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ORIGINAL INVESTIGATION

Older pedestrians' perceptions of the outdoor environment in a year-round perspective

Hanna Wennberg · Agneta Ståhl · Christer Hydén

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Abstract This paper focuses on older peoples' needs as pedestrians by examining their perceptions of the outdoor environment in both bare-ground and snow/ice conditions. Qualitative and quantitative methods are used, including focus group interviews, participant observations, and questionnaires. The results show that older people consider accessibility/usability issues as very important and that the importance depends on such individual background variables as age, sex, occurrence of functional limitations, use of mobility devices, and dependence on walking as transport mode. In bare-ground conditions, physical barriers are more important for the oldest old (80+) and for older people with functional limitations or mobility devices. However, orderliness-related issues (e.g. cyclists in pedestrian areas, lighting, and litter/graffiti) are equally important regardless of the background variables. In snow/ice conditions, ice prevention is considered more important than snow removal. Snow removal on a detailed level (e.g. removal of heaps of snow on pavements and zebra crossings) is emphasised. In conclusion, it is important to study subgroups, not older people as one group, in the analysis of accessibility/usability of outdoor environments. Further, even though those accessibility issues emphasised in current Swedish governmental directives on accessibility are considered as important by older people themselves, especially among the oldest old and among those with functional limitations and mobility devices, the needs will not totally be fulfilled by current directives. For example, winter maintenance, problems with cyclists in pedestrian areas, and the need for benches are neglected.

H. Wennberg (✉) · A. Ståhl · C. Hydén
Department of Technology and Society, Lund University,
Box 118, 221 00 Lund, Sweden
e-mail: hanna.wennberg@tft.lth.se

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Introduction

With increasing age, transportation as pedestrians or in public and special transport services is often the travel modes that older people rely on (Tacken 2004; Whelan et al. 2006). In fact, 30–50% of older peoples' journeys are made wholly on foot (OECD 2001). Providing transportation options for non-drivers in the community, such as accessible pavements and other pedestrian facilities as well as accessible public transportation, are therefore preconditions for people to stay mobile and independent in old age (Burkhardt et al. 1998; Mollenkopf et al. 2004; Michael et al. 2006). In the public health literature, extensive research has been carried out to examine correlations between environmental features and physical activity in terms of walking. A review of 18 studies, provided by Owen et al. (2004), concludes that walking among people of all ages is associated with aesthetic attributes, convenience of facilities for walking, accessibility of destinations, and perceptions about traffic and busy roads. There are often barriers to good access in the outdoor environment due to poor design and maintenance of pedestrian facilities. Such barriers include narrow pavements, poor crossing facilities, high kerbs, uneven or slippery surfaces, stairs without handrails, lack of benches, poor lighting, etc. (Lavery et al. 1996; Carlsson 2004; Ståhl et al. 2008). Improving conditions of pavements is actually one of the highest ranked solutions for improving mobility as stated by older people themselves (SIZE 2006). Barrier-free outdoor environments are also a major safety issue for older people as pedestrians. One-third of all people above

the age of 65 years falls at least once annually and almost every second fall occur outdoors (Luukinen et al. 1994). Berntman et al. (1996) show that 90% of the injuries occurring among older pedestrians are due to falls and that 80% of the falls occurring outdoors are caused by poor pavement conditions. Such poor conditions are also what older people themselves often report as accessibility problems (Ståhl and Berntman 2007). Even though previous studies have identified numerous of environmental factors associated with older peoples' activity, few have showed how to prioritise these factors in terms of relative contribution to environmental support (Sugiyama and Ward Thompson 2007). Furthermore, in some areas of the world, e.g. the Nordic countries, parts of the US, Canada, and Japan, snow and ice are barriers to access during winter (Pudas and Fjellström 2007). Previous research has mainly focussed on bare-ground conditions; however, how to keep outdoor environments accessible the year-round is also an issue yet to be examined.

Accessibility concerns person–environment relationships and is an important issue for people with reduced functional capacity, for example older people. According to the ecological model (Lawton and Nahemow 1973), there is an interaction between individual competence (capacity) and environmental pressure (demand). Some environments impose great pressure on individuals while others do not. In Lawton (1986), the environmental docility hypothesis suggests that the less competent the individual, the greater the impact of environmental factors on that individual. Hence, an improvement in the environment can make a huge difference for a person with lower capacity, while a minor deterioration in individual capacity can totally upset the balance. The concept of accessibility is defined by Iwarsson and Ståhl (2003) according to the ecological model and the environmental docility hypothesis, suggesting that accessibility comprises a personal as well as an environmental component. Hence, accessibility must be analysed by an integration of both components. Accessibility is an objective and measurable concept, and relates to societal norms and legislation. The concept of usability comprises, in addition to the personal and environmental components, also an activity component referring to the human activities in the environment (Iwarsson and Ståhl 2003). Thus, usability is subjective in the sense that it refers to a person's perception of a certain environment. Usability is difficult to predict due to the dynamics in the outdoor environment and variation in the capacity of the individual using the environment. For example, an accessible pavement (accessible according to current directives and recommendations concerning accessible pavements) may turn unusable if it is temporarily blocked by a parked car or by a heap of snow, i.e. dynamic factors of the environment. Likewise, a person's health may differ from day to day (or during the day), thereby decreasing functional capacity, which may cause the person's perception of the environment to vary. Furthermore, a trip, e.g. walking from the residence to the grocery store, can be a complex chain of events that all have to be usable. Several recurring minor barriers may, taken together, turn insurmountable for people with functional limitations. In this context, the travel chain perspective is essential; if one link in the travel chain is missing, the whole chain fails (Ståhl 1997; Börjesson 2002).

