AWARENESS OF 'SOUND' IN NURSING HOMES: A LARGE-SCALE SOUNDSCAPE SURVEY IN FLANDERS (BELGIUM)

Francesco Aletta [1,*], Tara Vander Mynsbrugge [2], Dominique Van de Velde [2,3], Patricia De Vriendt [2,3,4], Pieter Thomas [1], Karlo Filipan [1], Dick Botteldooren [1], Paul Devos [1]

[1]*Department of Information Technology – Ghent University, 9000 Ghent, Belgium*
[2]*Department of Occupational Therapy – Artevelde University College, Ghent 9000, Belgium*
[3]*Department of Rehabilitation Sciences and Physiotherapy – Ghent University, Ghent 9000, Belgium*
[4]*Department Gerontology and Frailty in Ageing, Vrije Universiteit Brussel, Brussels 1050, Belgium*
E-mail: francesco.aletta@ugent.be

Keywords: indoor soundscape; long-term care; sound quality; sound perception; noise sensitivity.

ABSTRACT

There are relatively few studies on the acoustic environment of care facilities. However, sound is an important component of the users' experience and quality of life in these spaces, and particularly in Nursing Homes, where both staff and residents have medium- to long-term perspectives, contrarily to hospital settings. This study included an online large-scale survey for Nursing Homes in Flanders and it targeted the group of professionals. It aimed at providing an overview about noise sensitivity and sound perception of the staff members in their work environment, as well as investigating the potential effects on sound perception of staff role and context. Results showed that limited differences emerged for staff roles, while more differences were found when exploring the context factor. Overall, the results of this study claim for further attention on the management and design of the sound environment in these facilities.

1. INTRODUCTION

With the world population ageing rapidly, care for older people and care environments are increasingly being studied both in their 'physical' as well as intangible settings (United Nations, 2001). Care facilities are places where different groups of people live (in case of long-term care) and work (employees). The acoustic environment is a key component of human experience, and it gains even more importance in such contexts. Nevertheless, it is often not adequately considered as an influencing factor for physical well-being and quality of life (van den Bosch, 2015), even if it has been reported that reducing noise annoyance is a crucial step towards promoting health in living and working environments, since annoying sounds might overload attentional resources and pose risks to one's needs, satisfaction and overall quality of life (Andringa, et al., 2013).

Soundscape research is trying to fill this gap by putting the human experience at the centre of the evaluation process of the acoustic environment. The term indeed entails a 'perceptual' approach to the physical part of the acoustic environments (International Organization for Standardization, 2014). While the concept has found ample application in urban contexts, it could definitely be applied to indoor environments, as shown by the recent studies of care facilities (van den Bosch, Andringa, Başkent, & Vlaskamp, 2016) and nursing homes (Aletta, et al., 2017).

Nursing homes are particularly interesting from the perspective that the residents usually live there on a medium- to long-term basis, and staff members, who interact with the former group, work there on a daily basis, but with different activity patterns.

This study targeted the group of staff members working in Nursing Homes in Flanders, Belgium. Such group is quite broad in terms of duties, responsibilities and roles that members play for the functionality of the facilities, as well as their level of involvement and interaction with the residents. Several studies (also in Belgium) have addressed staff members of care facilities to investigate perceived quality of work settings, both in terms of environmental conditions and social relationships (see, for instance: (Milisen, Abraham, Siebens, Darras, & Dierckx de Casterlé, 2006) (Paquay, De Lepeleire, Milisen, Ylieff, Fontaine, & Buntinx, 2007)), but sound or sound perception were not considered in the design of the research, in spite of being an important factor and sometimes powerful stressor of human experience.

The main aims of this study were: (1a) to provide an overview about noise sensitivity of staff members in Nursing Homes in Flanders, and (1b) to describe the perception of the acoustic environments of their working setting; (2) to investigate whether sound perception and awareness change depending on the staff role; and (3) to investigate whether sound perception changes depending on the place (i.e., working context) within the Nursing Home. The aims 1a and 1b are mainly covered in Sections 3.1 and 4.1; aim (2) is covered in Sections 3.2 and 4.2; aim 3 is covered in Sections 3.3 and 4.3.

For this purpose an online survey was prepared and sent via email to staff members to a list of Nursing Homes in Flanders retrieved through publicly available databases or manual search. General questions about noise sensitivity and noise annoyance, as well as some protocols for assessing soundscape qualities were used to investigate the awareness of 'sound' that the survey participants experienced.

2. METHODS

2.1 Selection of the Nursing Homes (NH)

A list of all Nursing Homes (NH) currently active in Flanders was obtained through the Agency of Care and Health database (Agentschap Zorg en Gezondheid, 2017). The database includes all NH, regardless of their legal status; i.e., whether they are private, public or non-profit organizations. In total, 786 were found and 936 corresponding email addresses were manually retrieved by a researcher. Umbrella organisations (Dementia Expertise Centre, Zorgnet-Icuro, etc.) also disseminated the survey, using their own databases.

The link to the questionnaire was sent to all retrieved emails. The text of the email message briefly explained the purpose of the survey; it included instructions on how to complete the questionnaire, and invited the recipient to forward the link to any potential person of interest working in the same NH. The message made it clear that the questionnaire was addressed to staff working in any capacity with the NH residents; thus managerial staff members (e.g., directors, administrative, clerical staff, etc.) were excluded at this stage. The rationale for this was to gather information about the perception of the acoustic environments, from the point of view of those working in contact with residents.

The questionnaire link was kept active for seven weeks (from March 31st to May 21st, 2017) and a reminder was sent on 21st of April. The overall response rate was 22.8%, leading to a final database of 206 complete responses by the caregivers. Since the questionnaire included the option of reporting the NH postal code (optional question), a density map (Fig. 1) of the collected responses was generated on the basis of 156 records (i.e., respondents willing to share their post code) for descriptive purposes.

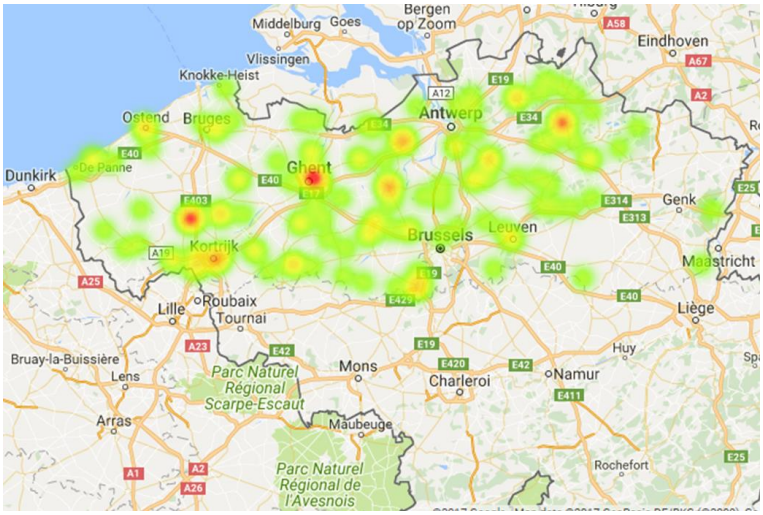

Figure 1. Density map of the responses gathered through the questionnaire in Flanders; red indicates higher response rate.

