approach means a shift away from narrow code compliance to inclusive design for everybody.⁴ That is, universal design is about social inclusion while accessibility measures implemented after the basic design of a building or a product represents exclusion. A term often used synonymously is ‘barrier-free design’, but to many people it is perceived more negatively since it is closely related to the needs of people with disabilities, still having a close connection to accessibility issues. Universal design is about democracy—about design for everybody; children and adults, elderly people, men and women, people of different nationalities, and so on. A better synonym to universal design is ‘design for all’, being the more popular expression in European countries.⁴

Based on the work of a group of 10 experts on universal design, in 1997 the Centre for Universal Design published the seven principles of universal design (table 1).³⁶ The purpose of these principles is to articulate the concept of universal design in a comprehensive way, and they are intended to be applied to all environments, products and communications. Application of the seven principles highlights that universal design requires integration of accessibility and usability features from the onset, removing

any stigma and resulting in social inclusion of the broadest diversity of users. That is, by definition universal design is clearly distinguished from accessible design. Summing up, universal design represents a new approach to design, and most of all it is about changing attitudes throughout society, describing a process more than a definite result.

Results: definitions of concepts for future application

In order to support basic and applied research concerning person-environment relationships, and to underfeed implementation of practical solutions integrating people with disabilities in society, there is an obvious need for updated conceptual definitions. As a result of this review and our practical and scientific experiences so far, the following positioning and definitions of the three concepts accessibility, usability, and universal design are suggested.

ACCESSIBILITY

Accessibility is a relative concept, implying that accessibility problems should be expressed as a person-environment relationship. In other words, accessibility is the encounter between the person’s or group’s functional capacity and the design and demands of the physical environment. Accessibility refers to compliance with official norms and standards, thus being mainly objective in nature.

Whenever using the concept of accessibility, statements must be based upon valid and reliable information gathered in three steps:

- (1) The personal component (description of functional capacity in the individual or group at target, based on knowledge on human functioning).
- (2) The environmental component (description of barriers in the environment at target, in relation to the norms and standards available).

Table 1 The seven principles of universal design†

<i>Principle</i>	<i>Definition</i>
1. Equitable use	Usable and marketable to people with diverse abilities
2. Flexibility in use	Accommodates a wide range of individual preference and abilities
3. Simple and intuitive use	Easy to understand, regardless of experience, knowledge, language skills or current concentration level
4. Perceptible information	Communicates necessary information effectively, regardless of ambient conditions or sensory abilities
5. Tolerance for error	Minimizes hazards and adverse consequences of accidental or unintended actions
6. Low physical effort	Can be used efficiently and comfortably, with a minimum of fatigue
7. Size and space for approach and use	Appropriate size and space for approach, reach, manipulation, and use regardless of body size, posture, or mobility

†Centre for Universal Design, North Carolina State University, NC, US (Follette Story, 2001).

- (3) An analysis juxtaposing the personal component and the environmental component (description of accessibility problems).

USABILITY

The concept of usability implies that a person should be able to use, i.e. to move around, be in and use, the environment on equal terms with other citizens. Accessibility is a necessary precondition for usability, implying that information on the person-environment encounter is imperative. However, usability is not only based on compliance with official norms and standards; it is mainly subjective in nature, taking into account user evaluations and subjective expressions of the degree of usability. Usability is a measure of effectiveness, efficiency, and satisfaction. Most important, there is a third component distinguishing usability from accessibility, viz. the activity component.

Whenever using the concept of usability, statements must be based upon valid and reliable information gathered in four steps:

- (1) The personal component (description of functional capacity in the individual or group at target, based on knowledge on human functioning).
- (2) The environmental component (description of barriers in the environment at target, in relation to the norms and standards available, but also based on user evaluation).
- (3) The activity component (description of activities to be performed by the individual or group at target, in the given environment).
- (4) An analysis integrating the personal, environmental, and activity components (description of usability problems, i.e. description of the extent to which human needs, based on individual or group preferences, can be fulfilled in terms of activity performance in the environment at target).

UNIVERSAL DESIGN

Universal design is synonymous to 'design for all' and represents an approach to design that incorporates products as well as building features which, to the greatest extent possible, can be used by everyone. Universal design is the best approximation of an environmental facet to the needs of the maximum possible number of users (table 1). Universal design is uttermost about changing attitudes throughout society, emphasizing

democracy, equity and citizenship. Universal design denotes a process more than a definite result.

