Awareness of 'sound' in nursing homes: A large-scale soundscape survey in Flanders (Belgium)

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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.

Introduction

With the world population ageing rapidly, care for older people and care environments are increasingly being studied both in their 'physical' and intangible settings.[1] Care facilities are places where

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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,[2] 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.[3]

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.[4] 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[5] and nursing homes (NHs): in a former study of the authors it was indeed pointed out that "raising awareness about the potential role of the sound domain in nursing homes is a necessary step towards healthy and stimulating acoustic environments."[6]

NHs 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 NHs 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 (e.g. Milisen et al.[7] and Paquay et al.[8]), 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.[2,5]

The main aims of this study were: (1a) to provide an overview about noise sensitivity of staff members in NHs 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 NH. The aims (1a) and (1b) are mainly covered in section 'Overview: noise sensitivity of staff members and overall sound environment's perception in NHs in Flanders' in sections 'Results' and 'Discussion', respectively; aim (2) is covered in section 'Effect of staff role on noise sensitivity and differences between staff groups for soundscapes in the NH' in sections 'Results' and 'Discussion'; and aim (3) is covered in section 'Effect of context on soundscape in the NHs' in sections 'Results' and 'Discussion'.

For this purpose, an online survey was prepared and sent via email to staff members to a list of NHs 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.

Methods

Selection of the NHs

A list of all NHs currently active in Flanders was obtained through the Agency of Care and Health database.[9] The database includes all NH, regardless of their legal status; that is, whether they are private, public or non-profit organisations. In total, 786 were found and 936 corresponding email
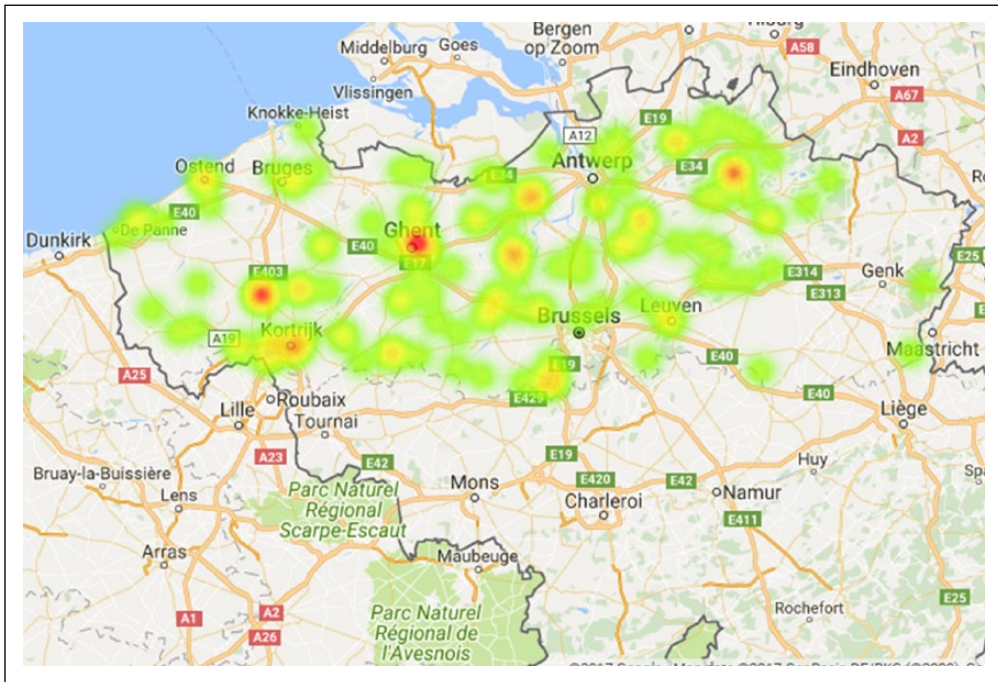
Figure 1. Density map of the responses gathered through the questionnaire in Flanders; red indicates higher response rate.

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 and clerical staff) 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 7 weeks (from 31 March to 21 May 2017), and a reminder was sent on 21 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 (Figure 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.