2.2 Questionnaire

There is still no unique standard on how to collect individual responses on the holistic perception of sound environments in context (Aletta, Kang, & Axelsson, 2016). The International Organization for Standardization has so far provided a general framework, but specific protocols are still a topic for debate (International Organization for Standardization, 2014). A number of different questionnaires have been proposed over the years (Axelsson, Nilsson, & Berglund, 2009) (Axelsson, 2015), with some specific applications in care facilities (van den Bosch, Andringa, Başkent, & Vlaskamp, 2016) (van den Bosch, Andringa, Peterson, Ruijssenaars, & Vlaskamp, 2016). Therefore, the questionnaire used in this study was adapted from a number of such protocols retrieved from literature.

The questions considered for this study mainly refer to six general categories: (a) noise sensitivity, (b) overall quality of the acoustic environment, (c) soundscape dimensions, (d) audible safety, (e) sound sources types' dominance and (f) their corresponding induced annoyance. The Noise sensitivity category was made of a reduced number of items extracted from the Weinstein's Noise Sensitivity Scale (Weinstein, 1980), which have been proven consistent to provide similar users' profiling as per the full scale (Benfield, et al., 2014). This category (a) does not provide information about the perception of the acoustic environment *per se*, but rather about the participants' attitude towards 'noise' since they have to report scores that reflect personal ideas. The following five categories (b-f), instead, referred to specific situations participants might have experienced during their working routine. Before these sections of the Questionnaire, participants were asked to "*think of a typical working day, and select the place where you are most in contact with the residents*". This approach is quite common in social sciences and helps reducing socially expected answers. Participants were further asked to indicate the context (options were: bedroom or living room) and to answer consequently, having in mind that specific context and moment of their working day. These five categories addressed accordingly: holistic quality and appropriateness of the sound environment (Axelsson, Nilsson, & Berglund, 2009) (Axelsson, 2015), core affect (Axelsson, Nilsson, & Berglund, 2010), familiarity and safety (van den Bosch, 2015), perceived dominance of different sound source' types and the noise annoyance induced by the same sources (Aletta, et al., 2017) (Aletta, Axelsson, & Kang, 2017).

It was not possible to skip questions; thus participants were supposed either to fully complete or quit the questionnaire. Nevertheless, incomplete questionnaires were still considered in this study, when answers were useful to address one of the above mentioned research questions. This resulted in slightly different sample sizes, depending on the considered question category. Finally, this research was approved by the Ethical Committee that reviewed the study, registered under the number B670

20 16 30 512 – 20161501 at the commission for Medical Ethics of the Faculty of Medicine and Health Sciences at Ghent University and Ghent University Hospital.

Question category	***Question***	***Scale (0 – 10)***
Noise sensitivity [Please, state to what extent you disagree/agree with the following sentences…]	*"I am sensitive to noise"*	Totally disagree – Totally agree
	"I find it difficult to relax in a place that's noisy"	
	"I get mad at people who make noise that keeps me from falling asleep or getting work done"	
	"I get annoyed when my neighbours are noisy"	
	"I get used to most noises without much difficulty"	
Overall quality of the acoustic environment [For all the following questions, please answer while thinking of a typical working day, and select the place where you are most in contact with residents (bedroom or living room)]	Overall, how do you think the acoustic environment was?	Very bad – Very good
	Overall, do you think the acoustic environment was appropriate for its context?	Not at all appropriate – Very appropriate
Soundscape dimensions [Please, state to what extent the acoustic environment you experienced was…]	Eventful	Not at all - Completely
	Vibrant	
	Pleasant	
	Calm	
	Uneventful	
	Monotonous	
	Annoying	
	Chaotic	
Audible safety [Please, state to what extent the acoustic environment you experienced was…]	Safe	Not at all - Completely
	Familiar	
Sound source's types [Please, state to what extent the following sound sources were dominant…]	Human sounds – vocal	Did not hear at all – Dominated completely
	Human sounds – non-vocal	
	Pets sounds	
	Installation sounds	
	Operational sounds	
	Electronic sounds	
	Environmental sounds	
Sound source's types (annoyance) [Please, state to what extent the following sound sources annoyed you…]	Human sounds – vocal	Not at all - Completely
	Human sounds – non-vocal	
	Pets sounds	
	Installation sounds	
	Operational sounds	
	Electronic sounds	
	Environmental sounds	

Table 1. Questionnaire used for the conducted survey. The information about the questions' category was not available to participants; the instructions they received for each question are reported in square brackets.

3. RESULTS

This section is divided into three sub-sections, which address the aims 1–3 stated in the introduction, accordingly. Thus, Section 3.1 has primarily a descriptive purpose, while in Sections 3.2 and 3.3, the statistical analysis of the effect of the investigated variables is shown.

3.1 Overview: noise sensitivity of staff members and overall sound environment's perception in Nursing Homes in Flanders

Results presented in this section are derived by aggregating data from all valid responses (these vary between different items, since not all participants completed the whole questionnaire). Considering the ten-point ordinal scale on which items were assessed, the Noise sensitivity category returned a picture of a slightly- to moderately sensitive sample (n = 214). The first four items are positive (i.e., higher scores imply higher noise sensitivity), while the last one is negative (i.e., higher scores imply lower noise sensitivity). For the first four items all mean scores are above 6.10, as shown in Figure 2, while the mean score for the last item is close to 5.00, reflecting a neutral attitude for this one.

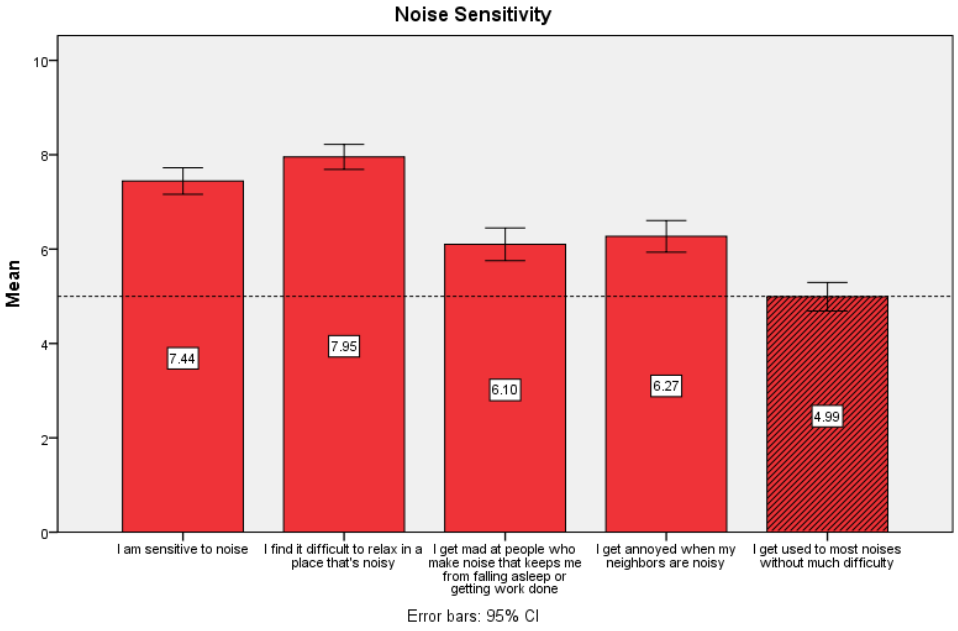

Figure 2. Mean scores and 95% Confidence Intervals for the five items of the reduced Weinstein's Noise Sensitivity Scale; higher values for the first four items and lower for the last (grey-shaded) item imply higher sensitivity to noise.