Discussion

In this paper, some of the discrepancies, overlaps, and obscurities inherent in the common use of the concepts accessibility, usability, and universal design have been reviewed and analysed. The positioning and definitions suggested is an attempt to introduce more distinctive definitions as concerns person-environment relationships in the context of health and societal participation. Whether a concept is useful depends on the way it is being used; but there is always the additional question whether things so conceptualised will lend themselves to the suggested use.³⁷

The definitions suggested in this paper have implications for research as well as practice, but influencing use of common, everyday language is a lengthy process. For comparison, the WHO introduced their novel definition to the word 'handicap' more than 20 years ago, acknowledging that handicap is not a characteristic of a person but a phenomenon arising in the person-environment encounter.³⁸ In 1999, the term was replaced by 'participation restriction',¹⁷ highlighting the societal dimension of the phenomena, but among people in general the word handicap still is used for labelling persons. Nevertheless, critical review of conceptual use is imperative for positive development, and suggestions for new definitions challenge and encourage discussion.

Well-defined concepts constitute one basic condition for any theoretical development, and concept formation and theory formation in science go hand in hand.³⁷ One of the distinctive features of a theoretical model is the description of relationships between the concepts included, and optimally the concepts in a model should be mutually exclusive. Even though theory development is beyond the scope of this paper, the results touch upon some basic difficulties.

First, if the objective-subjective perspective outlined in relation to accessibility and usability are looked at the definitions suggested state that accessibility is objective in nature, while usability is subjective. Despite this basic difference, both concepts can have streaks of objectivity as well as subjectivity. One facet of the problem relates to methodology, i.e. how is information collected? Even if the phenomenon in itself is subjective in nature, information can be collected with objective methods, e.g. psychometrically tested self-assessments scales.³⁹ This kind of consideration is often overseen. If not tested for reliability and validity, survey methods based on compliance with norms though considered

objective can be very subjective in nature. Only few instruments for objective, norm-based accessibility assessments^{6, 25} as well as for objective usability ratings²⁸ are at hand, and ongoing research aims at elucidating how accessibility and usability are related to one another.³¹ Furthermore there are different types of objectivity and subjectivity, of different value to the designing process. Though currently considered politically correct, the involvement of users themselves is not enough. The problem is the premise that anyone with a disability has expertise in all accessibility or universal design issues; unfortunately in most cases the representatives represent a unilateral dimension reflecting primarily their own situation.⁴⁰ In order to be of use for societal planning purposes, user evaluations should not be too personal in nature, but validly reflecting subjective evaluations on group or population level. The users have an important responsibility in expressing their problems and needs, while when it comes to defining norms and guidelines a more objective view, taking different user groups into consideration, is necessary. In the same way, in the implementation phase professional technical expertise is required. That is, each actor gives their input to the process of universal design, but in order to achieve design for all a synergy of subjective and objective perspectives ought to be optimal.

Second, the working out of definitions as presented in this paper led to further reflections on the relationships between the three concepts focused. Thoughts on the relationship between accessibility and usability have been outlined, and even if there are some overlaps between them they at least seem complimentary. However, from the suggested definitions it is not explicit enough how accessibility–usability are related to universal design. Adopting current ISO definitions of usability,²⁹ out of the two words accessibility and usability the latter is the one being more closely connected to universal design, even if universal design bears more of a political, democratic, citizenship, vision- and attitude oriented process character and less of a concrete, measurable nature. Trying to describe relations between concepts is a step towards theory formulation, but this kind of process is somewhat paradox. Proper concepts are needed to formulate a good theory, but good theory is needed to arrive at the proper concepts.³⁷ Hopefully, future endeavours in this field will shed light on the still obscure relationships.

Only if and when human diversity becomes a natural starting point for architectural design and societal planning, the need for special terms will vanish.⁴¹ Similarly, applying results of discussions on terms of disablement^{17, 38} to everyday language, in many Western world

countries user organizations strive for changing their names from ‘the disability movement’ to ‘the independent living movement’. Inferring from this to a societal planning perspective, a shift of paradigms is what is actually being talked about—from adaptations in terms of accessibility measures to universal design or design for all.

