

Characteristics and Attitudinal Changes of Senior Citizens and Persons with Functional Impairments Involved in a Citizen Science Project on Housing Accessibility



CITIZEN SCIENCE:
THEORY AND PRACTICE

RESEARCH PAPER

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ABSTRACT

Citizen Science (CS) projects targeting senior citizens and persons with functional impairments are rare, and interest among citizens to become involved in such remains uncertain. There is a lack of systematic analyses as to what distinguishes citizens' willingness to contribute, and what such involvement could lead to in terms of acquired skills or changed attitudes. Based on a Swedish CS project on housing accessibility – the Housing Experiment (HX) – this study aimed to investigate: 1) the characteristics of senior citizens and persons with functional impairments involved in the HX; and 2) changes in attitudes and mobile digital literacy after completing the HX. Data were collected via online questionnaires before and after the HX (N = 147), and were analyzed statistically. The response rates were lower than anticipated. Study participants completing the HX reported high levels of mobile digital literacy and functional ability, and a higher education level than the general Swedish population. The only attitudinal change was that significantly more participants rated the importance of housing accessibility lower after their involvement in the HX compared with those rating it higher. This study confirms indications from previous studies that limitations in mobile digital literacy and functional ability affect the willingness and ability to get involved in research. Further research is warranted to investigate how similar CS projects could be designed to attract more participants and to create the conditions for greater gains for citizen scientists.

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KEYWORDS:

aging; attitude; involvement;
motivation; participatory
research; public

TO CITE THIS ARTICLE:

Frögren, J, Granbom, M, Jonsson, O, Bergman, M and Iwarsson, S. 2023. Characteristics and Attitudinal Changes of Senior Citizens and Persons with Functional Impairments Involved in a Citizen Science Project on Housing Accessibility. *Citizen Science: Theory and Practice*, 8(1): 57, pp. 1–13. DOI: <https://doi.org/10.5334/cstp.551>

INTRODUCTION

Citizen Science (CS) is an umbrella concept for research that involves the public in addressing real-world problems using participatory approaches (Bonney et al. 2016).

A comparison can be made to traditional research methods (Kosmala et al. 2016). From the researchers' point of view, it has been argued that CS leads to a broader understanding of real-world problems, more relevant research questions being formulated (English et al. 2018), and increased research capacity (Cooper et al. 2007; Strasser and Haklay 2018). CS with the active involvement of senior citizens has, for example, been shown to enrich researchers' understanding of what constitutes age-friendly environments (Wood et al. 2022).

CS has been described as a potential path for participants to scientific citizenship (Cappa et al. 2018; Dean et al. 2018; Strasser et al. 2019), that is, to an understanding of the role of science in addressing important societal issues (Kasperowski and Brounéus 2016). Moreover, there is evidence that CS leads to improved understanding and application of research methodology among citizen scientists (Bremer et al. 2019; Haywood et al. 2016), as well as opportunities for senior citizens to develop new skills (James and Buffel 2022). In addition, researchers have had ambitions that CS involvement should encourage long-term engagement in the societal issue that constitutes the research topic (Kasperowski and Brounéus 2016; Vasiliades et al. 2021). Previous research has indicated that involvement in CS projects can lead to increased awareness and commitment to the societal issues at stake (Bremer et al. 2019; Haywood et al. 2016), although such awareness might be time limited (Jordan et al. 2011). Nevertheless, from an overall perspective, the gains from CS are often ignored, assumed, or subject to speculation and seldom analyzed systematically (Kasperowski and Brounéus 2016; Wehn et al. 2021).

A prerequisite for CS, however, is that citizens are willing to get involved. Previous research shows that the appeal of the research topic of a particular CS project likely affects the motivation to get involved (Rowbotham et al. 2019). Factors positively influencing senior citizens' willingness to become actively involved in research include higher education and previous experience of involvement (Frögren et al. 2022), while reduced health and functioning seem to have a negative effect (Brookfield et al. 2020; King et al. 2020; Wiggins and Wilbanks 2019). CS often involves digital data collection using mobile digital devices (Haklay 2022). Thus, the ability to handle digital devices such as smartphones and tablets, that is, mobile digital literacy (Asino et al. 2020; Traxler 2012), is important and also is likely to influence CS involvement. While there are

indications that there is selective exclusion of participants with low digital literacy in eHealth trials targeting senior citizens Poli et al. (2020), the phenomenon has not been studied sufficiently within CS.

ACCESSIBLE HOUSING FOR THE AGING POPULATION

Accessible housing for the aging population is a subject for public debate and is important in aging research (Jonsson et al. 2021). However, it has hitherto not received attention within CS. Living in housing with accessibility problems is associated with less autonomy and reduced participation in daily life (see, e.g., Norin et al. 2017). Furthermore, accessibility problems impair quality of life, increase the risk of falling and the burden on carers and social services (WHO 2018). For example, in Sweden, although the ordinary housing stock meets high standards, senior citizens with functional impairments face significant accessibility problems (Granbom et al. 2016). Valid data on environmental barriers generating accessibility problems in the ordinary housing stock are a prerequisite to improving housing accessibility (Jonsson et al. 2021).

As part of the European annual science festival European Researchers' Night (Public & Science 2021a), an annual CS project was organized in Sweden in 2009, coordinated by the nongovernmental organization Public & Science (2021b). Topics vary from year to year and usually engage mainly school children and their teachers. In addition, the annual national CS project is usually researcher-initiated, with citizen scientists involved in a limited part of the process (mainly the data collection). These CS projects can be categorized as *contributory* and not *co-creating* CS (Wiggins and Wilbanks 2019).

STUDY CONTEXT: THE HOUSING EXPERIMENT

Following the national tradition of annually recurring CS projects (with a varying theme each year) in Sweden since 2009, housing accessibility was chosen as the topic in 2021. The Housing Experiment (HX) (Public & Science 2021c) was implemented in Sweden because the provision of accessible housing is a "wicked problem" (Jonsson et al. 2021), meaning the topic includes a complexity that motivates the concentration to one national context to make the project manageable. Relating to this, housing policies and legislation are organized at the national level, where there have long since been policy ambitions (Granbom et al. 2016) as well as explicit interest among national senior citizen associations to secure the provision of forward-looking housing with the potential to accommodate the aging population. Statistics indicate that the use of mobile digital devices among senior citizens in Sweden is high (Swedish Internet Foundation, 2022), therefore, the concentration of

the study to Sweden was deemed appropriate to meet the goal of a large proportion of older citizens as participants.