Accessibility for people with disabilities has been attracting increasing interest on both international and national levels. The UN Standard Rules on Equalization of Opportunities for People with Disabilities (UN 1993) represent early international ambitions on accessibility. The UN Convention on the Rights of Persons with Disabilities (UN 2006) is emphasising disability as a broad human rights issue and a matter of law and has jointly been signed by the European Community and its member states. Accessibility is also a part of the agenda adopted by the EU council of Lisbon 2000 targeting 2010 as the goal for full accessibility (Euro Access 2008). The importance for governments to improve accessibility and thus the mobility of people with disabilities and older people is emphasised in, e.g. ECMT (2000a, b, 2006). In addition, OECD (2001) is one of several reports referring to the ageing population in developed countries, demanding governmental action to ensure older peoples' safe, lifelong mobility. On national levels, there are wide variations in the progress achieved. Legislation to improve access ranges from strongly proactive countries to those where few measures have been carried out (ECMT 2000b, 2006). In Sweden, the Parliament adopted a national plan in 2000 for a future policy for disabled people, "From patient to citizen", where one of the goals is to make public environments accessible to people with disabilities regardless of age (Prop. 1999/2000:79). This plan led to the Swedish governmental directives on accessibility, related to the Planning and Building Act, requiring municipalities to identify and eliminate different predefined types of barriers, so-called "easily removed barriers", in public environments before 2010 (BFS 2003:19 HIN1). These directives are retroactive, requiring not only that new constructions be accessible, but also that existing barriers be eliminated. BFS 2004:15 ALM1 goes still further than BFS 2003:19 HIN1, presenting stricter demands for new constructions. Similar detailed standards and guidelines, connected to planning and building legislation, for planning and design of roads and streets are adopted in many other European countries as well (Euro Access 2008). It should be noted that the directives do not take the dynamics of the environment, for example snow/ice conditions during winter, into consideration.

The focus of this paper is on older people, here defined as persons 65 years and older. Policy, legislation and guidelines on accessibility have seldom older people as main target group, rather people with disabilities in general. Older people and people with disabilities are often treated as one group with similar needs in policy and planning. However, older people often suffer from a combination of different functional limitations (Hovbrandt et al. 2007). The ageing process involves per definition gradually declining functional capacity and with increasing age, functional limitations and use of mobility devices becomes more common (Parker et al. 2008; Löfqvist et al. 2007). There is a large variation of functional capacity within the age group of older people and among persons of the same age. Age is therefore difficult to determine solely in chronological terms and can be biologically, psychologically and socially defined (Dehlin and Rundgren 2000). Various subgroups, for example "young old" (65–75 years), "middle old" (75–85 years), and "oldest old" (85 years and above), are found in the literature. Laslett (1991) point out two phases of old age: the third and the fourth ages. The third age begins with retirement and is a phase characterised by freedom from work, financial security, and personal achievement. However, entering the fourth age involves higher incidence of illnesses and/or functional limitations causing more or less dependence and decrepitude. The transition from the third to the fourth age occurs, in developed countries, at around 75–85 years of age depending on which definition is applied (Baltes and Smith 2003).

The physical environment must be adapted according to the needs of older people in order to ensure their safe, independent mobility. The aim of this paper is to examine older peoples' perceptions as pedestrians in the outdoor environment in a year-round perspective. First, the paper examines the perceived importance of environmental factors concerning the outdoor environment in both bare-ground and snow/ice conditions, here referred to as "usability factors". It also examines whether individual background variables (age, sex, functional limitations, use of mobility devices, and dependence on walking as transport mode) influence the perceptions of the usability factors. Second, the paper examines how older peoples' perceived needs in terms of importance match up with current governmental directives on accessibility in Sweden (the "easily removed barriers" directives, BFS 2003:19 HIN1).

Method

Study design

Two similar studies were conducted to examine older peoples' perceptions of the outdoor environment in a year-round perspective; one study focussed on bare-ground conditions (the Bare-ground study) and another one on snow/ice conditions (the Snow/ice study). The studies are parts of two before and after studies where measures to improve accessibility are implemented and evaluated. This paper is based on data from the before studies.

Qualitative methods, followed by quantitative, were used in the studies. Both studies began with focus group interviews in which relevant usability factors concerning the outdoor environment were identified. Participant observations were also included in the Bare-ground study (not possible within the Snow/ice study due to time limitations). The usability factors identified in the Bare-ground study were then also supplemented with issues included in the Swedish governmental directives on accessibility (the "easily removed barriers" directives, BFS 2003:19 HIN1). This was not possible within the Snow/ice study since current accessibility directives do not consider snow/ice conditions. The usability factors identified were then examined quantitatively, using questionnaires to quantify the importance of each factor. Such an exploratory mixed-method approach, with qualitative findings helping in developing and informing the quantitative method, is useful in terms of pre-screening potential respondents and their perception as well as other local preconditions concerning the study districts and in the end formulating relevant questions for the questionnaire (Creswell and Plano Clark 2007). The main focus in this paper is on the quantitative part though.

The studies were conducted in the urban area of two medium-sized cities in Sweden: the central area of Hässleholm in the south of Sweden (the Bare-ground study) and the central area of Piteå in the north (the Snow/ice study). The municipality of Hässleholm has a total population of 49,381 inhabitants (20% of 65 years and older) of which 1,610 (38% of 65 years and older) live within the study district. The municipality of Piteå has a total population of 40,943 inhabitants (18% of 65 years and older) of which 3,336 (52% of 65 years and older) live within the study district. All population statistics are from 2006. Medium-sized cities were selected since they are assumed to be typical Swedish cities. The studies focussed on urban areas and not rural, which excluded more sparsely populated municipalities.

Qualitative studies

Focus group interviews and participant observations

The qualitative studies began in spring 2006. In these studies, relevant factors concerning usability in bare-ground and snow/ice conditions were identified using focus group interviews with older people (65 years and older)

living in the two study districts. The focus groups were run by the first author and took around 1 h. The interview guide used in the focus groups consisted of the following themes, which were adapted to bare-ground conditions in the Bare-ground study and snow/ice conditions in the Snow/ice study.

- Introduction: place of living, places interesting to visit, frequency of walking, etc.
- General thoughts about living and walking in the study district.
- Difficulties associated with walking in the study district: perceived problems, actual incidents, avoidance of places and situations, suggestions for solutions, etc.
- Conclusions.