However, in spite of moderately high self-reported noise sensitivity, the sample assessed the overall quality of the acoustic environment as generally good and appropriate (n = 214), as shown in Figure 3. This is also reflected in Figure 4, where it can be observed that most of the soundscape assessments (n = 212) overlie the pleasant-calm region of the 'circumplex' model proposed by (Axelsson, Nilsson, & Berglund, 2010). According to this model, soundscapes can be assessed in a bi-dimensional space defined by the two orthogonal components of annoyance-pleasantness and uneventfulness-eventfulness; thus, a soundscape might either be calm (pleasant and uneventful), vibrant (pleasant and eventful), chaotic (annoying and eventful), or monotonous (annoying and uneventful). In order to contextualise the soundscape dimensions' profile that emerged from the survey, two more

profiles are reported in Figure 4 from a previous study (Aletta & Kang, 2015): a busy street heavily exposed to road traffic noise and a quiet urban park acoustic environment dominated by natural sound sources.

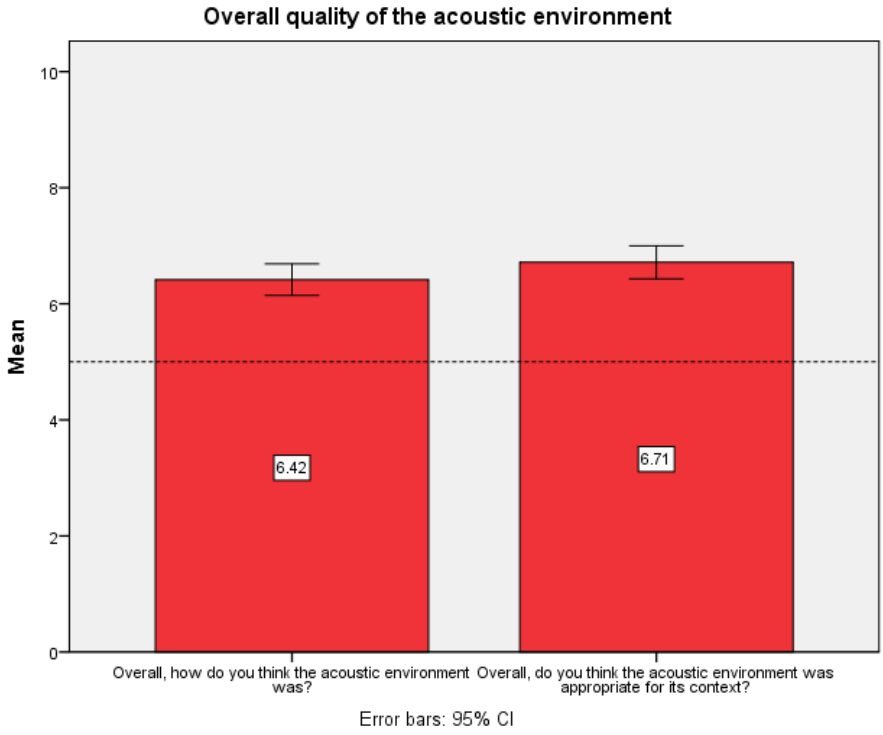

Figure 3. Mean scores and 95% Confidence Intervals of the items of the "Overall quality of the acoustic environment" category.

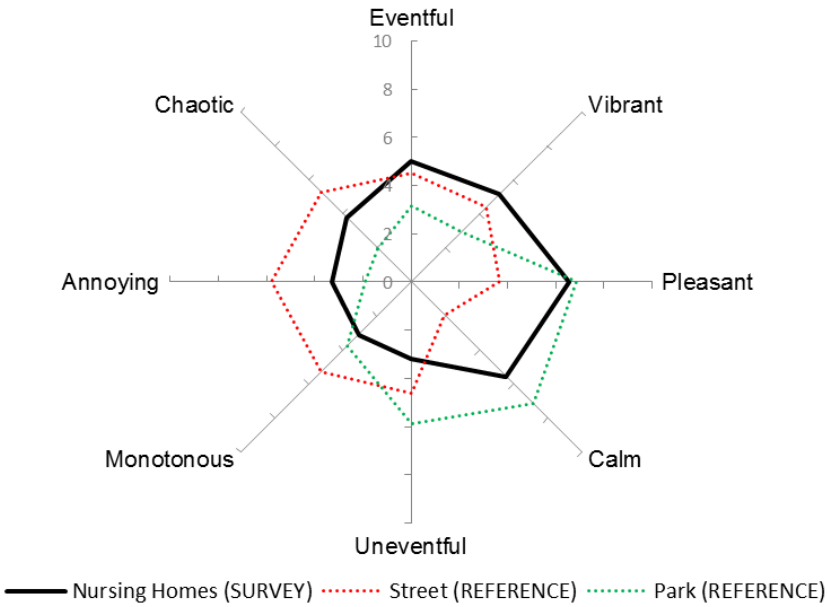

Figure 4. Mean scores (black line) of the "Soundscape dimensions" category plotted on the circumplex model by (Axelsson, Nilsson, & Berglund, 2010), as emerged from the survey. This profile is compared with two

reference profiles from (Aletta & Kang, 2015): a busy street (red dashed line) and an urban park (green dashed line).

Furthermore, in Figure 5 it can be observed that the sample reported soundscapes are moderately safe and familiar (n = 212). Eventually, when comparing the perceived dominance of the sound sources' types with the noise annoyance they induce, as shown in Figure 6, it can be observed that human vocal sounds (e.g., voices, laughter, sounds from individuals in the room...) are the most noticeable and dominant ones. The noise annoyance scores are quite low on average, but proportionally higher (when compared to other sound sources' types) for installation (e.g., fan/ventilation noise, medical equipment, telephone...) and operational sounds (door slamming, trolleys passing-by, kitchen functions...).

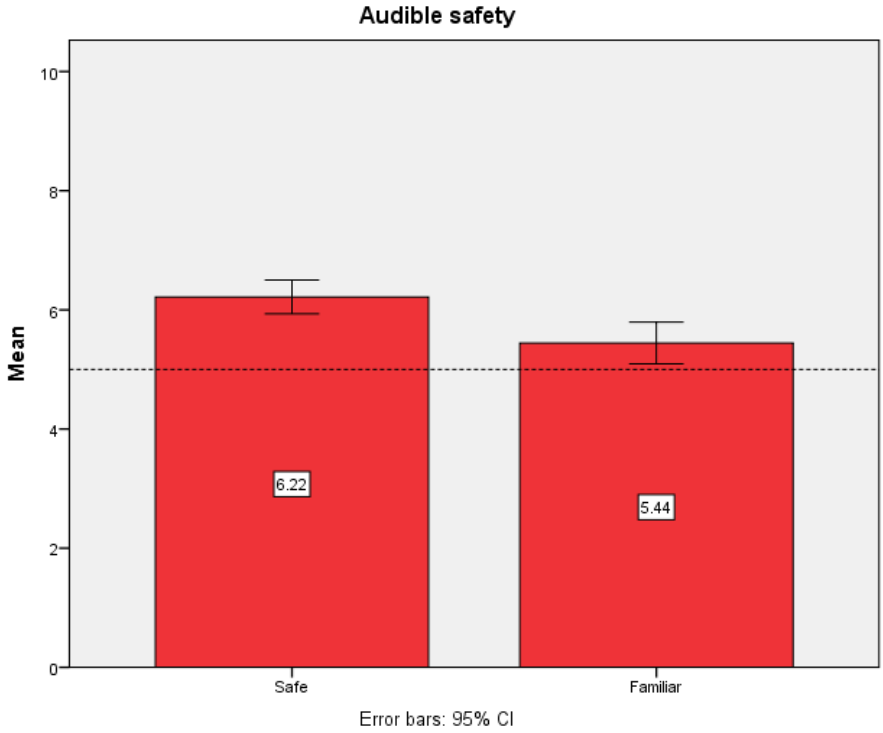

Figure 5. Mean scores and 95% Confidence Intervals of the items of the "Audible safety" category.

