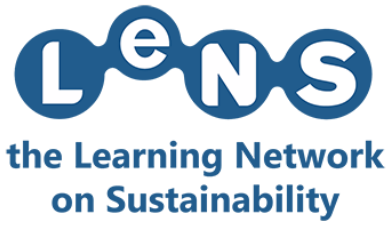

A Toolkit: Fostering a Participatory Study of Sustainable Pavement Development

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ABSTRACT

Walking is a popular transport means for seniors doing daily errands, and pedestrian pavements play a key role in influencing the quality of older people′s walking. Walking experience of older pedestrians and their perspectives to the outdoor environment are crucial in planning and designing pavements.

However, their walking experience and perspective on the pavement are less involved in the process of urban development. A participatory toolkit is created providing a chance for older people to share their walking experience and to indicate their opinions of the pavement in a group study conducted by researchers who develop the pedestrian environment. The tool allows users to identify hazardous factors of the pavement, seek the impact of pavement hazards, and improve the pavement using recommendations. Based on the outputs of the toolkit, the researchers can have a better understanding of the relationship between pavements and elderly people and create an age-friendly pedestrian environment.
Key Words: sustainable development, pavement, older adult, toolkit

1. INTRODUCTION

Walking is the most satisfying, environmental and age-friendly transport means for sustainable advancement (Kim, Choi, & Kim, 2011; Mateo-Babiano, 2016). It is also regarded as the most effective mode of travelling for older people who live in cities and want to be less reliant on driving (Fisk et al., 2009). However, the condition of built environments and environmental barriers can affect the safety and quality of older people′s walking (Achuthan, Titheridge, & Mackett, 2010; Rackliff, 2013). Furthermore, behavioural changes on the walking pattern of older pedestrians are associated with the hazardous appearance on walking paths (Caetano et al., 2016; Kovacs, 2005). Many guidelines, such as Manual for Streets (DfT, 2007) and Pedestrian Comfort Guidance for London (Iversen, 2010), have come out recommendations and guidance on building and designing the pavement to deal with the risk of falling and to promote walking in pedestrians. Even so, the walking experience of older pedestrians and their comments on pavements are not fully regarded by road engineers or design teams. Older adults consume much more time in local neighbourhoods, thus, it is vital to understand their concerns when building walkable environments for them (Grant, Edwards, Sveistrup, Andrew, & Egan, 2010). Therefore, we designed a map-based toolkit providing a participative process for older pedestrians to share their perceptions and walking patterns and generate ideas with researchers, namely urban planners, environment designer, and construction consultants, in the process of developing the pavement. Meanwhile, the tool enables the researchers to explore issues of the pavement and their impact on older people′s walking.

2. A PARTICIPATORY STUDY TOOLKIT

The tool enables researchers (e.g. urban designers) to conduct a study to identify hazardous factors of the pavement in specific locations, investigate the adverse effect of the pavement factors, exploring behavioural changes of older adults (study participants) caused by the pavement hazards, and propose recommendations to improve the pavement environment. Shih et al. (2009) found that more ideas could be generated between people when they share their individual opinions in a group. Therefore, the study will be done with a group of older adults. People older than 60 are usually defined as elders (Un.org, n.d.), and a mini group is easier to organise and to make participants feel more comfortable in a concentrate discussion (Krueger & Casey, 2015). So, there has to be a maximum of six participants in the study and they have to be aged over 60 and fit to walking.