In the authors experience, people representing different professional perspectives as well as user organizations sometimes raise critique against the definition of accessibility advocated, mainly because it is perceived as being too instrumental. This may be true, but instead it represents an advantage in making the relative concept of accessibility concrete.⁶ No matter the professional or user group affiliation, already from the onset people tend to integrate all the components of accessibility and usability presented, labelling it all ‘accessibility’. A first prerequisite for any efficient intervention is to be able to analyse the underlying causes of a problem, and by introducing our three-step definition of accessibility, different kinds of possible explanations to a problematic situation are made explicit. A positive effect is that the three methodological steps suggested call attention to the fact that different kinds of competencies are needed in order to analyse and solve accessibility problems; competence on human functioning as well as technical competence is required. When it comes to the demarcation from the concept of usability, being the result of our definition including the activity component, in advocating usability the need for including user perspectives is obvious. As accounted for in this paper, accessibility can be defined in quite different ways, depending on each person’s conception of it. The ultimate question is whether conceptions can be wrong or only inappropriate.¹⁴ The definition of scientific terms must be considered a process of successive definition; these definitions should not be closed prematurely but use scientific inquiry and empirical findings to introduce new specifications of meaning.³⁷ Future research in the field will show whether the definitions suggested in this paper are useful in the long run.

A third aspect made explicit when applying the definition of accessibility is the fact that even if accessibility is based on norms and official guidelines, it is not a constant phenomena. Due to international differences and societal ambitions varying over time, the environmental component is not consistent and stable. The main problem in this respect is the lack of valid norms. Although some of the existing norms and official guidelines are based on research, most of them are still based on the opinion of professionals, user group advocates, and industry representatives.³ That is, touching upon

the complex problem concerning objective versus subjective aspects discussed earlier, the objective norms currently in use are to a great extent based on subjective ratings. That is, the norms only to a limited extent are based on systematic investigations related to the population level. Whatever their origin, official norms reveal each society's current ambition of accessibility.⁴² Whenever this ambition changes and new norms are being implemented, applying our definition of accessibility the prevalence of accessibility problems changes accordingly. Following this line of thought, there are systematic differences to the prevalence of accessibility problems between different countries, since the norms often differ.⁴³ Another kind of problem connected to the environmental component of accessibility is the natural variability over time in physical environments, more obvious outdoors than indoors, viz. changing weather conditions, daylight and seasonal variations, etc.⁴⁴ Furthermore, outdoor activities are more complex and demanding,³¹ and taken together this kind of phenomena presumably affects usability.

On the other hand, applying the definition of accessibility as suggested in this paper the personal component of the concept must be considered as relatively stable. In operationalizing functional capacity, in particular at group or population levels, the information collected must be regarded as describing some kind of 'usual' or 'mean' state. In contrast, when it comes to the concept of usability, the personal component represents a substantial source of variation. Due to tiredness, fluctuating state of mood or health, etc., the user might report usability in a specific environment differently from one time to another. This reasoning ends up ascertaining that it is more difficult to make statements of usability on group and population levels, since it requires information reflecting individual perspectives.

The activity component of the concept of usability is another source of variation, since different users and user groups of course display different patterns of activity. None of the theoretical models referred to in today's accessibility research covers all the concepts and relationships necessary for further development in the field. Given the complexity of person-environment relationships, especially when including the performance of daily activities, there is an obvious need for theory development including the concepts of accessibility, usability, and universal design. The conceptual differentiation outlined in this paper certainly points out novel fields of inquiry. Taken together, there are considerable challenges in accessibility and usability research, but the first step to sound research is conceptual definitions, followed by theory development. A theory serves as a

research directive and guides data collection as well as data analysis—without theory there is only a miscellany of observations.³⁷

The most obvious and far-reaching consequence if the definitions suggested come into common use is that the term usability will restrict and presumably partly outdate the current use of the word accessibility. One example is the rather common strategy of implementing housing adaptations, today often denoted as a measure increasing accessibility. Housing adaptations are most often part of individual rehabilitation processes, and applying the definitions suggested in this paper, such interventions strive for usability. That is, in planning a housing adaptation, the analysis must be based on a specific individual's activity repertoire and his/her interaction with the housing environment at hand. In housing adaptation cases, official norms are of secondary importance since they might not be sufficient in supporting performance of daily activities for the individual at target for the intervention, and thus the term accessibility is not appropriate. In societal planning however, accessibility measures based on current official norms represent the most reasonable strategy, at least until sufficient knowledge is gained supporting usability interventions at group and population levels.