In addition to focus group interviews, the Bare-ground study also included participant observations, followed by interviews. During the participant observations, the participant took a walk on a self-chosen route, for example, from their home to the local senior centre, together with an observer (the first author). The walk and the interview took around 30 min each. The participant was systematically observed and all critical incidents occurring during the walk were noted either through the observer's annotations or by the participant's own remarks. This critical incident technique was originally developed by Flanagan (1954), and was further developed by Jensen et al. (2002) by adapting the technique to assess person/environment relations. Thus, our study defined critical incidents as a situation where a usability problem occurred because of a malfunctioning interaction between the person and the environment, or in other words, a troublesome situation that more or less hindered the participant's advance during the walk. For example, stumble on an unevenness, be forced to lift the rollator over a kerb, etc. Afterwards, the walk was also discussed with the participant during an interview consisting of the following themes:

- General perceptions of the walk.
- Alternatives to the route: is the chosen route better than other routes?
- Specific incidents/problems on the chosen route and ideas on changes/improvements.
- Other routes, places and locations of interest: changes of habits over the years and reasons for such changes?

Participants and recruitment

The participants for the focus groups were recruited at the local senior centre in the study districts. The selection was done by voluntary entry by older people visiting the senior centre. A municipal employee at the centre helped in spreading the word about the upcoming study and people could sign up on a list at the notice board. On this list, they should also state their age, sex, and use of mobility device. Before sending out a confirmatory invitation letter to each one of the volunteers, it was controlled for that both 65- to 79-year-old and those over 80 years, both men and women, and both users and non-users of mobility devices were represented. In the Bare-ground study, the focus group participants were also invited to partake in the participant observations. One focus group and four participant observations were held in the Bare-ground study, and two focus groups were held in the Snow/ice study. Table 1 shows characteristics of the participants in the qualitative studies.

Analysis

The qualitative information was transcribed and analysed with content analysis in order to find general patterns and to categorise identified problems and incidents into usability factors. In the Bare-ground study, focus group interviews and participant observations with interviews afterwards resulted in 15 usability factors concerning bare-ground conditions. Similarly, the text analysis of the current Swedish governmental directives on accessibility (the "easily removed barriers" directives, BFS 2003:19 HIN1), resulted in 19 accessibility factors. In all, the qualitative analysis in the Bare-ground study yielded a total of 27 usability/accessibility factors concerning bare-ground conditions (Appendix 1). The focus group interviews in the Snow/ice study resulted in 18 usability factors concerning

Table 1 Characteristics of the participants in qualitative studies

	Bare-ground study		Snow/ice study
	Focus groups	Participant observations	Focus groups
Age, mean (range)	77 (68–93)	85 (79–93)	76 (63–93)
Age groups, *N*			
65–79 years old	6	1	7
80 and over	3	3	3
Sex, *N*			
Men	5	0	5
Women	4	4	5
Mobility device, *N*			
Cane/crutch	2	2	0
Rollator	2	2	4
Wheelchair	0	0	1
No mobility device	7	2	5
Σ	9	4	11

It is possible to have more than one mobility device per person

snow/ice conditions (Appendix 2). Note that the usability factor "having half of the footpath sanded" (U18) refers to that kick-sled riders use their kick-sleds on the unsanded surface. Kick-sled is a type of mobility device used on snow/ice and is rather common in the north of Sweden, especially among older people.

Quantitative studies

Data collection

The quantitative studies included two questionnaires, one in the Bare-ground study and another in the Snow/ice study. The questionnaires were study-specific and were based on the results from the qualitative studies as well as on questionnaires used in a number of studies reported in previous literature, e.g. the study "Let's go for a walk!" (Hovbrandt et al. 2007; Ståhl et al. 2008). In both studies, the questionnaires were distributed by mail directly after the qualitative material was analysed and categorised. Before the questionnaires were mailed out, they were tested in a pilot study, in which three persons filled in the questionnaires and then gave feedback regarding length, formulations, difficult/technical language, text size, design, etc.

The questions in the questionnaires were structured with predefined alternatives; there were also a few open questions. Both questionnaires consisted of 36 questions. In one of the questions, the respondents were asked to state how important each one of the usability factors (27 usability factors in the Bare-ground questionnaire and 18 in the Snow/ice questionnaire) is to them on a five-point rating scale, where 1 = very unimportant, 2 = unimportant, 3 = neither, 4 = important and 5 = very important. Background information on the respondents, such as age, gender, functional limitations, use of mobility devices, and access to car and special transport services (STS), was collected as well. Based on respondents' access to car and STS, dependence on walking as transport mode was then defined as having access neither to a car (of one's own or someone else's) nor to STS. Thus, independence is defined as having access to either a car or STS. Based on the items of the personal component of the Housing Enabler (Iwarsson and Slaug 2001), functional limitations and reliance on mobility device were scored dichotomously (yes/no). Eleven different functional limitations and three

Table 2 Characteristics of the sample

	Bare-ground questionnaire ($N = 356$)	Snow/ice questionnaire ($N = 611$)
Age, mean (range)	77.5 (65–99)	77.1 (65–100)
Age groups, *N* (%)		
65–79 years old	202 (58.0)	374 (63.7)
80 and older	146 (42.0)	213 (36.3)
Sex, *N* (%)		
Men	129 (36.8)	229 (37.9)
Women	222 (63.2)	375 (62.1)
Functional limitations, *N* (%)		
Only reduced movement	133 (37.4)	225 (37.4)
Only reduced perception/cognition	40 (11.2)	55 (9.2)
Both reduced movement and perception/cognition	98 (27.5)	163 (27.1)
No functional limitations	85 (23.9)	158 (26.3)
Mobility device, *N* (%)		
Cane/crutch	51 (14.3)	60 (9.8)
Rollator	71 (19.9)	155 (25.4)
Wheelchair	22 (6.2)	22 (3.6)
No mobility device	232 (70.3)	361 (64.7)
Dependence on walking as transport mode, *N* (%)		
Dependent (= access neither to car nor to STS)	93 (26.6)	121 (20.1)
Independent (= access to car and/or STS)	256 (73.4)	482 (79.9)
Access to car	195 (54.8)	361 (59.9)
Access to special transport services (STS)	68 (19.5)	137 (22.7)

Percentages do not have to sum up. For example, it was possible to have more than one functional limitation and type of mobility device and also to have access to both car and STS. Furthermore, there were 8/24 respondents of unknown age, 5/7 of unknown sex, and 7/8 with unknown dependence on walking in the Bare-ground/Snow/ice questionnaires

types of mobility devices could be scored. For the purpose of this paper, the functional limitations were categorised into (1) only movement-related, (2) only perception/cognition-related, and (3) both movement- and perception/cognition-related (Hovbrandt et al. 2007).