The content of the toolkit was created based on the findings of our empirical study (Yin & Pei, 2018). As to the outcomes, it categorised 16 pavement hazards, namely uneven pavements, overgrown plants, slippery barriers, broken pavements, moving objects, temporary obstacles, poorly maintained or designed street amenities, manhole and drain covers, parked vehicles, construction, narrow pavements, absence of the pavement, shopkeeper's goods, confusing paving patterns, tactile paving areas, and changes in ground levels, such as steps and slopes. These pavement hazards could increase the risk of falling and physical burdens to older pedestrians and limit their walking and view. Additionally, they could trigger particular changes in the walking behaviour of older adults. There were 13 behavioural varies have been classified based on the study results and they were adopting cautious steps, stepping around, adjusting paces, walking slowly, giving way, stopping walking, walking on the outside of the pavement, walking in the street, crossing road to the opposite pavement, lowering one′s head, raising one′s legs higher, facing oncoming traffic, and swerving one′s body. To deal with the

hazards and build an age-friendly environment, pavements could be developed by improving the pavement quality, providing pedestrianized pavements, well-maintaining street amenities, and avoiding pavement obstructions.

2.1. Components of the toolkit

Figure 1 shows that the toolkit has five components: (1) code badges, (2) user instruction, (3) a card pack, (4) survey cards, and (5) a recording card.

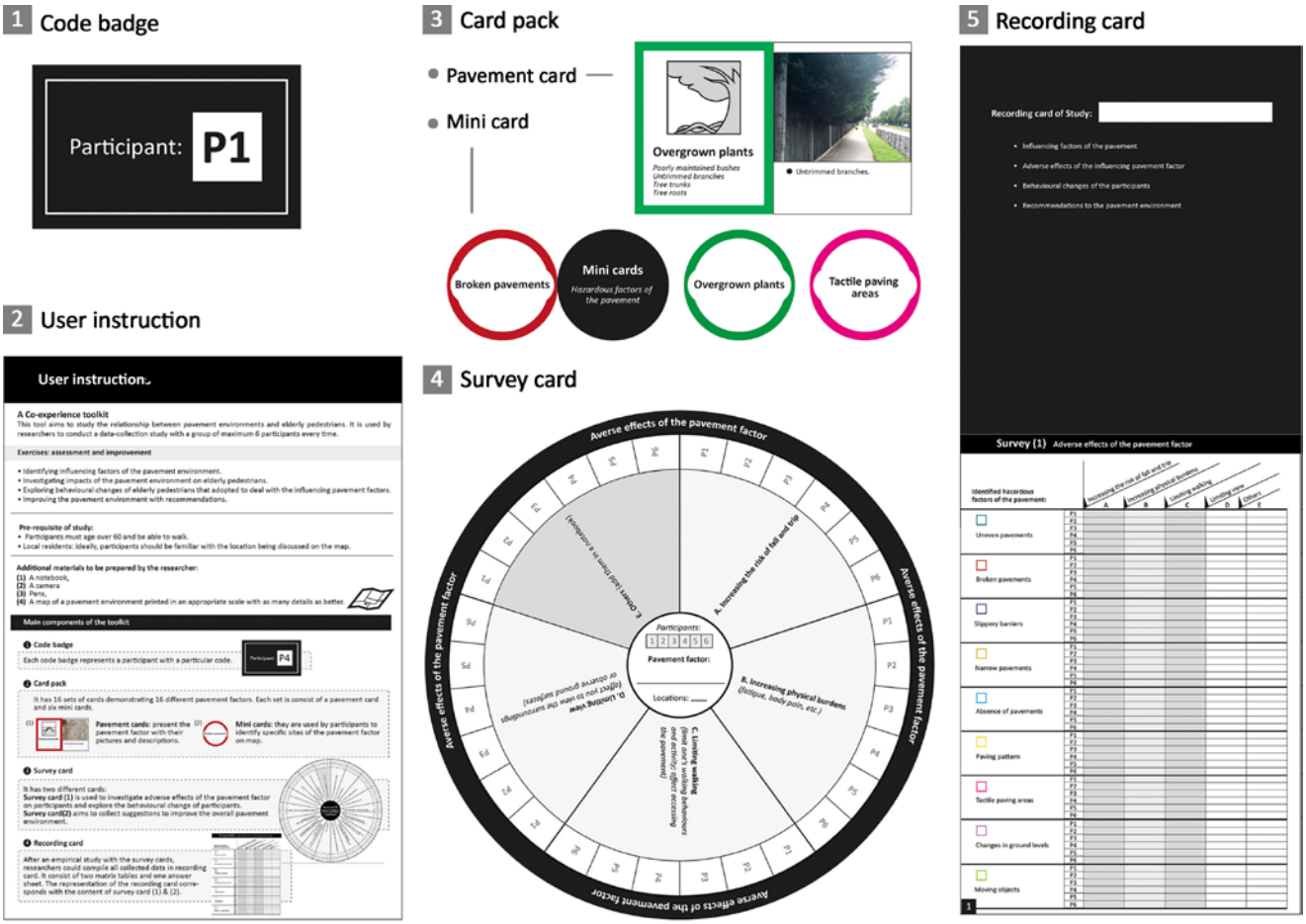
Code badges: there are six code badges, and each of them uses a unique number, such as 1, 2, or 3 to represent a study participant. The code badges allow participants' identity to be confidential and help to avoid participants giving answers repeatedly in group exercises.

