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Highlights

- Exploration of the impacts of weather on non-motorised human movement (soft-mobility) in winter.
- Highlighting of the weather and terrain conditions that act as barriers to soft-mobility in winter.
- Results that link changing barriers to soft-mobility in winter with climate change.

Abstract

Urban form can moderate the effects of weather on human movement. As such, the interrelationship between built environment, weather and human movement is a critical component of urban design. This paper explores the impacts of weather on non-motorised human movement (soft-mobility). Throughout we look at soft-mobility from the citizen's perspective and highlight the barriers to soft-mobility in winter.

The aim of this study was to test the traditional pallet of winter city urban design considerations. Those of solar-access, wind and snow management and explore other weather and terrain conditions that act as barriers to soft-mobility in winter. This study is based on survey responses from 344 citizens in the sub-arctic area of Sweden. Outcomes from the research highlight that rain, icy surfaces and darkness are today's most significant barriers to soft-mobility in winter.

Results from this study link changing barriers to soft-mobility in winter with climate change. The paper concludes that future urban design and planning for

winter cities needs to consider a wider pallet of weather conditions, especially rain.

Keywords: Winter Cities; Resilience; Outdoor Activity; Walkability; Urban

Microclimate

1. Introduction

Urban forms that enable soft-mobility can be seen as a fundamental objective of urban design. Since the beginning of the 21st century ‘walkability’, the prerequisite for soft-mobility has been a principle of urban design.

For planning, promoting soft-mobility has long been part of the urban form debate and is seen as helping deliver outcomes as diverse as social cohesion resource efficiency, sustainability and a better land economy (Carmona, 2002; Cowan, 2010; Frey, 1999; Gordon, 1997; Jenks, Burton & Williams, 1996; Urban Task Force, 1999).

Soft-mobility forms part of the density and viability debate and movement away from the car. A debate focusing on viable deliver public transport, local retail and neighbourhood facilities (DETR, 2000; Friends of the Earth, 1994; Jenks, Burton, and Williams, 1996; Newman & Kenworthy, 1989; Rudlin and Falk, 2000; Urban Task Force, 1999).

Soft-mobility is also emerging as playing an important role in facilitating health outcomes. Its importance is recognized by the World Health Organisation (WHO), the American Planning Association (APA), the Royal Town Planning Institute (RTPI) and the Environmental Protection Agency in Sweden. All highlight soft-mobility as a target or goal within development as physical inactivity is considered to be the 4th leading cause of death worldwide contributing to a mortality burden as

large as tobacco smoking (Kohl, 2012). In the UK, it is ranked the 4rd leading cause of disease, with high-blood pressure ranked 3nd and obesity 2nd (Murray, 2013).

Similarly in Sweden it is estimated about half of adults are insufficiently physically active to coffer health benefits (Faskunger, 2007).

For winter cities general soft-mobility at the population level is effected by weather. Population-based studies in Finland show that people spend 4% of their total time exposed to outdoor cold climate (Mäkinen et al. 2006). Whilst the effects of a cold climate environment are; 1) individual and linked to physical capacity and environment (Mäkinen, 2007); and 2) affected by weather, terrain and safety (Sievänen & Neuvonen, 2011), such places can offer possibilities for outdoor physical activity.

As such, and to deepen the knowledge of soft-mobility, research addressed in this paper explores the common weather barriers to soft-mobility in winter. The city of Luleå, a sub-arctic settlement in northern Sweden is the case study for this work.

2. Urban design for winter cities

The experience of outdoor environments in winter, with low temperatures and darkness, keeps many indoors. It is estimated that people spend 90% of their lives inside buildings (Evans & McCoy, 1998) and winter-related decreases in physical activity are found in various countries (Chan & Ryan, 2009).

Norman Pressman an early advocate of winter planning and founding member of the Winter Cities Association (1982 to 2005) aserted that reducing discomfort in sub-arctic climates (reducing wind chill and increasing sun exposure) could extend comfortable outdoor days by up to 30% annually (2004). As such, climatic considerations are one of the most important factors when planning and

should be a first step for people involved in urban design (Pressman, 1985; Børve, 1982; Erell, 2008; Givoni, 1998; Westerberg, 1994).

Pressman et al were influential in establishing three pillars of urban design for winter cities; preserve solar access, shelter from the wind, and design for snow management.