The HX was implemented as a collaboration between Public & Science and researchers at the Centre for Ageing and Support Environments (CASE) at Lund University. Other partners included the three largest national senior citizen associations (approximately 695,000 members in total) as well as the software company MiThings. All residents in Sweden were welcome to take part. However, the main target participants for the HX were senior citizens and persons with functional impairments. It was the first time that these groups constituted the main target groups for the annual national CS project.

While Public & Science, CASE, and MiThings led design and implementation, the national associations provided study input and spread information about the HX to their members. The aim of the HX was to engage people across the country to assess environmental barriers in the ordinary housing stock using a mobile app developed for this purpose (Granbom et al. 2023). The mobile app was based on Housing Enabler, an instrument for valid and reliable assessment of housing accessibility (Iwarsson et al. 2012).

From September 1 to November 12, 2021, the mobile app was available for free download from publicly available platforms. A website was created for the HX, containing information about the purpose of the CS project, an instructional video for data collection, and a detailed guide describing the project and the mobile app. Using the mobile app, the citizen scientists were asked to assess and register environmental barriers in their dwellings. When all questions were answered, the results were digitally submitted to a database.

To encourage interaction regarding the collected data, the database was updated as it grew, in real-time, on the project website. Citizen scientists were informed that by accessing the database they could explore how registered environmental barriers generated accessibility problems for different profiles of functional limitations (Iwarsson et al. 2012). Based on the registered data and the website's interactive interface, the citizen scientists were able to explore the accessibility of different housing types, different municipalities and nationally. The idea was that the citizen scientists could use this data as support for further discussions about accessibility with, for example, policymakers and wider society. In total, 1,203 people completed the HX.

AIM

This study involves a subset of the HX participants. The aims of the study were: 1) to investigate the characteristics of senior citizens and persons with functional impairments

involved in the HX; and 2) to investigate changes in attitudes toward research, housing accessibility, and individual ability to handle mobile digital devices (i.e., mobile digital literacy) after involvement in the HX. We also investigated how these attitudinal changes related to demographics, health and functioning, housing tenure, previous research experience, work experience in the housing sector, and previous experience with mobile digital devices.

MATERIALS AND METHODS

Consistent with the study's pre-post design, the data was collected from participants via online questionnaires before (pre-Q) and after (post-Q) completion of the HX (Figure 1). As no personal participant data were collected in the HX, the only way to determine who had completed it was through an explicit question in the post-Q. "Full study participants" referred to those who confirmed their completion in the post-Q, while "partial study participants" referred to those who responded to the pre-Q but did not take part in the HX and/or did not respond to the post-Q. "Study participants" referred to all participants in this study, regardless of their degree of involvement, thus including both the full and the partial study participants.

Study participants were recruited in two ways. The first way was via an email invitation sent to members of local branches of senior citizen associations and interest groups for persons with functional impairments in southern Sweden. Local senior citizen associations and interest groups were identified using convenience sampling and then contacted. Out of 14 associations and interest groups contacted, 11 agreed to distribute information about the study via email to their members. Approximately 2,500 potential study participants received three emails (Figure 1), which included an initial email and two reminders sent on average two weeks apart. The emails included a link to a Lund University website with study information and a link to the pre-Q. Up to five emails were sent to everyone who had answered the pre-Q but not the post-Q, reminding them to complete the HX. A link to the post-Q was included in these reminder emails, with an explanation that it should be filled out after completing the HX.

Study participants were also recruited via the HX support function (via email, telephone, and Facebook). This was done by informing people who contacted the HX support about the possibility of participating in the study. In this way, 10–15 potential study participants were referred to the project website for more information and to access the pre-Q.

At the time of the HX launch, a control question was added to the informed consent in which potential study

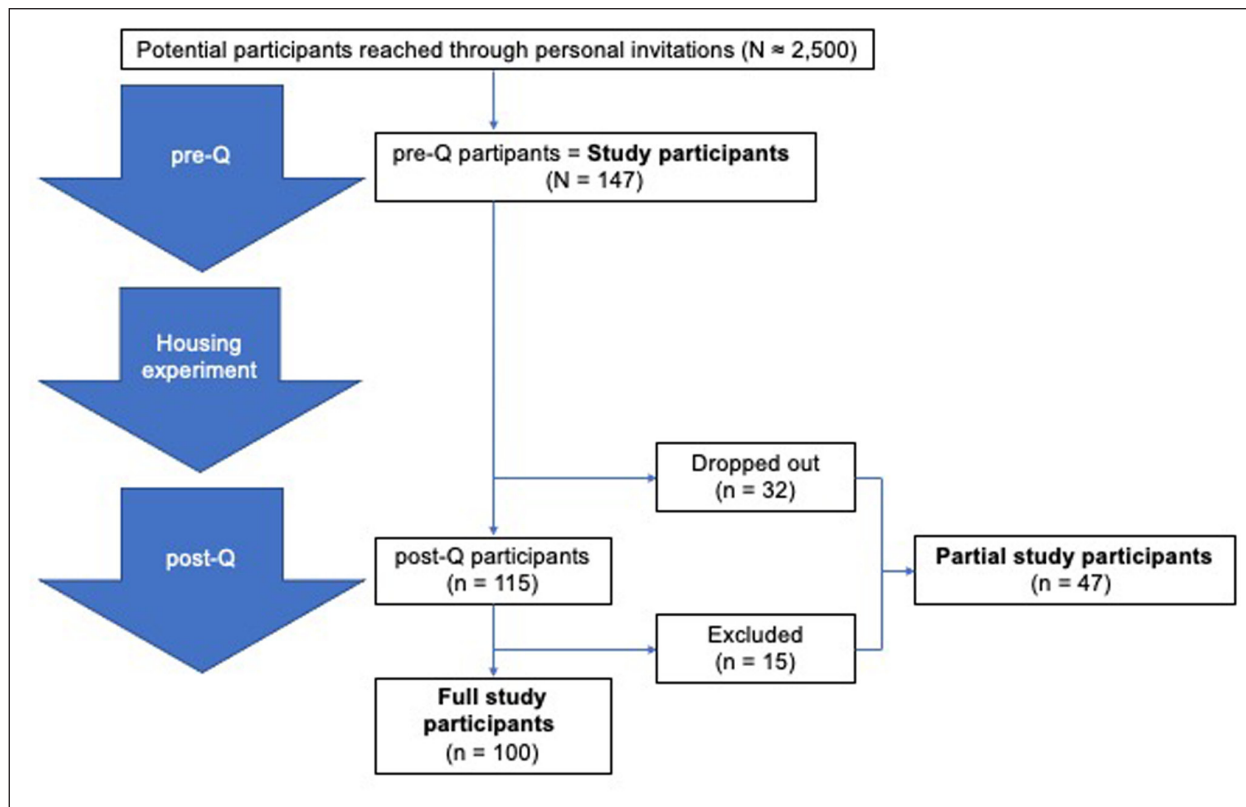


Figure 1 Flowchart of participation in the three parts of the study (pre-Questionnaire, pre-Q; Housing Experiment; post-Questionnaire, post-Q) resulting in the two groups compared: full study participants and partial study participants.