Sample and response

The respondents in the two studies were older people (65 years and older) living in the two study districts. For the Bare-ground questionnaire, all of the 616 older people living in the study district were included in the sample. The response rate on the Bare-ground questionnaire was 58% ($N = 356$). For the Snow/ice questionnaire, a random sample of the 1,726 older people living in the study district included 1,006 persons. The response rate on the Snow/ice questionnaire was 61% ($N = 611$). Table 2 shows the characteristics of the respondents in terms of age, sex, functional limitations, use of mobility device, and dependence on walking as transport mode.

Data analysis

Data from the quantitative studies were used to examine the importance of the usability factors. Factor analyses (Varimax rotation, eigen values >1) were conducted in order to categorise the 27 and 18 usability factors (U) into a number of usability categories (Uc). The rotated component matrixes from the factor analyses are presented in Appendixes 1 and 2. The factor analysis of the 27 usability factors (U) from the Bare-ground questionnaire resulted in the following five usability categories (Uc) concerning bare-ground conditions:

- Physical barriers (Uc1): usability factors U1–U8, concerning surface conditions, kerbs, and other physical barriers.
- Orientation and warning (Uc2): usability factors U23–U27, factors mainly relevant for blind and visually impaired people.
- Bus stops and shops (Uc3): usability factors U11–U13 and U21–U22, concerning public transport facilities and entrances to buildings, e.g. shops.
- Orderliness (Uc4): usability factors U9–U10 and U14–U16, concerning litter and graffiti, lighting, and cyclists in pedestrian areas.
- Benches and stairs (Uc5): usability factors U17–U20, concerning seating places (benches) and stairs.

The factor analysis of the 18 usability factors (U) from the Snow/ice questionnaire was rejected as it did not yield any factors that could be logically interpreted. Instead, these 18 usability factors were reduced into 12, where the 6 excluded factors were considered to be too peripheral for the scope of this paper since they referred to very specific locations within the study district and were not generally familiar. Categorisation based on expert knowledge of the remaining 12 usability factors (U) from the Snow/ice questionnaire yielded three usability categories (Uc):

- Snow removal, route level (Uc1): usability factors U1 and U3.
- Snow removal, detailed level (Uc2): usability factors U4–U7 and U16–U17.
- Ice prevention (Uc3): usability factor U11-U13 and U18.

Significance analyses with the Mann–Whitney U test ($P \leq 0.05$) were conducted in order to discover differences in the importance of usability factors and categories depending on individual background variables (age, sex, functional limitations, use of mobility device, and dependence on walking as transport mode). Only statistically significant differences ($P \leq 0.05$) are presented in the results, and mean values are used to illustrate the magnitudes of the significances even though equally spaced intervals on the scale cannot be fully assumed.

Results

Bare-ground conditions

Importance of single and categorised factors

The most important usability factors in bare-ground conditions concerned the category Orderliness (Uc4), especially the factors "no cyclists in pedestrian areas" (U15) and "lighting" (U10), and the least important factors concerned Orientation and Warning (Uc2). Benches and Stairs (Uc5) was the second most important usability category, where "Handrails on stairs" (U19) was found among the most important factors. The importance of usability factors and categories concerning bare-ground conditions is presented in Table 3.

Importance depending on background variables

Considering the background variables, there were differences in the importance of usability factors/categories in bare-ground conditions depending on the sex of the respondents (Table 3). Women stated all usability categories as more important than men. Differences were also found for several of the usability factors, except for single factors within Orderliness (Uc4). However, men and women showed no difference in the ranking of the factors, i.e. those factors that were considered to be the most important as perceived by women was also found among the most important factors as perceived by men. Further,

those respondents who were dependent on walking as transport mode, i.e. those who had access neither to a car nor to special transport services, perceived several of the usability factors as more important than those who were independent, especially as regarded the category Bus stops and shops (Uc3).

The importance of the usability categories increased with age, except for the category Orderliness (Uc4) (Table 3). To exemplify with single usability factors, the factors "no kerbs at zebra crossings" (U6), "high kerb at bus stops" (U12), "close to nearest bus stop" (U13), and "automatic door openers" (U21) were considered as more important by the oldest old (80 years and older) than by the young old (65–79 years of age). For the oldest old, Benches and stairs (Uc5) was as important as Orderliness (Uc4).

The importance of single usability factors and categories also depended on the occurrence of functional limitations and use of mobility devices. For example, the category Physical barriers (Uc1) was considered more important by respondents with functional limitations or by respondents using mobility devices than those who did not use them (Table 3). Further, when comparing the *types* of functional

Table 3 Mean values for the statistically significant differences (Mann–Whitney U, $P \leq 0.05$) of the importance of usability factors (U) and usability categories (Uc) in bare-ground conditions