User instruction: the user instruction introduces the aim, objectives, target users, practices, and components of the toolkit, and provides a step-by-step guide for using the toolkit.

Card pack: the card pack incorporates 16 pavement cards and 96 mini cards. Each pavement card corresponds with six mini cards representing one of the pavement hazards found in our empirical study. The pavement card box are not only used to expand users' ideas, but also employed by participants to preliminarily identify hazards of a pavement environment.

Survey cards: the survey cards constitute 16 copies of survey card 1 and a copy of survey card 2 that are used to explore the relationship between each pavement hazard and older pedestrians (study participants). Survey card 1 was made to explore the physical and behavioural impact of each pavement problem on study participants, and survey card 2 allows the participants to suggest improvements to the pavement environment using the recommendations constructed in the empirical study. The survey cards were made into a pie chart to ensure that all users to read them from different angles. Each segment of survey card 1 displays an adverse effect of the pavement hazard or a behavioural factor triggered by it, and each segment of survey card 2 offers a recommendation to the pavement. The outer ring of each division split into six individually showing one of the participant codes that allows participants to give an answer by ticking their code. Also, both of the survey cards provide an option of 'Others' allowing participants to add extra findings in addition to the provided content.

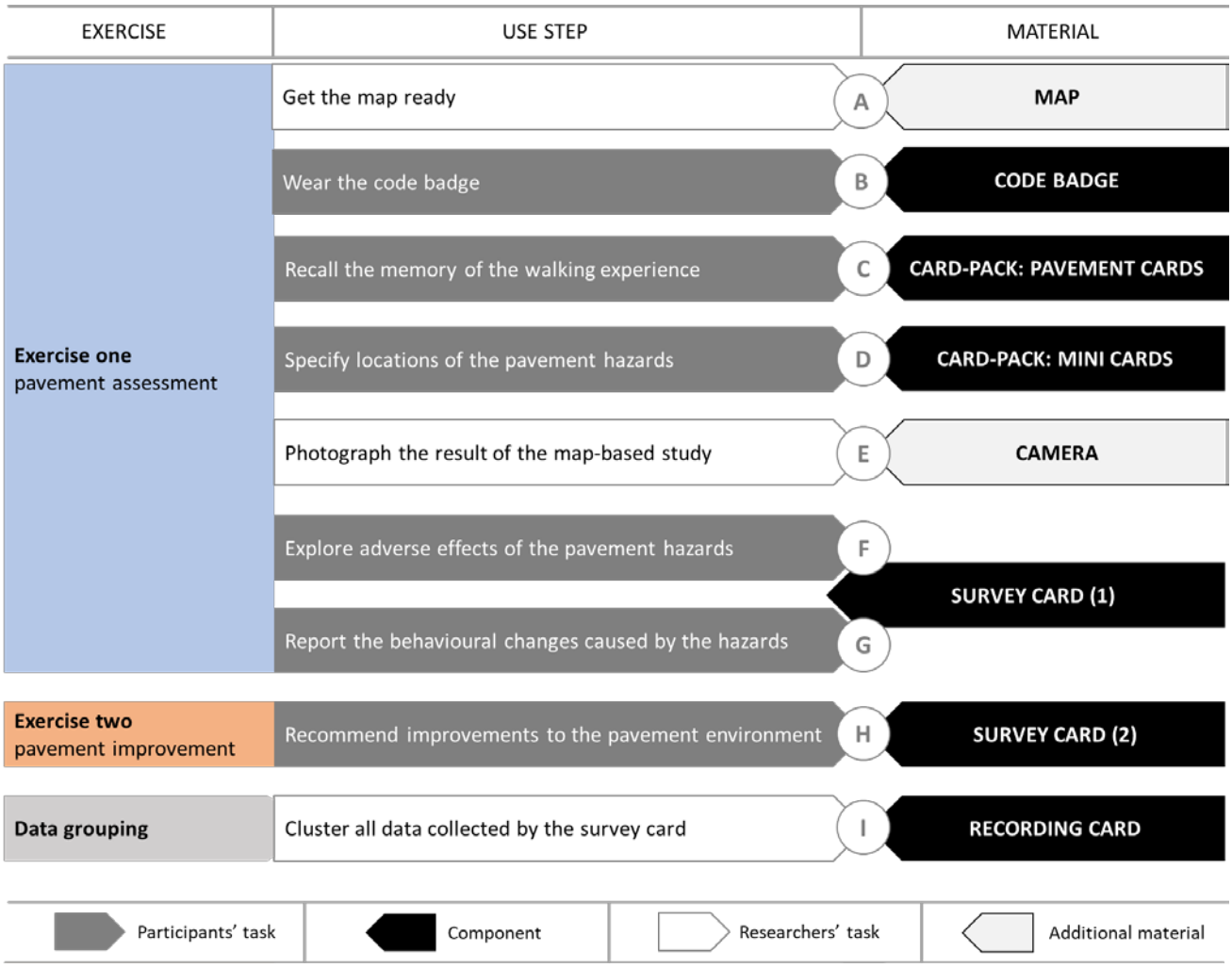
Recording card: the recording card has three matrices, and all their column headers is a list of the 16 pavement hazards while their row headers respectively are the impact of the pavement hazards, behavioural changes of participants, and improvements to the pavement. Each row of the matrices was divided into six divisions for researchers to group data while to distinguish different participants' answer to the same category.