participants had to state that they had not yet completed the HX before answering the pre-Q. All study participants who answered both the pre-Q and post-Q received a lottery ticket (value 3 USD).

THE QUESTIONNAIRES

The pre-Q and post-Q were drafted and revised in several rounds by the research group, including input from three senior citizens (not among the study participants) recruited from the first author's network. They were 70 years or older and interested in housing accessibility issues. Draft information letters and questionnaires were emailed separately to them; they then provided individual feedback through email and telephone. The pre-Q was made up of 27 questions, and the post-Q was made up of 18 questions. The questions pertained to demographics; health and functioning; housing tenure; previous research experience; work experience in the housing sector; previous experience with mobile digital devices; involvement in the HX; attitudes towards housing accessibility and research; and mobile digital literacy.

VARIABLES

The variables were divided into two categories. The first category related to the comparison of characteristics

between full and partial study participants. The second included variables related to the investigation of differences in attitudes and digital literacy between pre-Q and post-Q. For some variables, the study participants could enter free-text responses.

Variables related to study participant characteristics

Demographics included age, gender, level of education, and internet access. Education level was categorized into elementary school, upper-secondary school, and tertiary education. Internet access was assessed with the question: "Do you have access to the internet in your home?" (yes/no).

Health was assessed with the question: "In general, how is your health...?" (poor; fair; good; very good; excellent) (Ware Jr. and Sherbourne, 1992).

Home ownership was assessed with the question: "Do you own your housing, partially or fully?" (yes/no).

Functioning was assessed with the questions: "Does someone in your household use a walker or wheelchair?" (yes/no); and "Does someone in your household receive home help from the municipality or a private sector provider?" (yes/no).

Previous experience of mobile digital devices was assessed with the questions: "Do you use, or have you used digital devices such as computers, smartphones, or tablets

in your working life?” (yes/no); “In the latest three months, how often have you used a smartphone or tablet” (daily/less frequently); and “When was the last time you downloaded an app to a smartphone or tablet?” (last week; last month; the past year; have never downloaded a mobile app).

Housing work experience was assessed with the question: “Have you had a job that included planning, designing, building, adapting or managing housing?” (yes/no).

Research experience was assessed with the multiple-choice question: “Have you previously been involved in a research project?” Study participants were given response options as to how they had been involved. Responses were recoded: “previous research involvement” equaled “yes” if the participants answered “yes” to any of the types of involvement listed.

Variables related to the investigation of changes in attitudes and digital literacy

Attitude towards housing accessibility was assessed with the question: “How important is physical accessibility in housing to you?” (not at all important; not so important; quite important; important; very important).

Attitude towards research was assessed with the question: “How interested are you in research?” (not at all interested; not so interested; quite interested; interested; very interested).

Mobile digital literacy was assessed with the question: “How knowledgeable are you when it comes to using a smartphone or tablet?” (not at all knowledgeable; not very knowledgeable; quite knowledgeable; very knowledgeable).

DATA ANALYSES

To investigate the differences in characteristics between full and partial study participants, a between-subjects comparison was conducted. Depending on the character of each variable, either the Chi-square test (χ^2) or Mann Whitney test was used.

To investigate changes in attitudes and digital literacy from pre-Q to post-Q among the full study participants, a within-subjects comparison was conducted. For the analyses of the within-subjects comparison, a paired-sampled sign test was used. Only full study participants who recorded different responses in the pre-Q and post-Q were included as the sign test prescribes. In this way, the proportions of full study participants rating their attitudes and digital literacy lower after their involvement in the HX was compared with the proportions rating them higher. Descriptive statistics were used to account for how the response alternatives were distributed for those who did not report any change.

To analyze how changes in attitudes or digital literacy related to demographics, health and functioning, housing tenure, previous research experience, work experience in the housing sector, and previous experience with mobile digital devices, either the Chi-square test (χ^2) or Mann Whitney U test was used, depending on the character of each variable. These analyses compared the group that showed significant change with the remaining full study participants.

We used the IBM SPSS software version 27 for all the analyses. A two-sided p-value of ≤ 0.05 and a 95% confidence interval (CI) served as indicators of statistical significance.

ETHICS

Ethical approval was obtained from the Swedish Ethical Review Authority (Ref. 2021/02256). The invitation email that was sent to all potential study participants included a link to a website with information on the background and purpose of the study. Participants were required to provide informed consent before they could answer the pre-Q. They were asked to confirm that they had understood that participation was voluntary, that they had the right to discontinue their participation at any time, and that data would be processed per the General Data Protection Regulation (GDPR) and local data protection guidelines.

RESULTS

A total of 147 individuals responded to the pre-Q (approximately 6% response rate). Of those, 32 (22%) did not respond to the post-Q and 15 (10%) were excluded because they had not completed the HX (Figure 1). The study population thus included 100 full study participants and 47 partial study participants.

All study participants (N = 147) had access to the internet in their homes. The full study participants (n = 100) had a mean age of 72.9 (SD = 8.1) years. The gender distribution was 56% women and 44% men. In terms of education, 16% stated elementary school as the highest level of education, 17% upper secondary school, and 67% tertiary education (Table 1).

As preparation for the HX, almost half (48%, n = 48) of the full study participants reported that they had visited the project website. About a third of those had watched the instructional video, and three had read the detailed user guide available there. To complete the HX, 77% used a smartphone and the rest used a tablet. Forty-two percent of full study participants found it very easy to answer the questions; 39% quite easy, and the rest, neither easy

nor difficult. None experienced it as difficult. Two percent experienced practical problems during the assessment and registration of environmental barriers, while 98% did not. It took 10 minutes or less to complete the assessments and registrations of barriers for 26% of full study participants, 11–20 minutes for 50%, and more than 20 for 25%.