		Total	Age		Sex		Functional limitations		Mobility device		Walking as transport mode	
			65–79	80–	Men	Women	Yes	No	Yes	No	Dependent	Independent
Uc1	Physical barriers	4.0	3.9	4.1	3.7	4.1	4.1	3.6	4.2	3.9	4.2	3.9
U1	Smooth surface conditions, no holes	4.3			4.1	4.4	4.4	4.0	4.5	4.2		
U2	Drainage grooves can be easily crossed	3.8	3.8	4.0	3.5	4.1	4.0	3.4			4.1	3.7
U3	Low kerbs	4.0	3.9	4.2	3.8	4.2	4.2	3.6	4.5	3.8	4.3	3.9
U4	Pavements with no steep gradients	3.8	3.7	4.0	3.5	4.0	3.9	3.4	4.1	3.7	4.1	3.7
U5	Zebra crossings exist[a]	4.0	4.0	4.1	3.8	4.2	4.1	3.8				
U6	No kerbs at zebra crossings	3.9	3.7	4.1	3.6	4.1	4.0	3.3	4.4	3.7	4.1	3.8
U7	Resting surfaces exist in slopes	3.5	3.3	3.8	3.3	3.7	3.6	3.1	3.9	3.3	3.8	3.4
U8	Shrubbery and tree branches are cut	4.3			4.1	4.3						
Uc2	Orientation and warning	3.7	3.6	3.9	3.5	3.9	4.1	3.6	3.9	3.7	3.9	3.7
U23	No blocking commercial signs/baskets	4.0			3.7	4.1	4.1	3.7	4.2	3.9		
U24	Continuous guidance routes	3.5			3.3	3.7			3.8	3.5		
U25	Clear warning markings	3.9	3.8	3.9	3.7	4.0						
U26	Clear contrast markings	3.9			3.6	4.0					4.1	3.8
U27	Kerb exists at zebra crossings	3.4	3.3	3.6	3.1	3.6					3.7	3.3
Uc3	Bus stops and shops	4.0	3.8	4.1	3.7	4.1			4.2	3.8	4.3	3.8
U11	Bus shelter at bus stops[a]	3.9	3.8	4.1	3.7	4.1	4.0	3.6	4.1	3.8	4.3	3.8
U12	High kerb at bus stops	4.0	3.9	4.2	3.7	4.2	4.2	3.6	4.3	3.9	4.4	3.9
U13	Close to nearest bus stop[a]	3.8	3.7	4.0	3.5	4.0	3.9	3.4	4.0	3.8	4.2	3.7
U21	Automatic door openers in shops	4.0	3.9	4.2	3.7	4.2	4.1	3.7	4.4	3.9	4.3	3.9
U22	Ramps at entrances in shops	4.0	3.8	4.2	3.7	4.1	4.1	3.6	4.3	3.8	4.2	3.9
Uc4	Orderliness	4.4			4.3	4.5	4.3	4.0				
U9	Removal of graffiti and litter[a]	4.3			4.2	4.4						
U10	Lighting	4.5			4.3	4.6					4.6	4.4
U14	No parked bicycles	4.1			4.0	4.2						
U15	No cyclists in pedestrian areas[a]	4.6										
U16	Clear separation of pedestrians and cyclists[a]	4.4										
Uc5	Benches and stairs	4.2	4.2	4.3	4.0	4.3					4.4	4.2
U17	Seating places (benches) exist[a]	4.0	3.9	4.1	3.8	4.1	4.1	3.7				
U18	Seating places (benches) in good order[a]	4.2			4.1	4.2	4.2	4.0				
U19	Handrails on stairs	4.4	4.3	4.5	4.2	4.6	4.5	4.2	4.5	4.3	4.6	4.4
U20	Well-contrasted steps on stairs	4.3			4.0	4.5	4.4	4.1			4.5	4.2

[a] Not included in current Swedish governmental directives on accessibility (the "easily removed barriers" directives, BFS 2003:19 HIN1)

limitations (reduced movement vs. reduced perception/cognition), no differences were found. The comparison "reduced movement versus no reduced movement" showed almost similar results as the comparison depending on occurrence of functional limitations in general. However, the factor "no blocking commercial signs/baskets" (U23) was more important for people with reduced perception/cognition (4.1) than for those with no such reduction (3.9). Regarding type of mobility device (cane/crutch, rollator, and wheelchair), the following four differences were found; the single factor "low kerbs" (U3) was considered more important by wheelchair users (4.9) than by rollator users (4.3) and users of cane/crutch (4.1), and similar differences were found for the factors "no kerbs at zebra crossings" (U6) and "ramps at entrances at shops" (U22). However, "bus shelter at bus stops" (U11) was considered less important by wheelchair users (3.4) than by rollator users (4.3) and users of cane/crutch (4.0).

Factors included in current governmental directives on accessibility

The usability factors in the Bare-ground questionnaire included factors from the Swedish governmental directives on accessibility (the "easily removed barriers" directives, BFS 2003:19 HIN1), as well as other factors derived from the focus group interviews. The factors from the governmental directives on accessibility were perceived as important by older people. Several of these factors became increasingly important with age and among older people with functional limitations and those who use mobility devices. However, eight of the factors in the Bare-ground questionnaire were *not* included in the directives (these factors are marked in Table 3). Several of these neglected factors were found to be perceived as important by the respondents in general. This mainly concerned Orderliness (Uc4), for example "no cyclists in pedestrian areas" (U15), "clear separation of pedestrians and cyclists" (U16), and "removal of graffiti and litter" (U9), as well as Benches and Stairs (Uc5), for example "seating places (benches) exist" (U17) and "seating places (benches) in good order" (U18). Another neglected factor, "zebra crossings exist" (U5), was also considered important by the respondents.

Snow/ice conditions

Importance of single and categorised factors

The most important usability factors in snow/ice conditions concerned the category Ice prevention (Uc2), especially the factors "even surfaces, no rough ice" (U12) and "sanded surfaces" (U13). Snow removal on detailed level (Uc2) was considered less important than on route level (Uc1), however; "no blocking heaps of snow" (U7) and "no snow on zebra crossings" (U4) were two of the most important single factors. The factor "usable benches in winter" (U16) was regarded as the least important usability factor of all in snow/ice conditions. The importance of usability factors and categories concerning snow/ice conditions is presented in Table 4.