If the outcome is usability partly outdating the use of the word accessibility, this should be regarded as an advantage. Along with the fact that people in general have become more and more acquainted with the word accessibility as something that has to do with equal rights for people with disabilities, related to rehabilitation issues, at the same time this consciousness makes the term stigmatizing. Furthermore, planners are not very interested in solving the problems of a relatively small group of users. All special terms, defined in order to advocate the rights of people with disabilities tend to be stigmatizing,⁴¹ and restricting the use of the word accessibility to compliance with norms will highlight a more health promotion oriented perspective. Usability is more positive, more related to functioning than to disability. The term is increasingly being used in Human Factors Research, primarily not in relation to users with disabilities but in relation to any potential user group.⁴⁵ Functioning denotes the positive aspects of interaction between an individual and that individual's contextual factors, while disability labels the negative aspects.¹⁷ In this respect, the introduction of both usability and universal design will most likely have a positive impact, not at least when it comes to implementation. Both concepts bear more of democratic values and human rights perspectives, and hopefully they will lead the way towards fulfill-

ment of the equalization of opportunities for persons with disabilities.²

In conclusion, this paper is a serious attempt to contribute to the positioning and definition of concepts describing person-environment relationships in the health and societal context. The conceptual definitions suggested challenge current use of terminology, but can support in developing more efficient research and practice strategies. In order to develop adequate theory for application to societal planning issues, the definition of concepts is a first, most necessary step.

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References

- Preiser WFE, Ostroff E. (eds) *Universal Design Handbook*. New York: McGraw-Hill, 2001.
- United Nations (UN). *Standard Rules on the Equalization of Opportunities for Persons with Disabilities*. New York: UN, 1993.
- Steinfeld E, Danford GS. Theory as a basis for research on enabling environments. In: E Steinfeld, GS Danford (eds) *Enabling Environments. Measuring the Impact of Environment on Disability and Rehabilitation*. New York: Kluwer Academic/Plenum Publishers, 1999.
- Ostroff E. Universal design: the new paradigm. In: WFE Preiser, E Ostroff (eds) *Universal Design Handbook*. New York: McGraw-Hill, 2001.
- Iwarsson S. *Functional capacity and physical environmental demand. Exploration of factors influencing everyday activity and health in the elderly population*. Doctoral Dissertation. Lund University, Sweden: Department of Community Health Sciences, 1997.
- Iwarsson S, Slaug B. *The Housing Enabler. An Instrument for Assessing and Analysing Accessibility Problems in Housing*. Nävlinge och Staffanstorps: Vetén & Skapen HB & Slaug Data Management, 2001.
- Ståhl A. Changing mobility patterns and the aging population in Sweden. *Transportation Research Record* 1987; **1135**: 37–41.
- Ståhl A. Planning for a community responsive public transport system—the Swedish model. In: J Philips *et al.* *Broadening our Vision of Planning and Community Care for Older People*. UK: Anchor Research, 1998; 21–28.
- Ståhl A. Service Routes or low-floor buses? Study of the travel behavior among elderly and disabled people. *Proceedings of the 8th International Conference on Transport and Mobility for Elderly and Disabled People*. Western Australia: Indomed Pty Ltd, 1998; 595–602.
- Iwarsson S, Ståhl A. Traffic engineering and occupational therapy: a collaborative approach for future directions. *Scandinavian Journal of Occupational Therapy* 1999; **6**: 21–28.
- Carlsson G, Iwarsson S, Ståhl A. Exploration of physical accessibility in urban public transport: reflections on theory and methodology. Submitted.
- Oxford Popular Dictionary & Thesaurus*, third edition. Oxford, UK: Oxford University Press, 1998.
- National Encyclopaedia* (In Swedish). Höganäs, Sweden: Bra Böcker, 1998.
- Pirie, GH. Measuring accessibility: a review and proposal. *Environment and Planning A* 1979; **11**: 299–312.
- Didón LU, Magnusson L, Millgård O, Molander S. *Plan- och bygglagen, en kommentar. (The Law on Building and Planning. A Commentary*. In Swedish). Stockholm: Norstedts, 1987.
- Swedish National Road Administration. *Sectoral Report 99. Publication 2000:22E*. Borlänge, Sweden: Swedish National Road Administration, 2000.
- World Health Organization (WHO). ICF. *International Classification of Functioning, Disability and Health*. Geneva: WHO, 2001.
- Alexander C. The goodness of fit and its source. In: HM Proshanky, WH Ittleson, LG Rivlin (eds) *Environmental Psychology*. New York: Holt, Rinehart & Winston, 1970.
- Lewin K. *Field Theory in Social Science*. New York: Harper & Row, 1951.
- Lawton MP. *Environment and Ageing*, second edition. Albany, NY: Centre for the Study of Ageing, 1986.
- Canadian Association of Occupational Therapists (CAOT). *Enabling Occupation. An Occupational Therapy Perspective*. Ottawa, Canada: CAOT, 1997.
- Fougeyrollas P. Documenting environmental factors for preventing the handicap creation process: Quebec contributions relating to ICIDH and social participation of people with functional differences. *Disability and Rehabilitation* 1995; **17**: 145–153.
- US Access Board. *American Disabilities Act Accessibility Guidelines for Buildings and Facilities*. Washington: US Government Printing Office, 1991.
- Preiser WFE. Toward universal design evaluation. In: WFE Preiser, E Ostroff (eds) *Universal Design Handbook*. New York: McGraw-Hill, 2001.
- Iwarsson S. The housing enabler: an objective tool for assessing accessibility. *British Journal of Occupational Therapy* 1999; **62**: 491–497.
- Carlsson G, Iwarsson S, Ståhl A. Exploring functional capacity on group level: a new research approach for accessibility planning. *Scandinavian Journal of Occupational Therapy*, in press.
- Ewles L, Simnett I. *Promoting Health. A Practical Guide*. Harrow, UK: Scutari Press Ltd, 1992.
- Fänge A, Iwarsson S. Physical housing environment—development of a self-assessment instrument. *Canadian Journal of Occupational Therapy* 1999; **66**: 250–260.
- International Organization for Standardization. *ISO 9241-11: Guidance on Usability*. International Organization for Standardization, 1988. <http://www.iso.org/iso/en/CatalogueListPage>
- Lawton MP. Designing by degree: Assessing and incorporating individual accessibility needs. In: WFE Preiser, E Ostroff (eds) *Universal Design Handbook*. New York: McGraw-Hill, 2001.
- Fänge A, Iwarsson S. Housing accessibility and usability: an exploration of objective and subjective perspectives. Submitted.
- Fänge A, Iwarsson S, Persson Å. Accessibility to the public environment as perceived by teenagers with functional limitations in a south Swedish town centre. *Disability and Rehabilitation* 2002; **24**: 318–326.
- Conell BR, Sanford JA. Research implications of universal design. In: E Steinfeld, GS Danford (eds). *Enabling Environments. Measuring the Impact of Environment on Disability and Rehabilitation*. New York: Kluwer Academic/Plenum Publishers, 1999.
- Moore PA. Experiencing universal design. In: WFE Preiser, E Ostroff (eds) *Universal Design Handbook*. New York: McGraw-Hill, 2001.
- Mace R. *Universal Design, Barrier-Free Environments for Everyone*. Los Angeles: Designers West, 1985.
- Follette Story M. Principles of universal design. In: WFE Preiser, E Ostroff (eds) *Universal Design Handbook*. New York: McGraw-Hill, 2001.
- Kaplan A. *The Conduct of Inquiry. Methodology for Behavioural Science*. San Francisco: Chandler Publishing Company, 1962.