In the post-Q, 5% of full study participants reported that they had studied the results on the website. Almost half (45%) claimed they were not aware they could, 24% that they had not had the time, 20% that they were not interested, and the rest gave other reasons.

Full study participants had significantly ($p < 0.01$) more recent experiences with downloading apps to their

smartphones or tablets (Table 1), compared with the partial study participants ($n = 47$) before the HX. Among the 15 partial study participants who answered the post-Q but had not completed the HX, eight stated explicitly that they had tried to download the mobile app but had not succeeded.

Concerning health and functioning, it was more likely that someone in the household of the partial study participants used a walker or wheelchair ($p = 0.01$) and/or received home care ($p = 0.02$).

Regarding the attitude to housing accessibility (Table 2), before their involvement in the HX, 89% of full study participants considered housing accessibility to be

PARTICIPANT CHARACTERISTIC	FULL STUDY PARTICIPANTS (n = 100)	PARTIAL STUDY PARTICIPANTS (n = 47)	P-VALUE ¹
Gender, n%			0.56
men	44 (44.0)	17 (37.0)	
women	56 (56.0)	29 (63.0)	
Age, mean (SD)	73 (8.1)	75 (8.1)	0.80
Education, n (%)			0.16
elementary school	16 (16.0)	11 (23.9)	
upper-secondary school	17 (17.0)	11 (23.9)	
tertiary education	67 (67.0)	24 (52.2)	
Health, n (%)			0.08
poor	29 (29.3)	20 (43.5)	
fair/good/very good	39 (39.4)	15 (32.6)	
excellent	31 (31.3)	11 (23.9)	
Housing tenure, n (%)			0.29
own	78 (78.7)	33 (71.7)	
rent	21 (21.2)	13 (28.3)	
Mobility device use ² , n (%)	9 (9.0)	14 (30.4)	0.01
Homecare reciever ² , n (%)	2 (2.0)	5 (11.0)	0.02
Digital device experience ³ n (%)	92 (92.0)	37 (84.1)	0.13
Mobile digital device use, n (%)			0.17
daily	92 (93.9)	42 (93.3)	
less frequently	6 (6.1)	3 (6.7)	
Downloaded app, n (%):			< 0.01
in the previous week	51 (51.0)	13 (28.3)	
in the previous month	32 (32.0)	21 (45.7)	
in the previous year	16 (16.0)	5 (10.9)	
never	1 (1.0)	7 (15.2)	

(Contd.)

PARTICIPANT CHARACTERISTIC	FULL STUDY PARTICIPANTS (n = 100)	PARTIAL STUDY PARTICIPANTS (n = 47)	P-VALUE ¹
Housing construction experience, n (%)	7 (7.1)	4 (8.7)	0.74
Research experience, n (%)	77 (78.6)	36 (85.7)	0.21

Table 1 Characteristics of full study participants (n = 100) and partial study participants (n = 47).

Note: n varies due to internal missing, thus valid percent is used. ¹Chi-square test was used for nominal scale variables; Mann Whitney test for continuous/ordinal scale variables when comparing characteristics of full study participants and partial study participants. A p-value below 0.05 was considered a statistically significant difference. ²Anyone in household. ³Based on participant's use of digital tools (computer/smartphone/tablet) in professional practice.

ATTITUDES AND LITERACY	FULL STUDY PARTICIPANTS		FULL STUDY PARTICIPANTS WITH UNALTERED VIEWS ¹
	pre-Q	post-Q	pre-Q & post-Q
Housing accessibility, n (%)			
Not at all important	0 (0.0)	4 (4.0)	0 (0)
Not so important	11 (11.1)	19 (19.0)	7 (15.2)
Quite important	16 (16.2)	17 (17.0)	7 (15.2)
Important	36 (36.4)	38 (38.0)	19 (41.3)
Very important	36 (36.4)	22 (22.0)	13 (28.3)
Research, n (%)			
Not at all interested	0 (0.0)	2 (2.0)	0 (0.0)
Not so interested	15 (15.0)	10 (10.2)	5 (10.4)
Quite interested	27 (27.0)	40 (40.8)	15 (31.3)
Interested	38 (38.0)	31 (31.6)	17 (35.4)
Very interested	20 (20.0)	15 (15.3)	11 (22.9)
Mobile digital literacy, n (%)			
Not at all knowledgeable	0 (0.0)	1 (1.1)	0 (0)
Not so knowledgeable	17 (17.0)	15 (15.8)	9 (13.6)
Quite knowledgeable	62 (62.0)	52 (54.7)	41 (62.1)
Very knowledgeable	21 (21.0)	27 (28.4)	16 (24.2)

Table 2 Attitudes to housing accessibility and research, and mobile digital literacy in pre-Q and post-Q among full study participants (n = 100) and full study participants with unaltered views¹.

Note: n varies due to internal missing, thus valid percent is used. ¹The number of full study participants with unaltered views differs for the different variables, thus n varies between 46 to 66.

“quite” to “very” important, while 11% considered it not so important. Similar proportions were found for attitudes towards research. Regarding mobile digital literacy, 83% regarded themselves as “quite” to “very” knowledgeable when it comes to using a smartphone or tablet, while 17% considered themselves not so knowledgeable.

Regarding attitudinal changes between pre-Q and post-Q (Table 3), almost half of the full study participants did not report any change in their attitude to housing

accessibility (47%) or research (49%); and an even larger proportion did not report any change in their mobile digital literacy (70%).

About 47% of full study participants did not report any attitudinal change to housing accessibility (Table 3). Among those who changed their attitude, significantly more ($p = 0.006$) rated the importance of housing accessibility lower after their participation in the HX compared with those rating it higher. Almost 50% of full participants did

VARIABLES	UNALTERED VIEW	ALTERED VIEW: MORE POSITIVE OR LITERATE	ALTERED VIEW: LESS POSITIVE OR LITERATE	P-VALUE ¹
Housing accessibility, n (%)	46 (46.5)	16 (16.2)	37 (37.4)	0.01
Research, n (%)	48 (49.0)	20 (20.4)	30 (30.6)	0.20
Mobile digital literacy, n (%)	66 (69.5)	18 (18.9)	11 (11.6)	0.27

Table 3 Pre-Q to post-Q changes in attitude to housing accessibility, research, and mobile digital literacy among full study participants (n = 100).