Practitioners in Canada, North America, and Scandinavia have long aimed to maximise solar access on public spaces (Andbert, 1979; Børve, 1982; Jefferson, Rowe, & Brebbia, 2001; Collymore, 1994). Similarly a key concern has been wind as it causes loss of heat (Gehl, 2011; Jeong, Gunwon, & Seiyong, 2015; Pressman, 1985) and can make places feel much colder than the temperature (Andbert, 1979; Jeong, Gunwon, & Seiyong, 2015; Pressman & Zepic, 1986; SMHI, 2014).

Here when planning urban areas it has important to find a balance between the positive and negative local environmental aspects that may occur (Pressman & Zepic, 1986) and for winter settlements successful urban places depend on balancing sun and wind (Erell, 2011; Matus, 1988).

3. Study Context

3.1 Climatic Context

Luleå, capital of Norrbotten County, is located 66.5622° N (latitude) and 22.1567 E (Longitude) and identified by the Köppen-Geiger Climate Classification system as sub-arctic Group D (temperature of warmest month greater than or equal to 10 °C, and temperature of coldest month –3 °C or lower) in the sub-category of Dfc (D: snow; f: fully humid; c: cool summer). Throughout the winter, the area has extended periods of snow, snow and ice cover and darkness, coldness, wind and rain.

The climate in Luleå is however evolving with climate change. Before the end of the twentieth century Norrbotten had an average temperature of around -2 degree Celsius but since the early 1980's average temperatures have been rising and average temperature now commonly fluxuate around zero degrees. Future predictions (SMHI) show average temperature will continue to rise (Bredfeldt & Norrbottens Län, 2016; SMHI, 2014).

Figure 1: Change in mean temperature in winter in Sweden, scenario RCP4.5. Generated using SMHI Climate scenarios, <http://www.smhi.se/en/climate/climate-scenarios> Accessed: 2017-07-18.

Figure 2: Change in precipitation in winter in Sweden, scenario RCP4.5. Generated using SMHI Climate scenarios, <http://www.smhi.se/en/climate/climate-scenarios> Accessed: 2017-07-18.

3.2 Case study location

The Mjölkudden neighbourhood of Luleå was the case study for this research. The neighbourhood has a residential population of 3,491 with an average age of 46 years and male to female ratio of 1708: 1783 (Luleå Kommun, 2014). The area is a mixed-use neighbourhood containing; a healthcare centre, pharmacy, dentist, church, supermarket and leisure facilities (sports hall, football, hockey, tennis, open-air pool and marina). Housing accommodation is mixed stand-alone houses and flats and the within the neighbourhood there is an L School (F-3), MH-school (4-9), a nursery school and care home. The area has also been selected as the pilot for a new winter, blue-green-white, planning initiative. For the purposes of this paper, these plans have been tentatively defined as plans that; *address the structure, function and design of green, blue and public areas, spaces, streets and paths when they become white due to snow and ice. These plans seek to achieve an attractive built*

environment where transport by walking and biking is prioritised and inviting as an everyday activity, all year round. Plans focus on; winter connections, pathways and soft-mobility and formal vehicular infrastructure; public space maintenance and management; and the outdoor winter environment. As the winter season is also dark they include the structure, function and design of lighting. At a technical level, white plans address materials, snow removal and storage. As such, the selection is a strategic choice (Yin, 1994).

4. Methods

4.1 Research approach

This study forms part of the research programme Health on Thin Ice at Luleå University of Technology (LTU), Sweden. The projects within this programme seek to create built environments that promote health and wellbeing in a cold climate. It is investigating trans-disciplinary questions of the relationship between living environments in the arctic and sub-arctic regions and the promotion of human health and wellbeing.

The study aim is to explore individual perceptions of barriers to soft-mobility in winter. The objective is to explore these barriers and validate or discard the traditional principles of urban design for winter cities in relation to on-going climate change.

Data was collected with a thematic survey to obtain citizen's views on the barriers to soft-mobility during the winter season in a sub-arctic region.

4.2 Design of a structured questionnaire

To investigate people's movement behaviour and deepen the knowledge of soft-mobility in winter, research outlined in this paper deployed a tailored version of

Patla and Shunway-Cook's (1999) *Environmental Analysis of Mobility Questionnaire* (EAMQ). This approach, adapted from physiotherapy, allowed a structured methodology for researching the qualities that empower people to use and reuse the environment. The original EAMQ contained 37 questions, divided into eight dimensions that address environmental conditions from a systems perspective that interrelate environmental factors with community walking (i.e. walking related activities outside ones property and in the community) with individual capacity and human health. The dimensions addressed are distance, temporal, ambient, terrain, physical load, postural transition, attention, and density.