[Figure 1] *The participatory study toolkit*

2.2. Use of the toolkit

To use the tool, researchers must first prepare a map and bring a camera to photograph results of the map-based assessment. At the beginning of the study, researchers need to introduce all components of the toolkit to participants and teach them to use the tool and assign a code badge to each participant. Next, participants use the card pack to conduct a brainstorming session on problems with the pavement. Following this, researchers can start to assess the pavement environment by asking participants to demonstrate hazards that exist in the context using relevant pavement card boxes. Then, researchers collect these identified card boxes and take out mini cards from them, and participants use the mini cards to locate the hazards on the map. Afterwards, researchers photograph the result of the map-based exercise so that they can quickly record the exact locations of the pavement hazards and continue to review the results after the study. In the following step, researchers use a copy of survey card 1 to further explore one of the identified pavement hazards only with the participants who have referred this issue on the map. Before the data collection, researchers need to indicate the identified pavement issue on the centre of survey card 1 so that participants know what factor they need to focus upon. Also, researchers need to write down the code of the participants who pinpoint the problem on the map and the locating number of the hazard on survey card 1. As to participants' tasks of survey card 1, they need to tick their codes on card segments if they agree with the statement presented by the portion. Each survey card 1 is used to study a pavement hazard identified on the map already. The more pavement issues are analysed, the more copies of survey card 1 will be used. Based on the results of the map-based assessment and survey card 1, participants carry on recommending improvements to the pavement environment on survey card 2. Finally, researchers cluster all data collected by those survey cards in their recording card.