Note: Due to internal missing, n varies from 95 to 99, thus valid percent is used.

¹Paired-sampled sign test was used comparing the groups “More positive or literate” and “Less positive or literate.” A p-value below 0.05 was considered a statistically significant difference.

not change their attitude to research and 70% did not report any changes in their ability to handle mobile digital devices.

DISCUSSION

In terms of study participant characteristics, the main results from this study show that full study participants had more recently downloaded apps to their mobile digital devices compared with partial study participants. Moreover, it was more common among the latter group to have someone in their household with reduced functioning. The only attitudinal change concerned the attitude to housing accessibility. Specifically, significantly more full study participants attributed a lower importance to housing accessibility after their involvement in the HX compared with those rating it higher. However, this should be seen in light of the predominantly positive attitudes before HX.

The low response and completion rates reinforce the picture from previous studies (Frögren et al. 2022; Malm et al. 2021) about the challenges involved when recruiting participants for quantitative studies on public involvement in research. The low response rate applies not only to this study but also to involvement in the HX, where only 1,203 people took on the role of citizen scientists. This was despite extensive efforts to disseminate information on national television and radio, through seminars, and by word-of-mouth (Granbom et al. 2023). A recent study (Frögren et al. 2022) indicates that from the point of view of senior citizens, data collection activities are not as attractive as other types of user involvement in research. This may be a contributing factor to the low CS involvement. Another contributing factor to the low response and completion rates in the study discussed here could be the rather complex design of the study running in parallel with the HX—a study design that was somewhat difficult to explain and to communicate to potential study participants. In addition, this study entailed a fairly large commitment from

the participants, which may have affected the response and completion rates.

Education level is the factor that clearly distinguishes full study participants from Sweden’s national population as a whole. That is, 67% of full study participants had a tertiary education compared with 39% of the overall population and 33% of those between 65–74 years old (Statistics Sweden, 2022). It corresponds with the European Commission’s (EC) report on citizen science projects (Haklay 2022), which states that across CS projects in Europe, the proportion of citizen scientists with higher education has been at least twice that of the general population.

Another important result was that partial study participants were more likely to have someone in their household using a mobility device and/or receiving home care. It suggests that people living in a potentially strained situation due to their own or their partner’s ill health may find it challenging to get involved in research (Malm et al. 2021). This is despite the fact that they may be among those who are more affected by housing accessibility issues.

The result showing that full study participants had more recent experiences of downloading apps to their smartphones or tablets compared with partial study participants is also worth discussing. It indicates that familiarity with downloading applications from publicly available platforms was of importance for completing the HX as well as the study in its entirety. This presumption is further strengthened by the fact that among the partial study participants who answered the post-Q, but had not completed the HX, almost 50% stated that they had tried to download the mobile app without success. Full study participants also had a relatively good ability to handle mobile digital devices. Specifically, 83% rated themselves as “quite” to “very” knowledgeable in mobile digital literacy.

Regarding senior citizens’ ability to handle digital technology, the results from previous research are not clear-cut. Other CS projects have indicated that senior citizens can learn to use mobile digital devices to collect

and analyze data, and to use the data for advocacy work together with local stakeholders (King et al. 2020). However, Poli and colleagues (2020) have shown that there is selective exclusion of participants with low digital literacy in eHealth trials targeting senior citizens. Based on our results, there are reasons to believe that a certain conscious or unconscious selection of citizens in terms of mobile digital literacy also commonly occurs in CS projects. Up-to-date data show that among people in Sweden born in the forties, as many as 38% state that they need help using digital technology, while the figure is considerably lower for younger adults (Swedish Internet Foundation 2022). Aware of this digital divide, during the app development process before the HX, great emphasis was placed on usability testing with representatives of the intended target groups (Granbom et al. 2023). Pedagogical material was created in the form of detailed guides and an instructional video, available on the project website. Support functions were created through a telephone and Facebook group. In this study, however, it emerged that only about half of the 100 full study participants had accessed the website, and of these, only three people had read the guide. Thus, although in Sweden the use of mobile digital devices among senior citizens is high (Swedish Internet Foundation 2022), this study sheds light on challenges inherent in using smartphones and tablets for tasks that require a higher level of mobile digital literacy. Moreover, as indicated by experiences during the app development process, senior citizens do not always have smartphones with sufficient memory space to download additional apps (Granbom et al. 2023); this imposes challenges that might relate to economic resources. Challenges related to the use of mobile digital devices are a fact and important to consider for future CS projects with senior citizens and persons with functional impairments as the main target groups.

We can only speculate as to the underlying reasons for the decline in interest in housing accessibility. The free-text answers were not informative. Several studies highlight the relationship between housing accessibility and health, especially in later life and among persons with functional impairments (Cho et al. 2016; Granbom et al. 2016; MacLachlan et al. 2018). However, studies have indicated that the demand for accessible housing comes relatively late in life and is preceded by more lifestyle-oriented priorities such as closeness to nature and space in the home for social gatherings (Abramsson and Andersson 2016; Andersson et al. 2019). In contrast, the senior citizen associations that were partners in the HX and in this study have published several policy briefs focusing on housing accessibility and are active in the public debate on such matters. Such contrasting perspectives showcase that

providing accessible housing for the aging population is a wicked problem (Jonsson et al. 2021).

The attitudinal change regarding accessibility should also be considered in light of the very high proportion of full study participants who considered the issue of housing accessibility to be “quite” to “very” important before the HX. It should thus be kept in mind that almost half of the full study participants did not change their views regarding accessibility, or their interest in research. This indicates that CS involvement had a limited influence on attitudes, which is a finding supported by several studies (Evans et al. 2005; Jordan et al. 2011; Oturai et al. 2021). However, other studies showed that participant attitudes changed in a positive direction after CS involvement (Bremer et al. 2019; Haywood et al. 2016). What distinguishes the latter studies is mainly that they are evaluations of projects that extended over a relatively long time and contained recurring training and guidance by peers in performing the data collection. This allowed participants to make mistakes and learn through them, hence creating conditions for “deep learning” (Jordan et al. 2011). It raises the question of whether a more co-creating form of CS rather than contributory would have changed the results. While contributory CS is researcher-initiated, co-created citizen science usually derives from a grassroots movement with members of the public (often constituting a community) involved in most or all of the process (Wiggins and Wilbanks 2019). In the case of the HX, senior citizen associations took on a supportive role before and during the implementation of the project. However, this occurred from a top-down rather than grassroots level. The low response rates for both the HX and this study, indicate that we did not succeed in recruiting a large number of individuals to get involved in either. More resources to reach out locally to citizens with information about the HX, as well as to provide support with app management, probably would have made a difference. That the HX and this study took place during the COVID-19 pandemic likely also had an impact on recruitment—not least because it limited the possibility of meetings with potential study participants in real life.