This study adopts the EAMQ for urban design by tailoring it for climatic sensitive urban design research by selecting the dimensions of distance, ambient and terrain and expanding them to address summer and winter walking, the range of weather conditions found in winter, including coldness, wind, ice and ground surface properties (ice and snow). See table 1. This allowed the traditional pallet of winter city design considerations to be tested. Those of solar access, wind and snow and, in turn, for them to be placed in context with other weather conditions commonly found.

To differentiate this survey from the original, a suffix of climate has been added (EAMQ-Climate). EAMQ- Climate has twenty-two questions, eleven were encounter, for example; *when you go into the community, how often do you walk on snow covered surfaces* and eleven were avoidance; *when you go into the community, how often do you avoid walking on snow covered surfaces?* Questionnaire responses were limited to five options; Never, Rarely, Sometimes, Often, and Always.

Table 1: Climatic conditions addressed in the original EAMQ (distance (D), ambient (A), and terrain (T) dimensions) and additional climatic conditions added for inclusion in this study.

	Distance (D)	Distance – Summer (D)	Distance – Winter (D)	Dark (A)	Snow (A)	Rain (A)	Cold (A)	Wind (A)	Snow covered surfaces (T)	Ice covered surfaces (T)
EAMQ	✓			✓	✓	✓				
EAMQ- Climate		✓	✓	✓	✓	✓	✓	✓	✓	✓

The questionnaire was pilot tested by students of urban design on the Architecture Civil Engineering course at LTU. The pilot was undertaken in spring 2016 and resulted in 132 completed questionnaires. Participants were people who visited the city centre of Luleå and informed consent for using results was received from all participants.

On completion of the pilot, the questionnaire was amended to request the individual's gender and age to ascertain if the survey group reflects the general population.

4.3 Data collection and analysis: EAMQ – climate

In total 212 people from the case study location (Mjölkudden neighbourhood) answered the questionnaire. The survey was collected between 20th and 23rd June 2016. Participants surveyed were all visitors to Mjölkudden's centre (shopping area) during the four days. The mean age of participants was 56.4 years old (SD 20.4) with 48.5% being female and 51.5% male. All participants gave informed consent for the results to be used in this study.

To rationalise data collection, EvaSys survey automation software was used coupled with IBM SPSS Version 23 to analyse frequencies of answered received for each question. Legacy dialog graphs with error bars were generated and these are presented and discussed in the following sections.

The outcomes from the pilot are used as comparative data in the results section, as it helps to validate results from the case study.

Whilst questions addressed in the results are both avoidance and encounter, analysis of both is interpreted in terms of barrier effect to soft-mobility. The avoidance and encounter questions for walking more than a kilometre in summer or winter are considered to embody a variety of enabling and inhibiting environmental conditions for this task. As such, the distance questions include dimensions not measured in this research (e.g. attentional demands, postural transitions, or individual factors). For this research, weather conditions outside of this range of common barrier effects for summer and winter respectively are interpreted as having either a significantly positive (enabling) or negative (inhibiting) impact on soft-mobility in winter.

5. Results

The results show a slightly greater resistance in the groups to walking more than a kilometre in winter rather than summer. Participants will rarely or sometimes avoid this walk in winter but never or rarely avoid it in summer.

For both the neighbourhood and city centre, results highlight the most commonly avoided conditions were icy surfaces and rain. Both exceed the common

barrier effect of walking more than a kilometre in winter and as such, can be interpreted as significant barriers to soft-mobility.

At the other end of the spectrum walking on snow covered surfaces or when it snows was rarely if ever avoided. Suggesting that whilst snow and rain are both forms of precipitation, their impacts on walking are very different. Both in terms of the ambient dimension, raining versus snowing and the terrain dimension, snow covered surfaces versus ice. It can also be seen that snow covered surfaces have an avoidance impact similar to walking a kilometre in summer and as such, could be viewed as an enabler.

Other weather conditions can be seen to have a similar level of impact and can be ranked as: cold, darkness, wind and snow precipitation (Figure 3).

Figure 3: Avoidance: distance, ambient and terrain dimensions for the neighbourhood (n=212) and city centre group (n=132). Arranged in order of avoidance.

Encounter questions are listed in the same order as the previous avoidance questions. This ordering highlights that the hierarchy for encounter questions does not mirror results from avoidance questions. However, the patterns of hierarchies in both avoidance and encounter questions, respectively, can be seen to be similar.