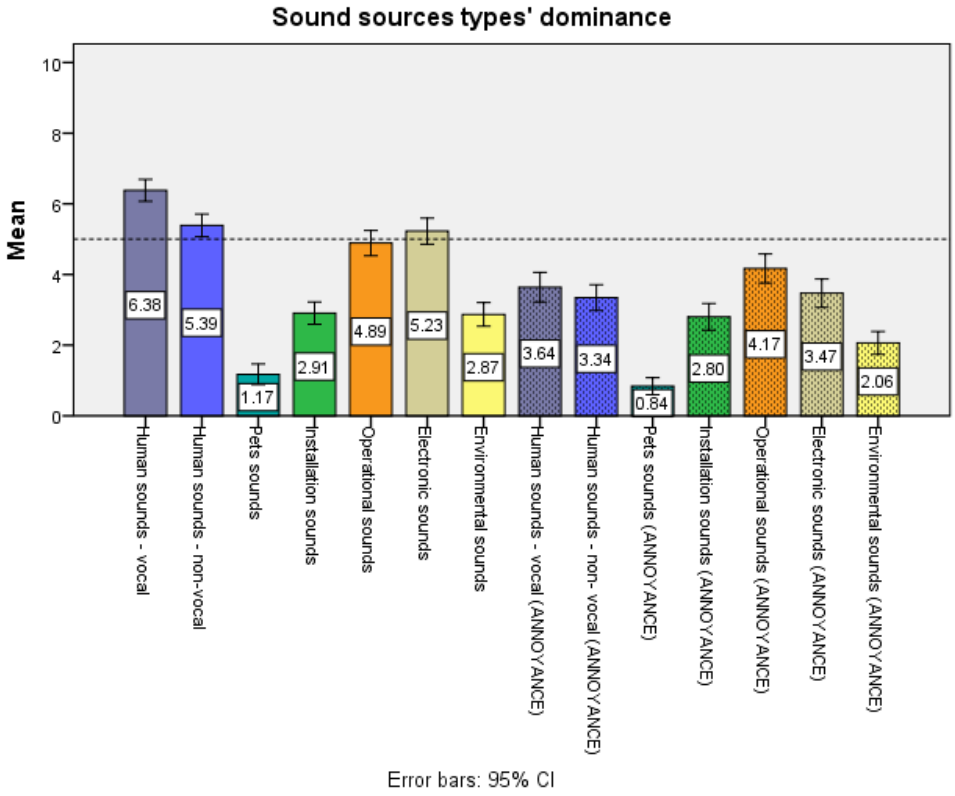

Figure 6. Mean scores and 95% Confidence Intervals of the items of the "Sound sources types' dominance" category (and corresponding noise annoyance).

3.2 Effect of staff role on noise sensitivity and differences between staff groups for soundscapes in the Nursing Homes

A set of one-way ANOVA tests was conducted to determine if the scores of the five selected items of the noise sensitivity scale (NSS score) were different for staff members' groups. Participants were classified into three groups: bedside (n = 89), head nurse (n = 82), and management (n = 43). Bedside staff members were those working in the most direct contact with the residents (e.g., nurses, caregivers, occupational therapists, animators, reference persons for dementia, etc.). Head nurse staff members are the ones coordinating nurses and caregivers, and generally responsible for the care and/or medical aspects; they do have frequent contact with the residents, but in a more supervising role. Management staff members are usually those having a supervision role (e.g., nurse director, quality coordinators, group leaders, etc.).

In general, as shown in Figure 7, members of the management group tend to report higher noise sensitivity levels than the members of the head nurse and bedside groups, accordingly. Nevertheless, the differences between these staff member groups were not statistically significant: "*I am sensitive to noise*" $F(2, 211) = 0.201$, $p = .818$; "*I find it difficult to relax in a place that's noisy*" $F(2, 211) = 0.194$, $p = .824$; "*I get mad at people who make noise that keeps me from falling asleep or getting work done*" $F(2, 211) = 0.759$, $p = .469$; "*I get annoyed when my neighbours are noisy*" $F(2, 211) = 0.419$, $p = .658$; "*I get used to most noises without much difficulty*" $F(2, 211) = 1.401$, $p = .249$.

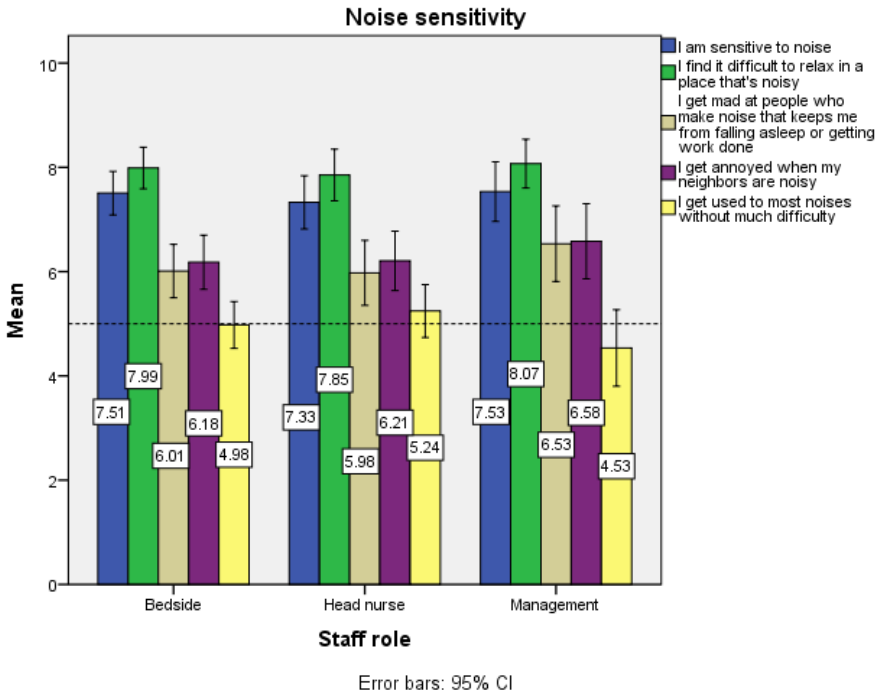

Figure 7. Mean scores and 95% Confidence Intervals for the five items of the reduced Weinstein's Noise Sensitivity Scale, as a function of the Staff role variable.