STRENGTHS AND LIMITATIONS

One limitation of this study is the restriction to a Swedish context. The research team is based in Sweden and was already collaborating with Public & Science (i.e., an organization with longstanding experience implementing national CS projects). Given the various types of challenges we’d faced in our international research about housing accessibility in different populations (see, e.g., Iwarsson et al. 2004), as well as the challenges encountered in the HX, it made sense to limit this CS project to Sweden. That said, with the experience gained in the HX, we are in a strong

position to engage in international CS projects involving older adults that focus on similar topics.

Another limitation was the amount of information collected. Cappa et al. (2022) have highlighted how, when CS projects obtain additional information that extends beyond a project's immediate scientific purposes (i.e., Big Data; BD), it has the potential to lead to future benefits for researchers, policymakers, and society as a whole. However, in our case, the opportunities to collect BD were limited due mainly to current national legislation whereby the collection of such information required ethical permission for the HX project as well as a less open design. In hindsight, considering the low response rates, this was a correct decision.

The low response rate is crucial to keep in mind when interpreting the results as they are based on a presumably non-representative share of the total sample of the HX participants. Recruitment mainly via email may have excluded senior citizens and persons with functional impairments who did not have access to digital resources or the ability to use the Internet; this should be taken into account in relation to the results. Nevertheless, we did collect data from 100 individuals out of the 1,203 involved in the HX. Given the general scarcity of data on involvement of senior citizens and persons with functional impairments in CS projects, this study is a contribution to the knowledge base that relates to the challenges with and outcomes of CS projects. While there certainly is a need for evaluations based on quantitative studies, the lack of in-depth qualitative feedback from the participants is a notable limitation of this study. Such descriptions of participant experiences are valuable to discern both context and causes (Wehn et al. 2021), which should be considered in further studies when exploring the prerequisites for the involvement of senior citizens and persons with functional impairments in CS.

CONCLUSIONS

In response to the scarcity of data on involvement of senior citizens and persons with functional impairments in CS projects, this study contributes knowledge about the characteristics and attitudinal changes of these user groups involved in a Swedish CS project on housing accessibility. The low response and completion rates reinforce the picture from earlier studies that it is challenging to get senior citizens in Sweden to participate in research about research. This is especially true for people with a lower level of education. The fact that mobile digital literacy and functional ability were factors characterizing the full study

participants strengthens the assertions from previous studies that limitations in these areas affect the interest in or ability to get involved in research. The only attitudinal change was that significantly more participants rated the importance of housing accessibility lower after their involvement in the HX compared with those rating it higher. However, this should be seen in light of the predominantly positive attitudes before the HX. The results from the study highlight the importance of designing CS projects based on the conditions and interests of those who are expected to be involved, especially if the intention is to reach a group that represents a broad group of citizens, as was the case here. The study also suggests that real attitudinal changes or increases in digital literacy might require a higher degree of involvement than was the case here. Such a degree of involvement might also need other types of resources that facilitate more opportunities for meetings between researchers and individual citizens. The knowledge that emerges from this study is useful for researchers and citizen science organizers because it highlights important aspects to take into account when designing similar CS projects. It is also useful for policymakers and the wider society through its contribution to the understanding of what gains can be expected based on the efforts made. Further research is warranted to investigate how CS projects that target senior citizens and persons with functional impairments could be designed, prepared, and executed to attract a wider group and to create conditions for greater gains.

DATA ACCESSIBILITY STATEMENT

The data used in this study contains sensitive information about the study participants who did not provide consent for public data sharing. The current approval by the Swedish Ethical Review Authority in Uppsala (Ref. 2021/02256) does not include data sharing. A minimal data set could be shared by request from a qualified academic investigator for the sole purpose of replicating the present study, provided the data transfer is in agreement with the EU general data protection regulation and the approval by the Swedish Ethical Review Authority.

ACKNOWLEDGEMENTS

The authors would like to extend thanks to L. Frögren, G. Gustafsson, and M. Källmar for their active involvement in the development of the questionnaires, to PhD, statistician S. Ullén for valuable analysis guidance and interpretation of the results, and PhD, professor R.J. Lawrence, University of

Geneva, for comments on the manuscript and cooperation in the supervision team for PhD student J. Frögren.

FUNDING INFORMATION

Funding was provided by the project Socially sustainable housing policy for people with disabilities: Development of a knowledge base that supports participation and active citizenship (the Swedish Research Council for Health, Working Life and Welfare [Forte, ref.: 2018-01793, PI: Professor Susanne Iwarsson]). Authors JF, MG and SI were financed by the Ribbingska Foundation in Lund. The study was conducted within the context of the Centre for Ageing and Supportive Environments (CASE; financed by the Faculty of Medicine and the Faculty of Engineering), Lund University, and the UserAge research program (the Swedish Research Council for Health, Working Life and Welfare [Forte, ref.: 2016-07090]). The first author's learning process was supported by the Swedish National Graduate School for Competitive Science on Ageing and Health (SWEAH), financed by the Swedish Research Council (ref. K2014-99X-22618-01-6; 2013-08755-11).


COMPETING INTERESTS


The authors have no competing interests to declare.


AUTHOR CONTRIBUTIONS

JF: Conceptualization, Methodology, Formal analysis, Investigation, Original draft writing, Review and editing; MG: Conceptualization, Methodology, Formal analysis, Project administration, Review and editing; OJ: Conceptualization, Project administration, Supervision, Review and editing; MB: Project administration, Review and editing; SI: Conceptualization, Methodology, Funding acquisition, Formal analysis, Review and editing.