- 38 World Health Organisation (WHO). *International Classification of Impairments, Disabilities, and Handicaps, ICDH: A Manual of Classification Relating to the Consequences of Disease*. Geneva: WHO, 1980.
- 39 Jette A. Measuring subjective clinical outcomes. *Physical Therapy* 1989; 69: 580–584.
- 40 Ringaert L. User/expert involvement in universal design. In: WFE Preiser, E Ostroff (eds). *Universal Design Handbook*. New York: McGraw-Hill, 2001.
- 41 Wijk M. The Dutch struggle for accessibility awareness. In: WFE Preiser, E Ostroff (eds). *Universal Design Handbook*. New York: McGraw-Hill, 2001.
- 42 Jensen G, Iwarsson S, Ståhl A. Theoretical understanding and methodological challenges in accessibility assessments focusing the environmental component: an example from travel chains in urban public bus transport. *Disability and Rehabilitation* 2002; 24: 231–242.
- 43 Christophersen J. Accessible housing in five European countries: standards and built results. In: WFE Preiser, E Ostroff (eds). *Universal Design Handbook*. New York: McGraw-Hill, 2001.
- 44 Iwarsson S, Jensen G, Ståhl A. Travel chain enabler: development of a pilot instrument for assessment of urban public bus transportation accessibility. *Technology and Disability* 2000; 12: 3–12.
- 45 <http://deyalexander.com/presentations/introusability.pdf>. 3 June 2002.