Subsequently, another set of one-way ANOVA tests was conducted to determine if the scores of the items of the soundscape question categories (i.e., overall quality of the acoustic environment, soundscape dimensions, audible safety and sound sources types' dominance) were different for staff members' groups. No statistically significant differences between groups were observed, except for three items; in soundscape dimensions category: *uneventful*, $F(2, 209) = 3.477$, $p = .033$; *safe*, $F(2, 209) = 4.003$, $p = .020$; and in audible safety category: *familiar* $F(2, 209) = 3.955$, $p = .021$. For the item *uneventful*, Bonferroni post hoc analysis revealed that the bedside staff scores ($M = 2.78$, $SD = 2.36$) were statistically significantly lower ($p = .033$) than the management staff scores ($M = 3.86$, $SD = 2.07$). For the item *safe*, Bonferroni post hoc analysis revealed that the bedside staff scores ($M = 5.81$, $SD = 2.28$) were statistically significantly lower ($p = .016$) than the head nurse staff scores ($M = 6.70$, $SD = 1.90$). Eventually, for the item *familiar*, Bonferroni post hoc analysis revealed that the bedside staff scores ($M = 4.91$, $SD = 2.75$) were statistically significantly lower ($p = .016$) than the head nurse staff scores ($M = 6.01$, $SD = 2.39$). This generally shows that for the significant items, bedside staff generally scores lower than the other two groups, which have a more supervising role. No other statistically significant pairwise differences were observed. Figures 8–11 show the mean scores with error bars for all the soundscape items of the questionnaire.

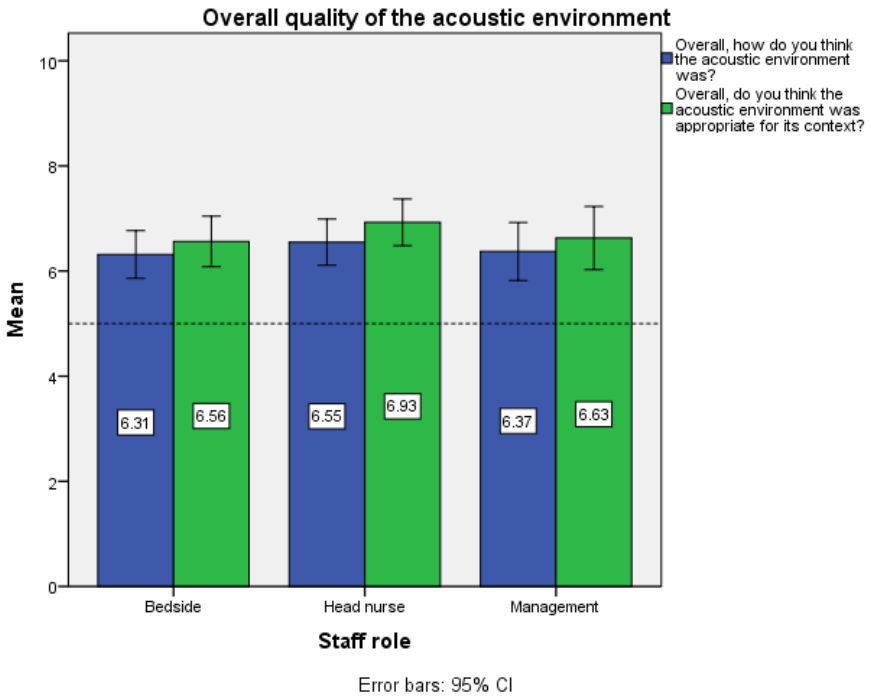

Figure 8. Mean scores of the items of the "Overall quality of the acoustic environment" category, as a function of the Staff role variable.

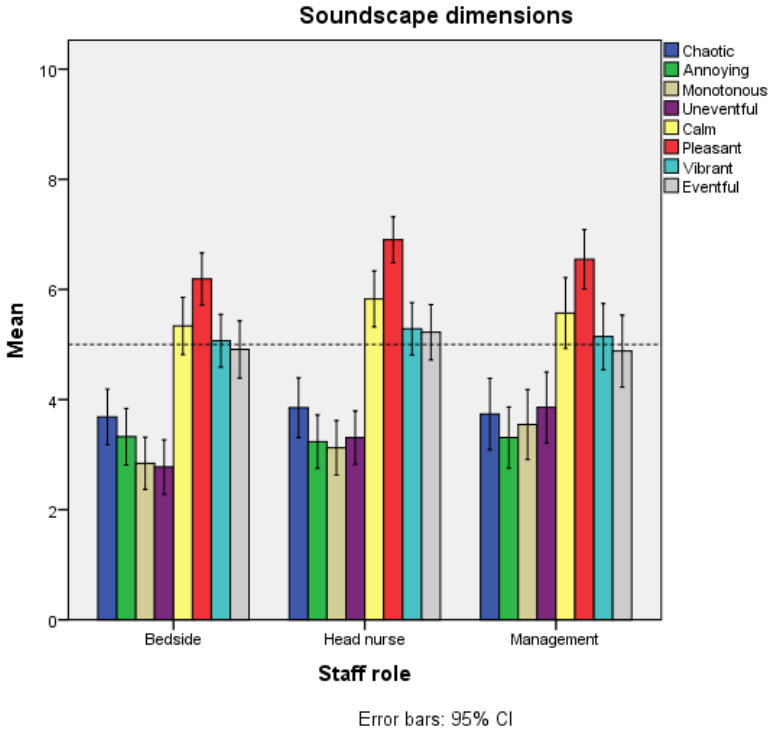

Figure 9. Mean scores of the items of the "Soundscape dimensions" category, as a function of the Staff role variable.

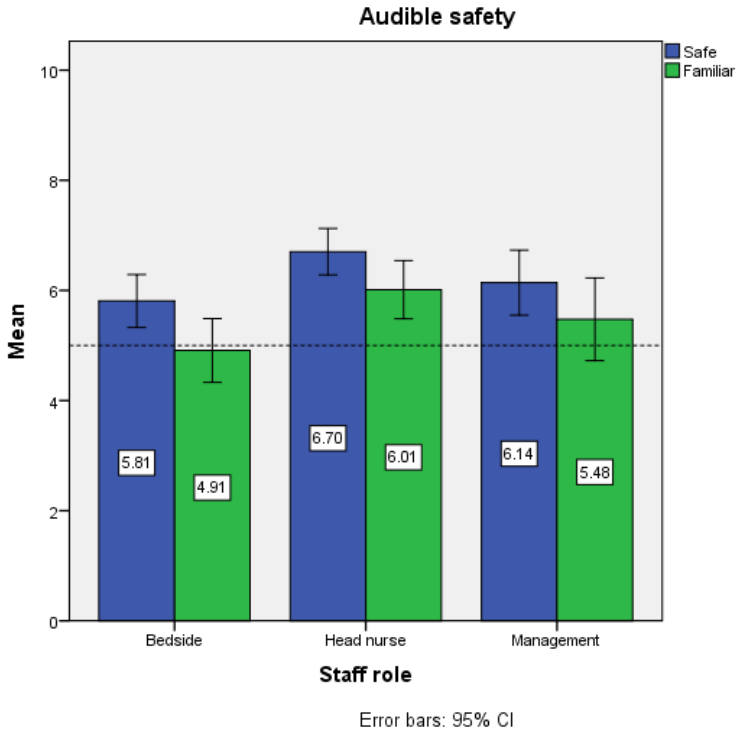

Figure 10. Mean scores of the items of the "Audible safety" category, as a function of the Staff role variable.