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REFERENCES

- Abramsson, M** and **Andersson, E.** 2016. Changing preferences with ageing–housing choices and housing plans of older people. *Housing, theory and society*, 33(2): 217–241. DOI: <https://doi.org/10.1080/14036096.2015.1104385>
- Andersson, EK, Abramsson, M** and **Malmberg, B.** 2019. Patterns of changing residential preferences during late adulthood. *Ageing & Society*, 39(8): 1752–1781. DOI: <https://doi.org/10.1017/S0144686X18000259>
- Asino, TI.** 2020. *Learning in the Digital Age*. Stillwater, OK: Oklahoma State University Libraries.
- Bonney, R, Phillips, TB, Ballard, HL** and **Enck, JW.** 2016. Can citizen science enhance public understanding of science? *Public Understanding of Science*, 25(1): 2–16. DOI: <https://doi.org/10.1177/0963662515607406>
- Bremer, S, Haque, MM, Aziz, SB** and **Kvamme, S.** 2019. ‘My new routine’: Assessing the impact of citizen science on climate adaptation in Bangladesh. *Environmental Science & Policy*, 94: 245–257. DOI: <https://doi.org/10.1016/j.envsci.2018.12.029>
- Brookfield, K, Scott, I, Tinker, A** and **Ward Thompson, C.** 2020. Perspectives on “novel” techniques for designing age-friendly homes and neighborhoods with older adults. *International Journal of Environmental Research and Public Health*, 17(5): 1800. DOI: <https://doi.org/10.3390/ijerph17051800>
- Cappa, F, Franco, S** and **Rosso, F.** 2022. Citizens and Cities: Leveraging Citizen Science and Big Data for Sustainable Urban Development. *Business Strategy and the Environment*, 31: 648–667. DOI: <https://doi.org/10.1002/bse.2942>
- Cappa, F, Laut, J, Porfiri, M** and **Giustiniano, L.** 2018. Bring them aboard: Rewarding participation in technology-mediated citizen science projects. *Computers in Human Behavior*, 89: 246–257. DOI: <https://doi.org/10.1016/j.chb.2018.08.017>
- Cho, H, MacLachlan, M, Clarke, M** and **Mannan, H.** 2016. Accessible home environments for people with functional limitations: A systematic review. *International Journal of Environmental Research and Public Health*, 13(8): 826. DOI: <https://doi.org/10.3390/ijerph13080826>
- Cooper, CB, Dickinson, J, Phillips, T** and **Bonney, R.** 2007. Citizen science as a tool for conservation in residential ecosystems. *Ecology and Society*, 12(2): 11. URL: <https://www.jstor.org/stable/26267884>. DOI: <https://doi.org/10.5751/ES-02197-120211>
- English, PB, Richardson, MJ** and **Garzon-Galvis, C.** 2018. From crowdsourcing to extreme citizen science: Participatory research for environmental health. *Annual Review of Public Health*, 39: 335–350. DOI: <https://doi.org/10.1146/annurev-publhealth-040617-013702>
- Evans, C, Abrams, E, Reitsma, R, Roux, K, Salmonsén, L** and **Marra, PP.** 2005. The neighborhood nestwatch program: Participant outcomes of a citizen-science ecological research project. *Conservation Biology*, 19(3): 589–594. URL: <https://www.jstor.org/stable/3591040>. DOI: <https://doi.org/10.1111/j.1523-1739.2005.00s01.x>

- Frögren, J, Schmidt, SM, Kylén, M, Jonsson, O, Slaug, B and Iwarsson, S.** 2022. Awareness of and attitudes towards public involvement in research on ageing and health among older people in Sweden. *PLoS One*, 17(6): e0269993. DOI: <https://doi.org/10.1371/journal.pone.0269993>
- Granbom, M, Iwarsson, S, Kylberg, M, Pettersson, C and Slaug, B.** 2016. A public health perspective to environmental barriers and accessibility problems for senior citizens living in ordinary housing. *BMC Public Health*, 16(1): 772. DOI: <https://doi.org/10.1186/s12889-016-3369-2>
- Granbom, M, Slaug, B, Brouneus, F, Bergman, M and Iwarsson, S.** 2023. Involving members of the public to develop a data collection app for a Citizen Science project on housing accessibility targeting older adults. *Citizen Science: Theory and Practice*, 8(1): 22. DOI: <https://doi.org/10.5334/cstp.509>
- Haklay, M.** 2022. Mutual learning exercise on citizen science initiatives: Policy and practice. *First topic report, introduction and overview of citizen science (Publications Office of the European Union)*. European Commission, Directorate-General for Research; Innovation. DOI: <https://doi.org/10.2777/29886>
- Haywood, BK, Parrish, JK and Dolliver, J.** 2016. Place-based and data-rich citizen science as a precursor for conservation action. *Conservation Biology*, 30(3): 476–486. DOI: <https://doi.org/10.1111/cobi.12702>
- Iwarsson, S, Haak, M and Slaug, B.** 2012. Current developments of the housing enabler methodology. *British Journal of Occupational Therapy*, 75(11): 517–521. DOI: <https://doi.org/10.4276/030802212X13522194759978>
- Iwarsson, S, Wahl, H-W and Nygren, C.** 2004. Challenges of cross-national housing research with older persons: lessons from the ENABLE-AGE Project. *European Journal of Ageing*, 1(1): 79–88. DOI: <https://doi.org/10.1007/s10433-004-0010-5>
- James, H and Buffel, T.** 2022. Co-research with older people: A systematic literature review. *Ageing & Society*, 1–27. DOI: <https://doi.org/10.1017/S0144686X21002014>
- Jonsson, O, Frögren, J, Haak, M, Slaug, B and Iwarsson, S.** 2021. Understanding the wicked problem of providing accessible housing for the ageing population in Sweden. *International Journal of Environmental Research and Public Health*, 18(3): 1169. DOI: <https://doi.org/10.3390/ijerph18031169>
- Jordan, RC, Gray, SA, Howe, DV, Brooks, WR and Ehrenfeld, JG.** 2011. Knowledge gain and behavioral change in citizen-science programs. *Conservation Biology*, 25(6): 1148–1154. DOI: <https://doi.org/10.1111/j.1523-1739.2011.01745.x>
- Kasperowski, D and Brounéus, F.** 2016. The Swedish mass experiments — a way of encouraging scientific citizenship? *Journal of Science Communication*, 15(1): Y01. DOI: <https://doi.org/10.22323/2.15010401>
- King, AC, King, DK, Banchoff, A, Solomonov, S, Ben Natan, O, Hua, J, Gardiner, P, Goldman Rosas, L, Rodriguez Espinosa, P, Winter, SJ and others.** 2020. Employing participatory citizen science methods to promote age-friendly environments worldwide. *International Journal of Environmental Research and Public Health*, 17(5): 1541. DOI: <https://doi.org/10.3390/ijerph17051541>
- Kosmala, M, Wiggins, A, Swanson, A and Simmons, B.** 2016. Assessing data quality in citizen science. *Frontiers in Ecology and the Environment*, 14(10): 551–560. DOI: <https://doi.org/10.1002/fee.1436>
- MacLachlan, M, Cho, HY, Clarke, M, Mannan, H, Kayabu, B, Ludolph, R and McAuliffe, E.** 2018. Report of the systematic review on potential benefits of accessible home environments for people with functional impairments. In: World Health Organization. *WHO Housing and Health Guidelines, Web Annex F*. Geneva, Switzerland: WHO, pp. 1–85. <https://archive.ph/qAcTt>.
- Malm, C, Andersson, S, Kylén, M, Iwarsson, S, Hanson, E and Schmidt, SM.** 2021. What motivates informal carers to be actively involved in research, and what obstacles to involvement do they perceive? *Research Involvement and Engagement*, 7(80): 1–14. DOI: <https://doi.org/10.1186/s40900-021-00321-x>
- Norin, L, Slaug, B, Haak, M, Jörgensen, S, Lexell, J and Iwarsson, S.** 2017. Housing accessibility and its associations with participation among older adults living with long-standing spinal cord injury. *The Journal of Spinal Cord Medicine*, 40(2): 230–240. DOI: <https://doi.org/10.1080/10790268.2016.1224541>
- Oturai, NG, Pahl, S and Syberg, K.** 2021. How can we test plastic pollution perceptions and behavior? A feasibility study with Danish children participating in “the mass experiment”. *Science of The Total Environment*, 806: 150914. DOI: <https://doi.org/10.1016/j.scitotenv.2021.150914>
- Poli, A, Kelfve, S, Klompstra, L, Strömberg, A, Jaarsma, T and Motel-Klingebiel, A.** 2020. Prediction of (non) participation of older people in digital health research: Exergame intervention study. *Journal of Medical Internet Research*, 22(6): e17884. DOI: <https://doi.org/10.2196/17884>
- Public & Science.** 2021a. European Researchers’ Night. 2021-03-21. Available at <https://archive.ph/Hhr2B> [Last accessed 2022-12-20].
- Public & Science.** 2021b. ForskarFredag [Researchers’ Friday]. 2021-03-21. Available at <https://archive.ph/jqIAh> [Last accessed 2022-12-20].
- Public & Science.** 2021c. The Housing Experiment. 2021-03-21. Available at <https://archive.ph/IA30y> [Last accessed 2022-12-20].
- Rowbotham, S, McKinnon, M, Leach, J, Lamberts, R and Hawe, P.** 2019. Does citizen science have the capacity to transform population health science? *Critical Public Health*, 29(1): 118–128. DOI: <https://doi.org/10.1080/09581596.2017.1395393>