Table 4 Mean values for the statistically significant differences (Mann–Whitney U, $P \leq 0.05$) of the importance of usability factors (U) and usability categories (Uc) in snow/ice conditions

		Total	Age		Sex		Functional limitations		Mobility device		Walking as transport mode	
			65–79	80–	Men	Women	Yes	No	Yes	No	Dependent	Independent
Uc1	Snow removal, route level	4.1	4.0	4.1	4.0	4.1	4.1	3.9	4.2	4.0		
U1	Snow removed immediately	4.1	4.0	4.1	4.0	4.1	4.1	3.9	4.2	4.0		
U3	No snow at footpaths in the central city	4.1	4.1	4.2	4.0	4.2	4.2	4.0	4.2	4.0		
Uc2	Snow removal, detailed level	3.7			3.6	3.8	3.8	3.6	3.8	3.7		
U4	No snow on zebra crossings	4.2	4.2	4.3	4.2	4.3	4.3	4.1	4.4	4.2		
U5	No snow at bus stops	3.4			3.1	3.6			3.2	3.5	3.7	3.3
U6	Kerbs are visible (snow removed)	4.2			4.0	4.3	4.2	4.0	4.3	4.1		
U7	No blocking heaps of snow	4.2			4.1	4.3			4.3	4.2		
U16	Usable benches in winter	2.6					2.7	2.2	2.8	2.4		
U17	Reachable poles	3.7			3.6	3.8						
Uc3	Ice prevention	4.2			4.0	4.3	4.2	4.1	4.3	4.1	4.3	4.1
U11	No ice at footpaths in the central city	4.4			4.3	4.4	4.4	4.3	4.5	4.3		
U12	Even surfaces, no rough ice	4.4	4.4	4.5	4.3	4.5	4.5	4.3	4.6	4.3		
U13	Sanded surfaces	4.4			4.3	4.5			4.5	4.4		
U18	Half of the footpath is sanded	3.5	3.4	3.6	3.3	3.6					3.8	3.4

Importance depending on background variables

Women judged almost all usability factors (except one) and all three usability categories as more important than men did (Table 4). For example, "no snow at bus stops" (U5) was far more important for women than for men. Men and women had, however, similar ranking of the factors, i.e. those factors that were considered to be the most important as perceived by women was also found among the most important factors as perceived by men.

Respondents using mobility devices stated all three usability categories and almost all of the single usability factors (except for two) as more important than non-users (Table 4). For example, "no snow on zebra crossings" (U4) and "no blocking heaps of snow" (U7) were more emphasised by users of mobility devices than by non-users. No differences were found, however, when comparing respondents with different *types* of mobility devices (cane/crutch, rollator, and wheelchair). Further, respondents with functional limitations considered all three usability categories and several of the single usability factors as more important than did those without functional limitations. The comparison "reduced movement versus no reduced movement" showed almost similar results as the comparison by occurrence of functional limitations. No differences were found when comparing respondents with reduced perception/cognition and those without. Likewise, no differences were found when comparing respondents with different types of functional limitations (reduced movement vs. reduced perception/cognition).

The importance of the usability category Snow removal on route level (Uc1) increased with increasing age (Table 4). However, only a few single factors were stated as more important with age. Further, only the two factors "no snow at bus stops" (U5) and "half of the footpath is sanded" (U18) were stated as more important by the respondents who were dependent on walking as transport mode than by independent respondents.

Discussion

This paper, examining older peoples' perceived needs as pedestrians, shows that older people themselves consider accessibility/usability issues in the outdoor environment as very important, since the factors examined were generally given scores above four on the five-point rating scale in the Bare-ground and Snow/ice questionnaires. Even though the paper presents usability factors in line with previous research (Ståhl et al. 2008; SIZE 2006; Mollenkopf et al. 2004; Lavery et al. 1996), it contributes with more knowledge of how different individual background variables influence older peoples' perceptions of these factors and also adds a year-round perspective on accessibility.

Both the Bare-ground and Snow/ice questionnaires showed an increasing importance of barriers as the age of the respondents increases, however; other individual background variables (sex, functional limitations, and use of mobility devices) indicated more, and larger, differences in the perceptions of the outdoor environment. The results show that older people with functional limitations in fact perceive accessibility issues as more important than older people without functional limitations, which is in line with the ecological model and the environmental docility hypothesis (Lawton and Nahemow 1973; Lawton 1986). Likewise, Shumway-Cook et al. 2002 suggested that environmental demands may disable older peoples' mobility and that demands such as stairs and other obstacles are a larger problem for older people with disabilities than for those without. Another interesting finding in this paper is that neither the type of functional limitation nor type of mobility device has any impact on the importance of barriers; it is only whether the person has functional limitations or not that matters. This is in line with Hovbrandt et al. (2007) who did not show any differences in perceived problems with physical barriers in the outdoor environment when comparing different functional limitations. Further, factors that are perceived to be the most important in general are not necessarily found among the most important factors among the oldest old (80 years and older), or among those respondents with functional limitations or those using a mobility device. It is interesting that in bare-ground conditions, there is a need for orderliness-related accessibility, i.e. prevention of litter/graffiti and cyclists in pedestrian areas, among those respondents 65–79 years old. However, after transition into the age group of 80+, removal of physical barriers becomes important as well. These results might not be considered very surprising since the transition between these two age groups involves functional decline (Baltes and Smith 2003). Ultimately, the results prove the importance of clear definitions of ageing and subgroups, not treating older people as one homogenous group, in the analysis of accessibility and usability of the outdoor environment. The vulnerability of older people also indicates the importance of being aware that several recurring minor barriers may make an otherwise accessible environment unusable. Thus, the studies presented in this paper emphasise the need for a travel chain perspective when planning for usable environments (Ståhl 1997; Börjesson 2002).

The results from the Bare-ground and Snow/ice questionnaires also show clear differences between men and

women, where women assign higher importance than men in both bare-ground and snow/ice conditions. Correlations between background variables (e.g. the female respondents have higher mean age than the male) might be one explanation, but not enough to explain the entire difference. The fact that women show more mobility limitations compared to men of the same age (Ahacic et al. 2000) might influence the stated importance of barriers. There might be other explanations as well. For example, the fact that women are more frequent users of public transport (Svensson 2003; Holmberg 2008) may explain why the female respondents consider usable bus stops as more important than the males do. Even so, no *relative* differences in the perception were found between men and women, i.e. those factors that women considered the most important were also identified as the most important factors by men.