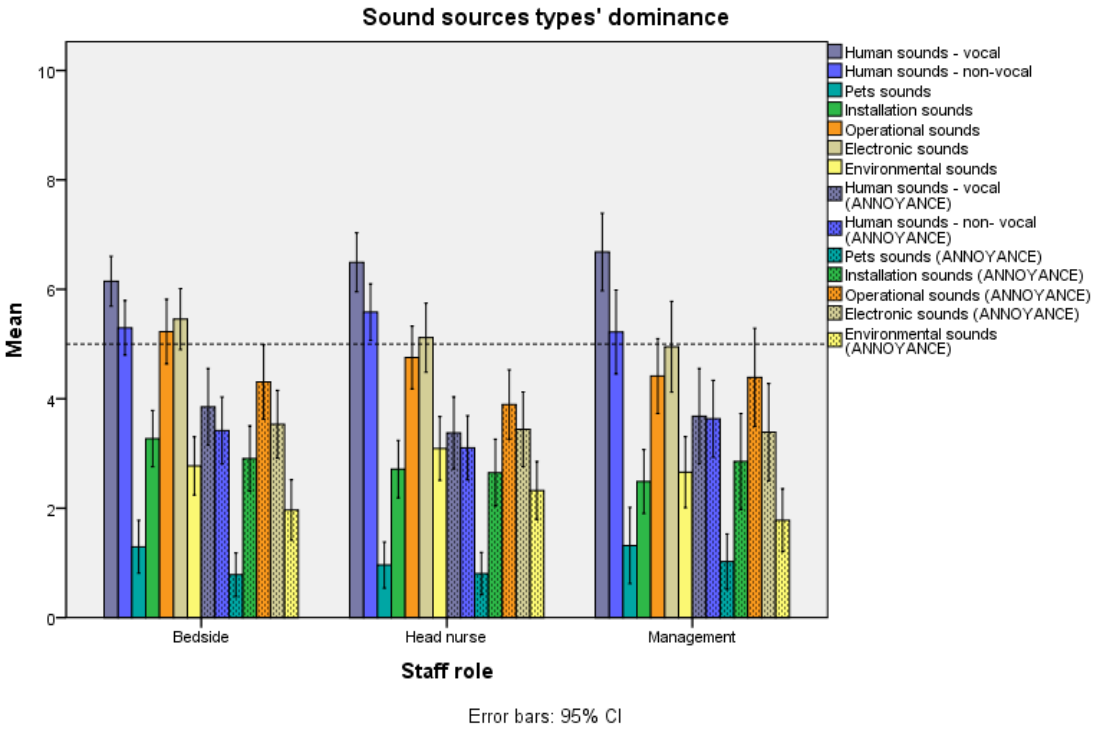

Figure 11. Mean scores of the items of the "Sound sources types' dominance" category (and corresponding noise annoyance), as a function of the Staff role variable.

3.3 Effect of context on soundscape in the Nursing Homes

This section addresses the third research question stated in the introduction, that is: whether sound perception changes depending on the place (i.e., context) within the Nursing Home.

A set of independent-samples *t*-tests was run to determine if there were differences in the scores of the items for the "Overall quality of the acoustic environment", "Soundscape dimensions" and "Audible safety" categories between bedrooms and living rooms. The overall perceived quality of the acoustic environment was statistically significantly higher for bedrooms (M = 6.91, SD = 1.56) than for living rooms (M = 6.28, SD = 2.10); $t(91) = -2.209$, $p = .030$.

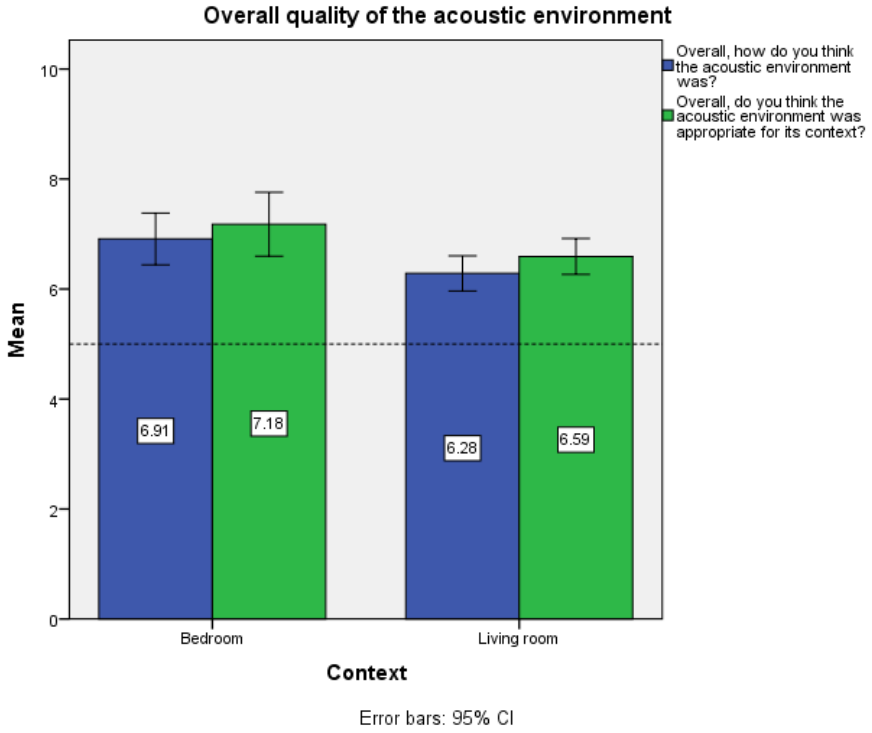

Figure 12. Mean scores of the items of the "Overall quality of the acoustic environment" category, as a function of the Context variable.

Regarding the "Soundscape dimensions" category, statistically significant differences only emerged for some items. For dimension *annoying*, there was a statistically significant difference between the scores of bedrooms (M = 2.64, SD = 2.08) and living rooms (M = 3.46, SD = 2.23); $t(210) = 2.209$, $p = .028$, the living rooms being more annoying. For *calm*, the scores were statistically significantly higher for bedrooms (M = 6.27, SD = 1.95) than for living rooms (M = 5.38, SD = 2.39); $t(83) = -2.566$, $p = .012$. On the other hand, for *vibrant*, the scores were statistically significantly lower for bedrooms (M = 4.24, SD = 2.45) than for living rooms (M = 5.41, SD = 2.01); $t(60) = 2.944$, $p = .005$. Moreover, for *eventful*, there was a statistically significant difference between the scores of bedrooms, with lower scores (M = 3.69, SD = 2.34) than for living rooms (M = 5.38, SD = 2.18); $t(210) = 4.553$, $p < .001$. No statistically significant differences were observed for the rest of the items. Figure 13 reports the mean scores of all evaluated soundscape dimensions, where it can be observed that the soundscapes of the living rooms tended to be more eventful, while the soundscapes in the bedrooms were experienced as calmer.