[Figure 2] *Use of the toolkit*

3. TESTING OF THE TOOLKIT

As the toolkit would be used to implement a group study within two kinds of users, the feedback from researchers and study participants (older people) could be different according to their standpoints. Therefore, the toolkit was evaluated in two sections conducted separately with elderly participants in workshops and with researchers in an interview-based study to seek their in-depth and diverse views. Workshop is a common method to develop a design tool and to identify users' interests and the impact of a design solution (Rail Safety and Standards and Board, 2008). The workshop aimed to examine if elderly participants could use the toolkit to carry out practices properly in a group activity. Eight senior residents (older than 60 and fit enough to walking) in London were recruited to the workshops and they were divided into groups of four. A map was used for the map-based assessment and it was created based on Google Maps. It displayed a part of the pavement environment in London and it was made in A1 size with the ratio scale of 1:2000 to enable all group members to read it correctly. Interviews allow interviewees' experience and feelings to be expressed and enables their perspectives to be in-depth explored (Kvale, 2003 and Berg, 2007, cited in Alshenqeeti, 2014). The interview-based study was adopted to test if researchers could self-learn the tool and use it to plan a study themselves. Eight researchers were invited from academic and industrial fields and the local authority of Uxbridge to the study. They were sampled for a purpose of diversity (Patton, 2009) and a reason that they acquired relevant knowledge or research interest regarding the content of the toolkit (Creswell & Plano Clark, 2017). The participants comprised four experienced researchers, two younger researchers, a designer, and a councillor. They were professionally engaged in the field of transport environments, travel behaviour, inclusive design, tool design, highway and pavements, neighbourhood maintenance, residential services, or architectural design. In the study, the researchers were asked to simulate a

data collection using the tool and to share their user experience and perspective of the toolkit. In addition to the testing, a questionnaire was used in both workshop and the interview to collect the user feedback concerning the design, information, utility, and outputs of the tool.

3.1. Results and discussion

Data collected by the questionnaires were analysed using statistical analysis (Lavrakas, 2008) to work out response rate to each question. Some qualitative information, such as additional explanations, insights, and narratives of the users, were transcribed and coded and finally grouped into content, design, usability, inputs, outputs, and other comments. In general, the tool was simple and well designed, and it enabled the users to efficiently investigate pavement hazards and their impact in walking among older pedestrians. It assisted the researchers to improve the pavement environment and to understand older pedestrians' walking needs from a new angle. The elderly users indicated that the tool covered almost every factor of their walking behaviour and every aspect of the pavement. These views were well defined and emerged all problems that they had encountered in the real world. The tool also included some facets that the older adults had not thought of or considered before that made them think they had the same responsibility as local councils. The researchers said that the tool provided them a new way to conduct an easy group study with older adults. It helped them to quickly and efficiently get information about hazardous factors of the pavement and barriers to walking. Some of the researchers would introduce the tool to local governments and use the tool to train construction engineers and road designers so that they could be more aware of older pedestrians and, hence to improve the age-friendliness of the pavement environment. The researchers also said that the data collected by the tool was analysable that could be easily transcribed into an assessment report or design guidance or solutions. They would interpret the outcomes with more evidence in their work field, analyse the data using a technical approach, seek insights into the results, and explore pavements in different areas with diverse populations. An expert would improve the travel experience of older people in outdoors based on the behavioural varies identified by the tool.