Questionnaire

There is still no unique standard on how to collect individual responses on the holistic perception of sound environments in context.[10] The International Organization for Standardization (ISO)[4] has so far provided a general framework, but specific protocols are still a topic for debate. A number of different questionnaires have been proposed over the years,[11,12] with some specific applications in

care facilities.[5,13] Therefore, the questionnaire used in this study was adapted from a number of such protocols retrieved from the literature.

The questions considered for this study mainly refer to six general categories (Table 1): (1) noise sensitivity, (2) overall quality of the acoustic environment, (3) soundscape dimensions, (4) audible safety, (5) sound sources types' dominance and (6) their corresponding induced annoyance. The noise sensitivity category was made of a reduced number of items extracted from the Weinstein's[14] Noise Sensitivity Scale, which has been proven consistent to provide similar users' profiling as per the full scale.[15] This category (1) 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 (2–6), 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,[11,12] core affect,[16] familiarity and safety,[2] perceived dominance of different sound source' types and the noise annoyance induced by the same sources.[6,17]

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.

Results

This section is divided into three sub-sections, which address the aims (1)–(3) stated in the introduction, accordingly. Thus, section 'Overview: noise sensitivity of staff members and overall sound environment's perception in NHs in Flanders' has primarily a descriptive purpose, while in sections 'Effect of staff role on noise sensitivity and differences between staff groups for soundscapes in the NH' and 'Effect of context on soundscape in the NHs', the statistical analysis of the effect of the investigated variables is shown.

Overview: noise sensitivity of staff members and overall sound environment's perception in NHs 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 10-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.

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.

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' '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'	Totally disagree– Totally agree
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? Overall, do you think the acoustic environment was appropriate for its context?	Very bad–Very good Not at all appropriate– Very appropriate
Soundscape dimensions [Please state to what extent the acoustic environment you experienced was …]	Eventful Vibrant Pleasant Calm Uneventful Monotonous Annoying Chaotic	Not at all–Completely
Audible safety [Please state to what extent the acoustic environment you experienced was …]	Safe Familiar	Not at all–Completely
Sound source's types [Please state to what extent the following sound sources were dominant …]	Human sounds – vocal Human sounds – non-vocal Pets sounds Installation sounds Operational sounds Electronic sounds Environmental sounds	Did not hear at all–Dominated completely
Sound source's types (annoyance) [Please state to what extent the following sound sources annoyed you …]	Human sounds – vocal Human sounds – non-vocal Pets sounds Installation sounds Operational sounds Electronic sounds Environmental sounds	Not at all–Completely