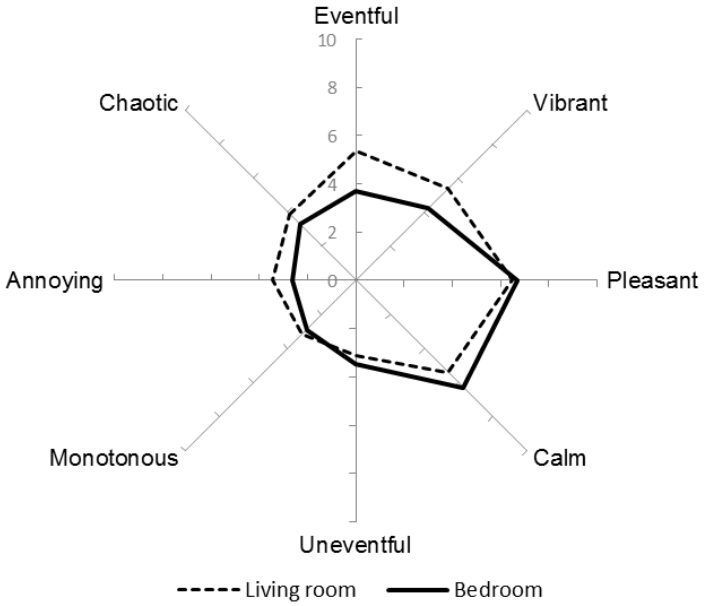

Figure 13. Mean scores of the "Soundscape dimensions" category on the circumplex model by (Axelsson, Nilsson, & Berglund, 2010), plotted separately for the living rooms and bedrooms of the Nursing Homes.

Regarding the "Audible safety" category, for the item *familiar*, there was a statistically significant difference between the scores of bedrooms (M = 6.51, SD = 2.45) and living rooms (M = 5.16, SD = 2.55); $t(210) = -3.184$, $p = .002$. Thus, bedrooms were considered as having a more familiar soundscape than living rooms, while no statistically significant differences were observed for theitem *safe* between bedrooms and living rooms. Mean scores are reported in Figure 14.

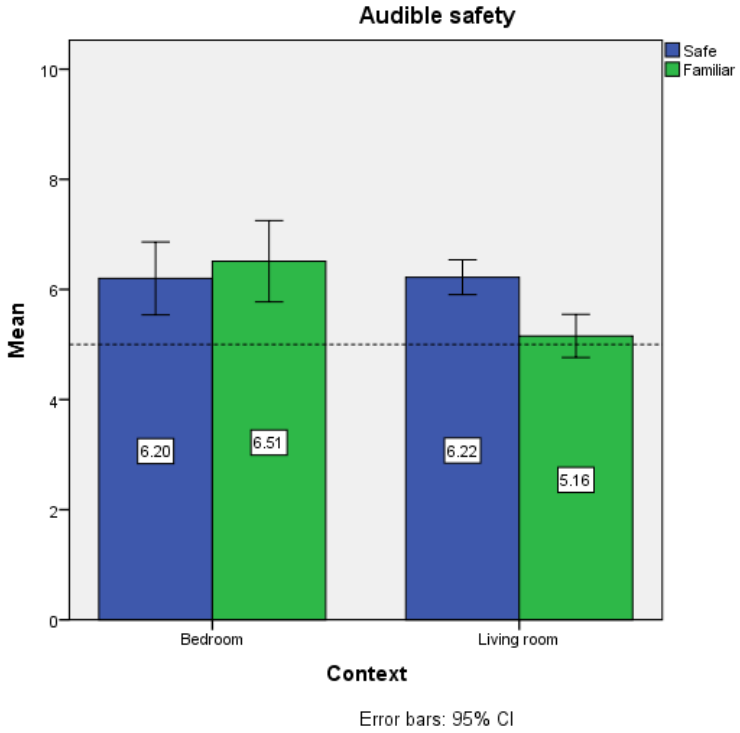

Figure 14. Mean scores of the items of the "Audible safety" category, as a function of the Context variable.

4. DISCUSSION

This study aimed at performing a large-scale survey on sound perception and, more generally, 'awareness about sound' for staff members working in Nursing Homes in Flanders. As a general limitation, it could be argued that, considering the methodology for data collection used in this study, it is hard to define the actual coverage of the survey at a regional level (and thus to assess precisely the effectiveness of the study in depicting the global picture), considering the Nursing Homes that are represented in this study, those which were invited to participate to the survey, and those which are actually active in Flanders. However, the overall response rate of approximately 22.8% could be deemed as satisfactory, considering that web-surveys have usually much lower response rates than postal or on-site surveys (Fan & Yan, 2010). A further shortcoming is that the data collection was done online and was therefore entirely unsupervised. Consequently, participants did not have the possibility to ask for clarifications about the stated questions, which could have caused different interpretations and understanding of the meaning of some items (particularly soundscape dimensions). However, in both cases, it is worth noticing that the sample size was ample enough to allow for reasonable statistical analysis of the dataset potentially mitigating the effect of the above-mentioned uncontrolled aspects.

4.1 Overview: noise sensitivity of staff members and overall sound environment's perception in Nursing Homes in Flanders

The first aim of this study was mainly a descriptive one. Data were presented as aggregated scores for all participants from all Nursing Homes included in the survey. To the knowledge of the authors, this was the first study of its kind – a large-scale soundscape survey in Nursing Homes in Flanders that investigated personal characteristics of staff with respect to 'sound'. Thus, it is not possible to compare the obtained results with the previous studies. As a general trend, the participating sample resulted to be slightly- to moderately sensitive to noise. This is a personal aspect, not related to the actual acoustic environment of the Nursing Homes, but there might be some associations with the fact that working in a NH is physically demanding *per se*, and the level of moral distress is high. Other studies, even if they do not explicitly mention noise as an environmental stressor, seem to confirm this circumstance (Lake, 2002) (Ulrich, Buerhaus, Donelan, Norman, & Dittus, 2005) (Milisen, Abraham, Siebens, Darras, & Dierckx de Casterlé, 2006) (Paquay, De Lepeleire, Milisen, Ylieff, Fontaine, & Buntinx, 2007). On the other hand, when asked to think about specific work situations, staff members seemed to report quite positive assessment about the soundscapes they experienced. Therefore, when considering the personal noise sensitivity of the participants mentioned above, this can be seen as an indicator of good quality of the acoustic environments in the Nursing Homes.

4.2 Effect of staff role on noise sensitivity and differences between staff groups for soundscapes in the Nursing Homes

One of the aims of this study was to investigate whether there are differences in terms of self-reported noise sensitivity and soundscape assessment, depending on the staff group one belongs to, because of different working routines and/or different degrees of involvement with the everyday life of the NH residents. In the case of noise sensitivity, this could even imply that the staff role itself influences sensitivity; i.e., the noise sensitivity is 'induced' by one's work type (Yang & Kang, 2005), while for other soundscape dimensions, it could suggest that the different staff roles are exposed to substantially different sound environments. Nevertheless, statistically significant difference between staff role groups only emerged for three perceptual items – soundscape dimension *uneventful*, and *safe* and *familiar* for audible safety question. For all cases, bedside staff had lower scores than head nurse or management staff. Bedside staff is possibly the most dynamic group within a NH, that is: they move often within the facility, change a lot of work-spaces and therefore it is assumed that they

are exposed to quite different acoustic environments. This would explain why members of this group experience a soundscape that is less uneventful or consequently, more eventful. Additionally, they perceived soundscape as less safe (probably due to the unexpected circumstances connected to the daily life of the patients) and less familiar (change of the work settings). Correspondingly, head nurse and management staff members experience a soundscape that is more uneventful, safe and familiar, given the more 'static' role they assume and the places they work in.