On the other hand, some users had to take a longer time to learn the toolkit, especially at the beginning of the study, as they were confused about the instruction and the link between each section of the tool. However, the tool worked well for them as soon as they understood the principle. Some operations of survey card 1, such as the recording of the results of the map-based exercise, was less useful to the researchers. Also, the size and layout of the survey cards restricted the elderly participants' action although they indeed promoted the group discussion. In this situation, two participants had to play a leadership role to write down other people's answers to the survey cards. In line with O.Nyumba et al. (2018), they were found to influence the study results especially when the other participants did not stand firm on their opinions or were not active. To avoid the issue, the survey cards needed to be redesigned into a more user-friendly layout with a larger size to enable all participants to be more engaged in the group interaction. Apart from that, grouping data from the survey cards to the recording card was not an effective action as the layout of the two materials were different. In this case, some researchers preferred to use a different approach, such as Excel, to compile data. An interviewee also recommended a digital format for the recording card.

4. CONCLUSION

Wennberg, Phillips, & Ståhl (2017) state that it is crucial to understand older people′s knowledge and perspectives to outdoor environments and to include them in the process of shaping their environments. The toolkit gives a chance for older people to participate in urban development and provides a new way for urban planners, environment designers, and local councillors to know about the hazardous impact of poor pavement conditions and better understand the need and experience of walking among older pedestrians. User-involvement studies have been commonly conducted in the environment-development as they could help to mitigate the unnecessary cost and unaccepted design (Kujala, 2003). Collaborating with older people in urban development has a great impact on building a sustainable community and making policies for age-friendly cities (Buffel, Phillipson, & Scharf, 2012). In addition, outdoor infrastructure can be improved based on a better understanding of elderly people′s mobility requirements and walking experience and an in-depth investigation of walking hazards in older

adults (Ormerod et al., 2015). In future, the toolkit will be modified based on the user feedback so that it better assists target users with the participatory study.

BIBLIOGRAPHY

Achuthan, K., Titheridge, H., & Mackett, R. L. (2010). Mapping accessibility differences for the whole journey and for socially excluded groups of people. *Journal of Maps, 6*(1), 220–229. http://doi.org/10.4113/jom.2010.1077

Alshenqeeti, H. (2014). Interviewing as a Data Collection Method: A Critical Review. *English Linguistics Research*, *3*(1), 39–45. http://doi.org/10.5430/elr.v3n1p39

Buffel, T., Phillipson, C., & scharf, T. (2012). Ageing in urban environments: Developing “age-friendly” cities. *Critical Social Policy, 32*(4), 597–617. http://doi.org/10.1177/0261018311430457

Caetano, M. J. D., Lord, S. R., Schoene, D., Pelicioni, P. H. S., Sturnieks, D. L., & Menant, J. C. (2016). Age-related changes in gait adaptability in response to unpredictable obstacles and stepping targets. *Gait and Posture, 46,* 35–41. http://doi.org/10.1016/j.gaitpost.2016.02.003

Chang, W. R., Chang, C. C., Lesch, M. F., & Matz, S. (2017). Gait adaptation on surfaces with different degrees of slipperiness. *Applied Ergonomics, 59,* 333–341. http://doi.org/10.1016/j.apergo.2016.09.008

Creswell, J. & Plano Clark, V. (2017). *Designing and conducting mixed methods research* (3rd ed.) Thousand Oaks: Sage Publications.

DfT. (2007). *Manual for Streets*. Thomas Telford Ltd (Vol. 162). London: Thomas Telford Publishing. http://doi.org/10.1680/muen.2009.162.3.129

Day, R. (2008). Local environments and older people’s health: Dimensions from a comparative qualitative study in Scotland. *Health and Place, 14*(2), 299–312. http://doi.org/10.1016/j.healthplace.2007.07.001

Fisk, A., Czaja, S., Rogers, W., Charness, N. and Sharit, J. (2009). *Designing for older adults*. Boca Raton, FL: CRC Press.

Grant, T. L., Edwards, N., Sveistrup, H., Andrew, C., & Egan, M. (2010). Neighborhood Walkability : Older People ’ s Perspectives From Four Neighborhoods in Ottawa , Canada. *Journal of Aging and Physical Activity, 18,* 293–312.