The year-round perspective on accessibility emphasised in the Bare-ground study and the Snow/ice study illustrates the fact that outdoor environments that are usable in bare-ground conditions are not necessarily usable in snow/ice conditions. For example, a smooth and even pavement in summer may turn unusable in winter due to blocking heaps of snow. Poles that are used for showing directions at crossings may become unusable if covered in snow. Snow may also turn kerbs invisible, which results in poor visual and tactile guidance. The Snow/ice study shows that preventing ice and slipperiness is perceived as important by older people. For example, attaining smooth surfaces without any rough and insidious ice is considered as very important. Snow removal on *detailed* level in terms of removal of blocking heaps of snow on pavements and zebra crossings is almost as important as ice prevention. The importance of details in the design of outdoor environments is also emphasised by Ståhl and Iwarsson (2007), although their study mainly focussed on accessibility in bare-ground conditions. Few studies have been conducted in the field of winter accessibility, except for a study by Pudas and Fjellström (2007) comparing accessibility in bare-ground and snow/ice conditions by means of an inventory. They showed that for people with reduced mobility-related functional limitations, there is decreased accessibility in snow/ice conditions regarding unevenness, slipperiness and sight. For people with reduced perception and cognition, snow/ice conditions bring considerable deterioration regarding visual and tactile guidance. Signs and other information may be covered by snow, which also makes orientation more difficult. However, in some respects snow/ice conditions may improve accessibility if differences in levels are reduced and pavements become wider (Pudas and Fjellström 2007). Hence, snow/ice conditions place great pressure on planners and practitioners involved in maintenance in order to achieve accessible and usable outdoor environments during the winter season as well.

The results essentially indicate that factors included in the current Swedish governmental directives on accessibility "Easily removed barriers" (BFS 2003:19 HIN1) are perceived as important by older people. In fact, these factors become increasingly important with age and among older people with functional limitations and mobility devices. However, not all barriers reported by older people themselves as usability problems in the outdoor environment are included in current governmental directives on accessibility. It should be remembered that the directives on accessibility consider people with disabilities in general and that this paper focus on older people. Even so, in order to completely fulfil older peoples' needs as pedestrians, those neglected factors must be considered as well. This concerns, for example, removing barriers in snow/ice conditions in terms of developing effective strategies for winter maintenance, providing benches to rest on (and keep them in good order), and designing pavements and footpaths with clear separation of pedestrians and cyclists. In other words, even though the municipalities eliminate all barriers according to the directives in BFS 2003:19 HIN1, there are still barriers to access remaining. Another issue worth pointing at is that the consideration and treatment of accessibility issues in daily planning varies among Swedish municipalities; several municipalities have made extensive efforts within the field, as opposed to others that have accomplished less (Wennberg et al. 2009). Thus, there is still much to be done before achieving accessible and usable environments for all citizens. Nevertheless, the municipal process of removing physical barriers in public outdoor environments according to policy, legislation and guidelines on accessibility directives is likely to benefit from better knowledge of which measures to prioritise, and this paper provides such knowledge.

The design of the two studies, including both qualitative and quantitative research methods, was successful in terms of benefiting from the advantages and avoiding the disadvantages of each research method. Creswell and Plano Clark (2007) points out the strengths of such exploratory mixed-method design where qualitative findings help in developing and informing the quantitative method. Both focus group interviews and participant observations created a pre-comprehension of the characteristics of potential respondents, their needs and problems, and the characteristics of the two study districts. The qualitative studies therefore helped in formulating questions, not missing any relevant issues, but also in interpreting and understanding the results from the questionnaire. The discussions in the focus groups

revolved around the local outdoor environment and local preconditions. For example, half-sanded footpaths were brought up in the focus groups of the Snow/ice study as a rather important issue for some of the participants. The Snow/ice study was conducted in northern Sweden, where kick-sled riding is still rather common during winter, especially among older people. Kick-sled riding requires smooth and slippery surface conditions, whereas ordinary pedestrians prefer sanded surfaces, and that is why the municipality has compromised by providing half-sanded footpaths on several routes. This local precondition may have been forgotten if the qualitative study had not been conducted. Further, the questionnaire enabled testing the results from the qualitative studies on a representative sample of the population, i.e. quantifying and thereby verifying the qualitative findings. Orderliness-related issues, such as the presence of strangers/gangs, litter/graffiti, crime, and problems with cyclists in pedestrian areas, etc. were discussed animatedly in the focus groups. Physical barriers in the outdoor environment were discussed as well, although mainly among people using a mobility device or among those who knew people using one. Thus, the quantitative results presented in this paper agree with the qualitative findings.

There are of course methodological difficulties associated with conducting mail surveys, not least concerning how to reach a representative sample of the population. For example, women tend to be overrepresented (Trost and Hultåker 2007), however; in this study the proportion of women is similar among the questionnaire respondents as among the residents in the study district. Further, by limiting population samples to "older people living in the community", very old people tend to become undersampled since larger proportions of them live in residential establishments (Gubrium and Holstein 2001). This might also be the case in this study. It is also likely that questionnaires, especially a complex and extensive questionnaire like this, are not a suitable method for examining accessibility/usability needs among people with perceptive/cognitive disabilities. This might be the reason why this study found no differences in perceived importance of barriers between those who have reduced perception/cognition and those who have not, even though people with reduced perception/cognition are assumed to be in need of, for example, clear visual and tactile guidance (SKL 2004). The questionnaire contained some technical language, e.g. pole, drainage groove, resting surface, contrast/warning marking and continuous guidance route, even though we tried to avoid this in view of the findings in the pilot study. In order to facilitate the respondents' understanding, such technical language was rephrased if possible, or a short explanation was provided.