Results from this part of the survey reinforce icy surfaces and rain as two of the main barriers to walking in winter. However, darkness is also highlighted as a similar barrier as icy surfaces, a result not shown in previous avoidance questions. As all three exceed the common barrier effect of walking more than a kilometre in winter, they can all be interpreted as significant barriers to soft-mobility.

Similarly encounter results show snow covered surfaces as the smallest barrier to winter walking but in contrast to avoidance questions, show wind as a lesser barrier to walking than snowfall. Overall, the hierarchy of barriers based on encounter questions is rain, darkness, icy surfaces, coldness, snowing, wind, and snow covered surfaces (Figure 4).

Figure 4: Encounter: distance, ambient and terrain dimensions for the neighbourhood (n=212) and city centre group (n=132). Arranged in order of avoidance (Figure 3).

Both avoidance and encounter results show rain as the main reductive weather condition for soft-mobility. Due to high rankings in both series of questions, icy surface can also be seen as a major limiting factor for soft-mobility in winter.

Likewise, darkness is shown as a similar barrier in encounter questions and can influence soft-mobility. Other factors of coldness, darkness, wind and snow precipitation all impact individual soft-mobility but their impacts appear less significant. Falling within the range of walking a kilometre in either winter or summer. Snow covered surfaces in both results, however, could be seen as an enabler in winter that can be compared to walking over a kilometre in summer.

6. Discussion

6.1 Results

The study aim was to explore individual perceptions of barriers to soft-mobility in winter. The objective was to explore these barriers and validate or discard the traditional principles of urban design for winter cities in relation to on-going climate change.

The literature background suggested that the overarching urban design principles for winter city design are three pillars. Those of preserve solar access, reduce wind and manage snow (Pressman, 1985; Collymore, 1994). In winter city urban design, solar access is seen as a positive contributor to outdoor activity and soft-mobility and should be maximized. Wind and snow, on the other hand, can be seen as potential 'barriers' to outdoor activity and soft-mobility and their impacts should be managed. As such, these pillars are mixed enablers and barriers.

Sun, wind and snow, however, are only three weather conditions common in cities such as Luleå and other Dfc (D: snow; f: fully humid; c: cool summer) category areas. Dfc category climates are found in Australia, Canada, Finland, Greenland, Norway, United States, Russia, Switzerland.

The EAMQ-Climate questionnaire was developed to cover the range of weather conditions found in Luleå and Dfc areas and was deployed to explore individual perceptions of barriers to soft-mobility in winter. Unsurprisingly, results show individuals are more likely to travel by foot in summer than in winter. However, it was also found that winter walking was not avoided, with the average result to this avoidance question being rarely or sometimes. Suggesting that while

winter walking may not be as desirable as summer walking, it is not infeasible and therefore can be influenced.

In regard to traditional principles of winter city urban design and the barriers of wind and snow, results suggest that these conditions may not now be as important as literature suggested (Pressman, 1985; Collymore, 1994). Rather than being of the highest order in terms of avoidance, wind, snow and snow covered surfaces were the three lowest order concerns at the neighbourhood and city centre scale. The same pattern is seen in encounter questions at the neighbourhood scale. However, snow precipitation was replaced by coldness as one of the three lowest in the city centre.

For wider Luleå as least, these results may reflect how the city is managed rather than showing wind and snow are not an issue. For example, Luleå municipality is highly experienced in snow management and ensuring the city's streets and pathways are cleared and usable even when there are heavy snowfalls. The City has also avoided creating unusually high buildings and maintained relatively constant building heights in the city and neighbourhoods. An approach known to reduce the creation of wind around buildings.

However, if the traditional winter city barriers of snow and wind are now being managed, the survey suggests that a new range of weather conditions have moved to the top. From the survey, the conditions of rain, icy surfaces and darkness can now be seen as the primary barriers to soft-mobility in winter and should be subject to enhanced urban design consideration.

Although the EAMQ-Climate results clearly show rain precipitation as now the leading barrier to soft-mobility in winter, it does not however establish why this is and these outcomes need to be considered in light of on-going climate change.

As highlighted in Section 3.3 Climate context, Norrbotten had an average temperature of around -2 degree Celsius during the twentieth century. However, since the early 1980's average temperatures have been rising. The average temperature now commonly fluxuates around zero degrees with predictions showing average temperatures continuing to rise.

Whilst numerically small, crossing the freezing point has a significant impact on the type of precipitation that occurs. For precipitation, below zero degrees Celsius, snow precipitation can occur but not rain. Whilst the opposite is not strictly true, snow can fall above zero, it will generally not settle and is more likely to fall as rain.