Iversen, G. (2010). *Pedestrian Comfort Guidance for London: An assessment tool to evaluate the real impact of street furniture and available footway, and guidance for understanding the implications for different preferences for space in different area types*. Association for European Transport and contributors.

Kujala, S. (2003). User involvement: A review of the benefits and challenges. *Behaviour and Information Technology, 22*(1), 1–16. http://doi.org/10.1080/01449290301782

Kovacs, C. R. (2005). Age-related changes in gait and obstacle avoidance capabilities in older adults: A review. *Journal of Applied Gerontology, 24*(1), 21–34. http://doi.org/10.1177/0733464804271279

Kim, S., Choi, J., & Kim, Y. (2011). Determining the sidewalk pavement width by using pedestrian discomfort levels and movement characteristics. *KSCE Journal of Civil Engineering, 15*(5), 883–889. http://doi.org/10.1007/s12205-011-1173-1

Krueger, R. & Casey, M. (2015). *Focus groups*. Los Angeles [etc.]: SAGE.

Lavrakas, P. (2008). *Encyclopedia of survey research methods*. Thousand Oaks, Calif.: SAGE Publications.

Mateo-Babiano, I. (2016). Pedestrian’s needs matters: Examining Manila’s walking environment. *Transport Policy, 45,* 107–115. http://doi.org/10.1016/j.tranpol.2015.09.008

Un.org. (n.d.). *Ageing*. Retrieved from http://www.un.org/en/sections/issues-depth/ageing/

Ormerod, M., Newton, M. R., Phillips, J., Musselwhite, A. C., Mcgee, S., & Russell, R. (2015). *How can transport provision and associated built environment infrastructure be enhanced and developed to support the mobility needs of individuals as they age ? Future of an ageing population: evidence review*. London: Government Office for Science. Retrieved from https://www.gov.uk/government/publications/future-of-ageing-transport-and-mobility

O.Nyumba, T., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution, 9*(1), 20–32. http://doi.org/10.1111/2041-210X.12860

Patton, M. (2009). Qualitative research & evaluation methods (2nd ed.) Thousand Oaks, Calif.: Sage.The Older People’s Commissioner for Wales. (2013). *A Thousand Little Barriers*. Cardiff. Retrieved from http://www.olderpeoplewales.com/en/news/news/13-08-28/A_Thousand_Little_Barriers.aspx#.W6FAcfmPKUk

Rail Safety and Standards, & Board. (2008). *Understanding Human Factors a guide for the railway industry*. *Rail Safety and Standards Board*. Rail Safety and Standards Board. Retrieved from https://www.rssb.co.uk/Library/improving-industry-performance/2008-guide-understanding-human-factors-a-guide-for-the-railway-industry.pdf

Rackliff, L. (2013). *Deriving and validating performance indicators for safety mobility for older road users in urban areas*. Loughborough University. Retrieved from http://ezproxy.nottingham.ac.uk/login?url=https://search.proquest.com/docview/1774246183?accountid=8018 http://sfx.nottingham.ac.uk/sfx_local/?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=dissertations+%26+theses&sid=ProQ:ProQue

Shih, P. C., Nguyen, D. H., Hirano, S. H., Redmiles, D. F., & Hayes, G. R. (2009) 'GroupMind : Supporting Idea Generation through a Collaborative Mind-mapping Tool', In *Proceedings of the ACM 2009 international conference on Supporting group work*, pp. 139–148. doi: 10.1145/1531674.1531696.

Wennberg, H., Phillips, J., & Ståhl, A. (2017). How older people as pedestrians perceive the outdoor environment – methodological issues derived from studies in two European countries. *Ageing and Society*, 1–33. http://doi.org/10.1017/S0144686X17000666

Yin, L. & Pei, E. (2018). A Co-Experience Toolkit: investigating the issues of the pavement environment and the relationship with elderly pedestrians. *In DRS2018 Design as a catalyst for change,* Volume 3 ISBN 978-1-912294-18-3. 25-28 June 2018, Limerick, Ireland.