- Statistics Sweden.** 2022. Population statistics. 2022-03-18. Available at <https://archive.ph/CEV90> [Last accessed 2022-12-20].
- Strasser, B, Baudry, J, Mahr, D, Sanchez, G and Tancoigne, E.** 2019. “Citizen science”? Rethinking science and public participation. *Science & Technology Studies*, 32(2): 52–76. DOI: <https://doi.org/10.23987/sts.60425>
- Strasser, B and Haklay, M.** 2018. Citizen science: Expertise, democracy, and public participation (SSC Policy Analysis No. 1). Bern, Switzerland: Swiss Science Council. URL: <https://discovery.ucl.ac.uk/id/eprint/10062223>.
- The Swedish Internet Foundation.** 2022. The Swedes and the Internet, 2022-04-28. Available at <https://archive.ph/pIvY2> [Last accessed 2022-12-20].
- Traxler, J.** 2012. Context as text in mobile digital literacy: A European university perspective. *CEUR Workshop Proceedings*, 955: 289–293. URL: https://ceur-ws.org/Vol-955/papers/paper_42.pdf.
- Vasiliades, MA, Hadjichambis, AC, Paraskeva-Hadjichambi, D, Adamou, A and Georgiou, Y.** 2021. A systematic literature review on the participation aspects of environmental and nature-based citizen science initiatives. *Sustainability*, 13(13): 7457. DOI: <https://doi.org/10.3390/su13137457>
- Ware, JE, Jr. and Sherbourne, CD.** 1992. The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection. *Medical Care*, 30(6): 473–483. DOI: <https://doi.org/10.1097/00005650-199206000-00002>
- Wehn, U, Gharesifard, M, Ceccaroni, L, Joyce, H, Ajates, R, Woods, S, Bilbao, A, Parkinson, S, Gold, M and Wheatland, J.** 2021. Impact assessment of citizen science: state of the art and guiding principles for a consolidated approach. *Sustainability Science*, 16(5): 1683–1699. DOI: <https://doi.org/10.1007/s11625-021-00959-2>
- Wiggins, A and Wilbanks, J.** 2019. The rise of citizen science in health and biomedical research. *The American Journal of Bioethics*, 19(8): 3–14. DOI: <https://doi.org/10.1080/15265161.2019.1619859>
- Wood, GER, Pykett, J, Daw, P, Agyapong-Badu, S, Banchoff, A, King, AC and Stathi, A.** 2022. The Role of Urban Environments in Promoting Active and Healthy Aging: A Systematic Scoping Review of Citizen Science Approaches. *Journal of Urban Health*, 99: 427–456. DOI: <https://doi.org/10.1007/s11524-022-00622-w>
- World Health Organization (WHO).** 2018. *WHO housing and health guidelines*. Geneva, Switzerland: WHO. <https://archive.ph/qAcTt>.

TO CITE THIS ARTICLE:

Frögren, J, Granbom, M, Jonsson, O, Bergman, M and Iwarsson, S. 2023. Characteristics and Attitudinal Changes of Senior Citizens and Persons with Functional Impairments Involved in a Citizen Science Project on Housing Accessibility. *Citizen Science: Theory and Practice*, 8(1): 57, pp. 1–13. DOI: <https://doi.org/10.5334/cstp.551>

Submitted: 26 July 2022 **Accepted:** 26 August 2023 **Published:** 26 September 2023

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Citizen Science: Theory and Practice is a peer-reviewed open access journal published by Ubiquity Press.