In conclusion, accessibility and usability in both bare-ground and snow/ice conditions are considered as very important by older people themselves. Physical barriers in the outdoor environment become increasingly evident with increasing age, and among older people with functional limitations and users of mobility devices. Nevertheless, orderliness-related accessibility issues (cyclists in pedestrian areas, lighting, and litter/graffiti) are also to be considered in planning. Accessibility for older people and people with disabilities in a year-round perspective needs to be further examined. One interesting issue for future research is to study effects of improvements in the accessibility of outdoor environments in bare-ground and snow/ice conditions on older peoples' mobility and safety as pedestrians. Concerning winter accessibility, improvement of methods for ice prevention is necessary, as well as strategies for snow removal on a detailed level, e.g. clearance of blocking heaps of snow on pavements and crossings including how to handle clearance around poles and other objects. Future collaborations between researchers and practitioners could be successful in such technical developments. Further, the results presented in this paper are relevant for a broader audience and might have implications for the accessibility agenda at both national and international levels. This paper concludes that older peoples' needs as pedestrians in the outdoor environment are not completely fulfilled by current Swedish governmental directives on accessibility. For example, winter maintenance, problems with cyclists in pedestrian areas, and the need for benches to rest on are not emphasised in the directives. These relevant issues should be considered as well when planning and designing for accessible and usable outdoor environments ensuring older peoples' safe, independent mobility the year around.

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Appendix 1

See Table 5.

Table 5 The 27 usability/accessibility factors concerning bare-ground conditions identified within the qualitative studies and the rotated component matrix from the factor analysis (the Bare-ground study)

Usability factor (U)		Source (qualitative studies)		Factor analysis					Name of usability category
		Perceived by older people (usability)	Governmental directives on accessibility[a]	Usability category (Uc)					
				Uc1	Uc2	Uc3	Uc4	Uc5	
U1	Smooth surface conditions, no holes	•	•	0.761	0.053	0.138	0.174	0.160	Uc1: Physical barriers
U2	Drainage grooves can be easily crossed		•	0.727	0.152	0.104	0.124	0.218	Uc1: Physical barriers
U3	Low kerbs	•	•	0.794	0.260	0.228	0.085	0.159	Uc1: Physical barriers
U4	Pavements with no steep gradients		•	0.709	0.293	0.214	0.212	0.116	Uc1: Physical barriers
U5	Zebra crossings exit	•		0.630	0.226	0.194	0.247	0.091	Uc1: Physical barriers
U6	No kerbs at zebra crossings	•	•	0.734	0.328	0.279	0.085	0.073	Uc1: Physical barriers
U7	Resting surfaces exist in slopes		•	0.527	0.290	0.282	−0.010	0.364	Uc1: Physical barriers
U8	Shrubbery and tree branches are cut		•	0.551	0.214	0.098	0.361	0.292	Uc1: Physical barriers
U9	Removal of graffiti and litter	•		0.045	0.005	0.123	0.660	0.100	Uc4: Orderliness
U10	Lighting	•	•	0.257	0.103	0.026	0.479	0.409	Uc4: Orderliness
U11	Bus shelter at bus stops	•		0.196	0.112	0.741	0.226	0.314	Uc3: Bus stops and shops
U12	High kerb at bus stop		•	0.360	0.238	0.707	0.238	0.169	Uc3: Bus stops and shops
U13	Close to nearest bus stop	•		0.288	0.148	0.758	0.170	0.286	Uc3: Bus stops and shops
U14	No parked bicycles	•	•	0.284	0.189	0.103	0.644	−0.006	Uc4: Orderliness
U15	No cyclists in pedestrian areas	•		0.181	0.060	0.066	0.791	0.088	Uc4: Orderliness
U16	Clear separation of pedestrians/cyclists	•		0.056	0.214	0.125	0.735	0.124	Uc4: Orderliness
U17	Seating places (benches) exist	•		0.221	0.188	0.285	0.064	0.740	Uc5: Benches and stairs
U18	Seating places (benches) in good order	•		0.134	0.192	0.262	0.200	0.753	Uc5: Benches and stairs
U19	Handrails on stairs		•	0.340	0.301	0.301	0.124	0.541	Uc5: Benches and stairs
U20	Well-contrasted steps on stairs		•	0.267	0.417	0.088	0.222	0.509	Uc5: Benches and stairs
U21	Automatic door openers in shops	•	•	0.204	0.498	0.595	0.049	0.128	Uc3: Bus stops and shops
U22	Ramps at entrances in shops	•	•	0.262	0.541	0.579	0.011	0.118	Uc3: Bus stops and shops
U23	No blocking commercial signs/baskets		•	0.291	0.517	0.232	0.315	0.111	Uc2: Orientation and warning
U24	Continuous guidance routes		•	0.189	0.748	0.164	0.136	0.268	Uc2: Orientation and warning
U25	Clear warning markings		•	0.246	0.737	0.135	0.239	0.192	Uc2: Orientation and warning
U26	Clear contrast markings		•	0.242	0.752	0.144	0.145	0.231	Uc2: Orientation and warning
U27	Kerbs exist at zebra crossings		•	0.157	0.650	0.119	0.017	0.057	Uc2: Orientation and warning

[a] The "easily removed barriers" directives, BFS 2003:19 HIN1

Appendix 2

See Table 6.

Table 6 The 18 usability factors concerning snow/ice conditions identified within the qualitative studies and the rotated component matrix from the factor analysis (the Snow/ice study)

Usability factor (U)		Components		
		1	2	3
U1	Snow removed immediately	0.178	0.849	0.116
U2	No snow at footpaths nearby my residence	0.338	0.808	0.078
U3	No snow at footpaths in the central city	0.380	0.804	0.090
U4	No snow at zebra crossings	0.397	0.712	0.162
U5	No snow at bus stops	0.040	0.314	0.643
U6	Kerbs are visible (snow removed)	0.463	0.464	0.375
U7	No blocking heaps of snow	0.623	0.434	0.123
U8	No snow at pedestrian streets	0.610	0.461	0.175
U9	No snow at footpaths to my grocery shop	0.657	0.389	0.147
U10	No ice at footpaths nearby my residence	0.775	0.319	0.031
U11	No ice at footpaths in the central city	0.775	0.390	0.055
U12	Even surfaces, no rough ice	0.762	0.252	0.140
U13	Sanded surfaces	0.848	0.228	0.114
U14	No ice at pedestrians streets	0.863	0.138	0.165
U15	No ice at footpaths to my grocery shop	0.846	0.135	0.130
U16	Usable benches in winter	0.065	0.017	0.593
U17	Reachable poles	0.273	0.073	0.702
U18	Half of the footpath is sanded	0.045	0.034	0.694

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