Documented temperature increases in Norrbotten and projected climate change scenarios (SMHI) have seen and suggest average temperatures that are more and more commonly above zero Celsius. This, by default is leading to less precipitation falling as snow and more as rain.

Here results from the survey suggest that perceptions of barriers to soft-mobility could be changing in line with global warming and the prevalent weather conditions being created. Temperature fluxuations around the freezing point may also be resulting in more ice build on ground surfaces as a pattern or cycle of rain and freeze can be created. Equally, as snow fall is replaced by rain, communities do not benefit from the reflective light created by snow. Snow reflects approximately

85% of solar radiation in comparison to asphalt which reflects only 10% (Børve, 1982) and naturally improves the outdoor lighting levels.

As the traditional principles of urban design for winter cities were all in place prior to the 1980's, it can be argued that whilst rain is now the primary barrier to soft-mobility in winter, it wasn't then. The weather barriers to soft-mobility are instead changing in line with global warming.

If this is the case and weather projections are close to correct, the barriers to soft-mobility will continue to change and require resilient urban thinking to address both known and uncertain future.

6.2 Method discussion

A uniqueness of this study is the adoption of an established methodology from the discipline of physiotherapy for use within architectural research. In itself, the original EAMQ embodied a number of urban design dimensions and the selection of questions simply needed tailoring to cover only the wider range of weather conditions found in DfC areas.

The analysis presented in this paper focused on both avoidance and encounter questions in the distance, ambient and terrain dimensions. This was because both provide individual subjective responses to the barrier effect of different weather related conditions.

Icy surfaces, rain and darkness emerged as the main barrier. The relative impact of rain and darkness, however, differed as questions were posed as avoidance instead of encounter. As earlier research has proposed, this maybe because that while avoidance occurs temporally prior to, encounter occurs temporally during the walking related activities in community (Robinson, Matsuda,

Ciol, & Shumway-Cook, 2013). It is also possible that the frequency of different weather conditions, as well as the individuals' motivation and need to take a walk or walk to a destination, affect how encounter questions are perceived by the individual. As such, avoidance questions maybe more direct and are more clearly understood.

Utilization of the pilot study results from the city centre with the results from the case study location provided comparative data for establishing if results from the two groups followed a similar trend concerning the hierarchy of conditions.

Due to lack of data on age and gender of respondents in the city centre no further statistical comparisons were made.

The research method and questionnaire deployed allowed barriers to winter soft-mobility to be tested in scientific manner without bias to one weather type. It also allowed the ranking of responses and hierarchies of the barrier effects of different weather conditions to be prepared. Even though earlier research have analysed the joint effects of ambient conditions (Robinson, Matsuda, Ciol, & Shumway-Cook, 2013), it was useful in the study to discriminate between weather conditions. This is because each weather condition may be tackled by different urban design or planning approaches to reduce their impact on soft-mobility in the built environment in winter.

In the results, questions for walking more than a kilometre were used in the analysis to encompass the range of weather conditions that inhibit or enable soft-mobility in winter. This approach was beneficial to the study as it allowed weather conditions with a significantly positive or negative impact on soft-mobility to be identified.

The study would have benefited from additional questions about enabling weather conditions, such as sun. Inclusion of such questions would have allowed other enabling weather conditions to be established. For example snow covered surfaces, which had similar responses to walking more than a kilometre in summer, emerged as an enabling condition for soft-mobility in winter.

7. Conclusion

The results from this research project challenge traditional urban design thinking for winter cities. At first glance the research suggests that the pillars of urban design for sub-arctic cities may not be correct or grounded in evidence. However, when placed in a wider context of when these principles were established (roughly between the 1980's and 2000) and climate change, it may be less that they are incorrect and more that the barriers to soft-mobility in winter are changing. It also suggests that as winter cities continue to warm, approaches to urban design in winter cities may need to learn from cool climate areas and their urban design approaches.

Designing for sun, wind and snow will remain important but today designers and planners should place greater emphasis on other weather conditions that can hinder soft-mobility and other outdoor activities. In particular, those involved in the built environment should account for the barrier effects of rain, icy surfaces and darkness on soft-mobility.

It can also be concluded that if climate change continues at the pace of today, and as scenario project, tomorrow's barriers to soft-mobility maybe different. As such planner and designers should not consider weather conditions as stable and we should expect them to change with global warming.