4.3 Effect of context on soundscape in the Nursing Homes

Differences in terms of soundscape appreciation depending on the context in the NH were also explored. The rationale of considering bedrooms and living rooms as separate conditions is that these are the places were staff members spend most of their working time. Moreover, the ratio of staff to residents is different in these two conditions (i.e., typically one-to-one in bedrooms, and one-to-many in living rooms). It was found that the overall perceived soundscape quality was higher in bedrooms than in the living rooms possibly due to the fact that in a more confined context like bedroom, background noise or other disturbing sources are more limited. No differences were observed for the appropriateness dimension, meaning that regardless of the overall quality, the sound environment was found to be consistent with the context in both bedrooms and living rooms. This confirms previous findings that the appropriateness should be used as a complementary dimension to soundscape assessment and little can be said when considering it alone (Axelsson Ö. , 2015). When looking at the soundscape dimensions, it can be observed that living rooms generally reported higher scores in the eventfulness dimension. While this is useful to offer a variety of vibrant soundscapes, it also represents a risk to expose people to chaotic soundscapes; therefore, attention should be paid to the management of the sound sources that constitute the sound environment of the living rooms.

5. CONCLUSIONS

In this study, a soundscape survey was circulated to the staff members of 786 Nursing Homes in Flanders to get better insights into how 'sound' is understood and perceived both at the personal level and in the working environment. As general findings, this study revealed that:

- Staff members of the Nursing Homes included in the study are slightly- to moderately sensitive to noise (personal factors), but their perception of the sound environment in the work settings is rather positive.
- Statistically significant differences in terms of perception between different staff role groups emerged only for very few soundscape dimensions (i.e., uneventful, safe and familiar)
- There were statistically significant differences in several perceptual dimensions between the soundscapes of bedrooms and living rooms in the Nursing Homes, in particular: bedrooms were perceived as calmer while living rooms were perceived as more eventful.

All these results together suggest that it could be worth investigating additional personal factors (e.g., gender, age of service, etc.) of staff members, which could turn out to be important in determining the individuals' perception of the sound environments. Finally our findings show that there is a potential to re-think the management of the sound environments in the Nursing Homes using the soundscape strategies for different situations and contexts.

Acknowledgements

The AcustiCare project is supported by the Flemish Agency for Innovation and Entrepreneurship (VLAIO) under the TETRA program for applied research (grant no. HBC.2016.0089). The authors are grateful to the staff members of the nursing homes who took part in the survey.

References

Agentschap Zorg en Gezondheid. (2017). *Adressen van woonzorgcentra en rust- en verzorgingstehuizen*. Retrieved March 2017, from Agentschap Zorg en Gezondheid: https://www.zorg-en-gezondheid.be/per-domein/ouderenzorg/woonzorgcentra/adressen

Aletta, F., & Kang, J. (2015). Soundscape approach integrating noise mapping techniques: a case study in Brighton, UK. *Noise Mapping, 2*(1), 1-12.

Aletta, F., Axelsson, Ö., & Kang, J. (2017). Dimensions Underlying the Perceived Similarity of Acoustic Environments. *Frontiers in Psychology, 8*, 1162.

Aletta, F., Botteldooren, D., Thomas, P., Vander Mynsbrugge, T., De Vriendt, P., Van de Velde, D., et al. (2017). Monitoring Sound Levels and Soundscape Quality in the Living Rooms of Nursing Homes: A Case Study in Flanders (Belgium). *Applied Sciences, 7*(9), 874.

Aletta, F., Kang, J., & Axelsson, Ö. (2016). Soundscape descriptors and a conceptual framework for developing predictive soundscape models. *Landscape and Urban Planning, 149*, 65-74.

Andringa, T. C., Weber, M., Payne, S. R., Krijnders, J. D., Dixon, M. N., v.d. Linden, R., et al. (2013). Positioning soundscape research and management. *Journal of the Acoustical Society of America, 134*(4), 2739-2747.

Axelsson, Ö. (2015). How to measure soundscape quality. *Proceedings of the Euronoise 2015 Conference*, (pp. 1477-1481). Maastricht.

Axelsson, Ö., Nilsson, M. E., & Berglund, B. (2009). A Swedish instrument for measuring soundscape quality. *Proceedings of the Euronoise 2009 Conference.* Edinburgh.

Axelsson, Ö., Nilsson, M., & Berglund, B. (2010). A principal components model of soundscape perception. *Journal of the Acoustical Society of America, 128*(5), 2836-2846.

Benfield, J. A., Nurse, G. A., Jakubowski, R., Gibson, A. W., Taff, B. D., Newman, P., et al. (2014). Testing Noise in the Field: A Brief Measure of Individual Noise Sensitivity. *Environment and Behavior, 46*(3), 353-372.

Fan, W., & Yan, Z. (2010). Factors affecting response rates of the web survey: A systematic review. *Computers in Human Behavior, 26*(2), 132-139.

International Organization for Standardization. (2014). *ISO 12913-1:2014 Acoustics — Soundscape — Part 1: Definition and conceptual framework.* Geneva: ISO.

Lake, E. T. (2002). Development of the practice environment scale of the nursing work index. *Research in Nursing and Health, 25*(3), 176-188.

Milisen, K., Abraham, I., Siebens, K., Darras, E., & Dierckx de Casterlé, B. (2006). Work environment and workforce problems: A cross-sectional questionnaire survey of hospital nurses in Belgium. *International Journal of Nursing Studies, 43*, 745-754.

Paquay, L., De Lepeleire, J., Milisen, K., Ylieff, M., Fontaine, O., & Buntinx, F. (2007). Tasks performance by registered nurses and care assistants in nursing homes: A quantitative comparison of survey data. *International Journal of Nursing Studies, 44*, 1459-1467.

Ulrich, B. T., Buerhaus, P. I., Donelan, K., Norman, L., & Dittus, R. (2005). How RNs View the Work Environment: Results of a National Survey of Registered Nurses. *The Journal of Nursing Administration, 35*(9), 389-396.

United Nations. (2001). *World Population Ageing: 1950-2050.* Department of Economic and Social Affairs - Population Division. New York: United Nations Publications.

van den Bosch, K. A. (2015). *Safe and Sound: Soundscape research in special needs care.* Groningen: University of Groningen.

van den Bosch, K. A., Andringa, T. C., Başkent, D., & Vlaskamp, C. (2016). The Role of Sound in Residential Facilities for People With Profound Intellectual and Multiple Disabilities. *Journal of Policy and Practice in Intellectual Disabilities, 13*(1), 61-68.

van den Bosch, K. A., Andringa, T. C., Peterson, W., Ruijssenaars, W. A., & Vlaskamp, C. (2016). A comparison of natural and non-natural soundscapes on people with severe or profound intellectual and multiple disabilities. *Journal of Intellectual and Developmental Disability*.

Weinstein, N. D. (1980). Individual differences in critical tendencies and noise annoyance. *Journal of Sound and Vibration, 68*, 241-248.

Yang, W., & Kang, J. (2005). Soundscape and Sound Preferences in Urban Squares: A Case Study in Sheffield. *Journal of Urban Design, 10*(1), 61-80.