This research has also shown the importance of being clear in definition. Precipitation is generally used to cover a range of conditions including snow, rain, sleet or hail. The research highlights that rain precipitation is a very different barrier to soft-mobility than snow precipitation. As such, forms of precipitation should not be clustered together.

7 Future studies

Results and conclusions from this study have been used to argue that the full range of weather conditions should be used in urban design for winter cities.

Whilst results and conclusions have been based on a case study in Sweden, Luleå, many countries have similar Dfc climates. As such, outcomes from this research should be tested in other winter cities. Repeating the methodology elsewhere would highlight if trends are similar and add to the scientific evidence around the impact of weather on soft-mobility in winter.

Future studies should also seek to establish how a broader pallet of urban design and planning solutions can be developed that respond to the changing barriers to soft-mobility in winter.

Appendix A – EAMQ – Climate

EAMQ (1999)	Questions Deployed (2016)
Distance	Distance
When you go into the community, how often do you walk long distances (10 or more blocks)?	When you go into the community, how often do you walk more than a kilometer in winter conditions?
When you go into the community, how often do you avoid walking long distances (10 or more blocks) on trips into the community?	When you go into the community, how often do you avoid walking more than a kilometer in winter conditions?
	When you go into the community, how often do you walk more than a kilometer in summer conditions?
	When you go into the community, how often do you avoid walking more than a kilometer in summer conditions?
Temporal	
When you go into the community, how often do you cross a busy street?	
When you go into the community, how often do you	

avoid crossing a busy street?	
When you go into the community, how often do you cross a street that has a traffic light?	
When you go into the community, how often do you avoid crossing a street that has a traffic light?	
Ambient	
When you go into the community, how often do you go out when it is dark?	When you go into the community, how often do you go out when it is dark?
When you go into the community, how often do you avoid going out when it is dark?	When you go into the community, how often do you avoid going out when it is dark?
When you go into the community, how often do you go out when it is snowing?	When you go into the community, how often do you go out when it is snowing?
When you go into the community, how often do you avoid going out when it is snowing?	When you go into the community, how often do you avoid going out when it is snowing?
When you go into the community, how often do you go out when it is raining?	When you go into the community, how often do you go out when it is raining?
When you go into the community, how often do you avoid going out when it is raining?	When you go into the community, how often do you avoid going out when it is raining?
	When you go into the community, how often do you go out when it is cold?
	When you go into the community, how often do you avoid going out when it is cold?
	When you go into the community, how often do you go out when it is windy?
	When you go into the community, how often do you avoid going out when it is windy?
Terrain	
When you go into the community how often do you walk up or down a single flight of stairs?	When you go into the community, how often do you walk on snow covered surfaces?
When you go into the community, how often do you avoid going up or down a single flight of stairs?	When you go into the community, how often do you avoid walking on snow covered surfaces?
When you go into the community, how often do you walk up or down two flights of stairs?	When you go into the community, how often do you walk on icy surfaces?
When you go into the community, how often do you avoid walking up or down two flights of stairs?	When you go into the community, how often do you avoid walking on icy surfaces?

When you go into the community, how often do you walk up or down a curb?	
When you go into the community, how often do you avoid walking up or down a curb?	
When you go into the community, how often do you walk on uneven surfaces?	
When you go into the community, how often do you avoid walking on uneven surfaces?	
Physical Load	
When you go into the community, how often do you carry two or more heavy items?	
When you go into the community, how often do you avoid carrying two or more heavy items?	
When you go into the community, how often do you push open a heavy door?	
When you go into the community, how often do you avoid pushing open a heavy door (for example push the wheel chair button to open a door rather than push it open yourself)?	
Postural Transition	
When you go into the community to shop, how often do you reach above shoulder level?	
When you go into the community to shop, how often do you avoid reaching above shoulder height?	
When you go into the community to shop, how often do you reach below your knee level?	
When you go into the community to shop, how often do you avoid reaching below knee level?	
Attention Dimension	
When you go into the community, how often do you travel alone?	
When you go into the community, how often do you travel with 2 or more people?	
When you go into the community, how often do you avoid travelling alone?	

When you go to into the community, how often do you go to noisy or busy places?	
When you go into the community, how often do you avoid going to noisy or busy places?	
When you go to into the community, how often do you go to unfamiliar places?	
When you go into the community, how often do you avoid going to unfamiliar places?	
Density Dimension	
When you go to into the community, how often do you go to crowded places, where people might bump into you?	
When you go into the community, how often do you avoid going to crowded places, where people might bump into you?	

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