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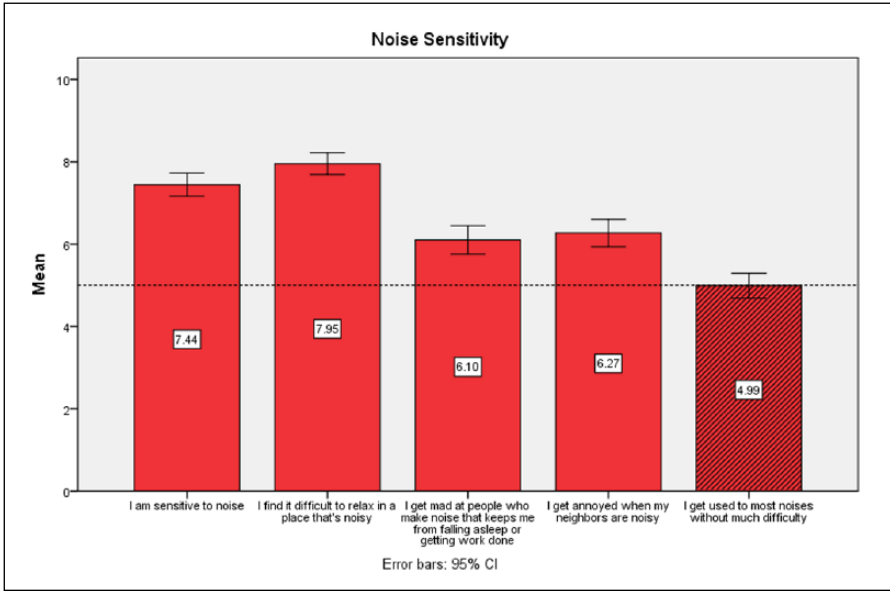
Figure 2. Mean scores and 95% confidence intervals for the five items of the reduced Weinstein's Noise Sensitivity Scale; higher values for the first four items and lower for the last (grey-shaded) item imply higher sensitivity to noise.
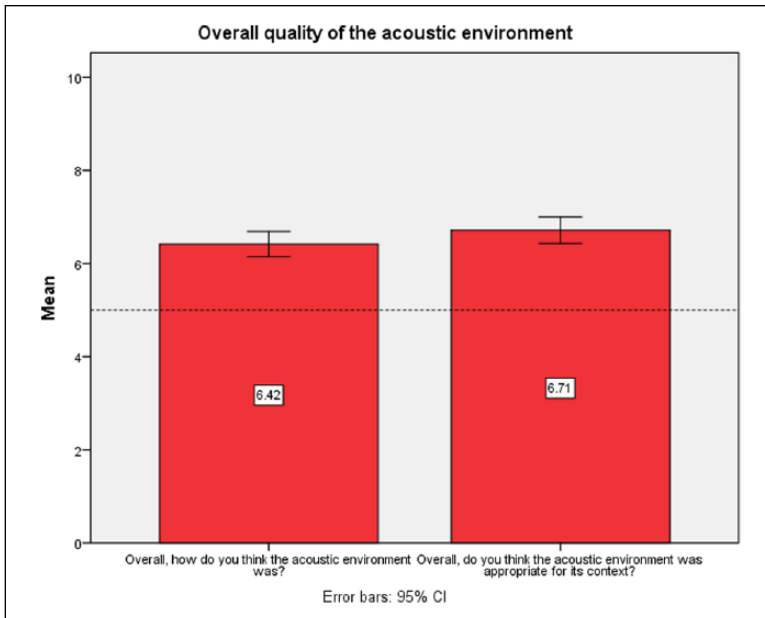

Figure 3. Mean scores and 95% confidence intervals of the items of the 'Overall quality of the acoustic environment' category.
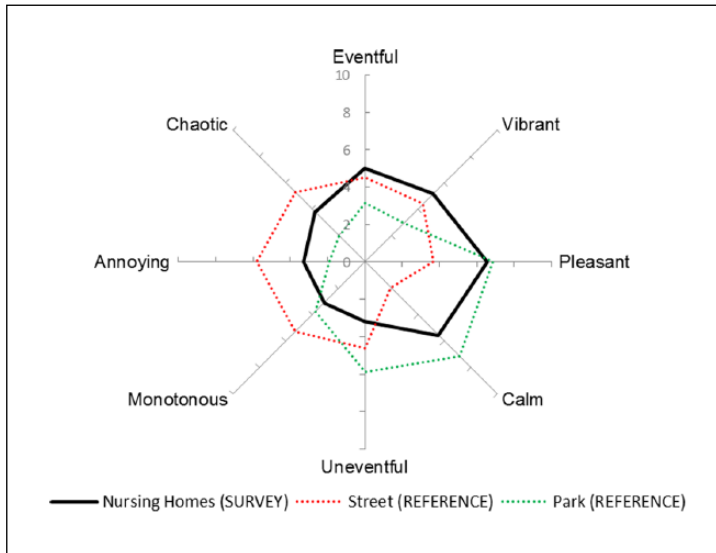
Figure 4. Mean scores (black line) of the 'Soundscape dimensions' category plotted on the circumplex model by Axelsson et al.,[16] as emerged from the survey. This profile is compared with two reference profiles from Aletta and Kang:[18] a busy street (red dashed line) and an urban park (green dashed line).

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 et al.[16] 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:[18] a busy street heavily exposed to road traffic noise and a quiet urban park acoustic environment dominated by natural sound sources.

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 and 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 and telephone) and operational sounds (door slamming, trolleys passing-by, kitchen functions, etc.).

Effect of staff role on noise sensitivity and differences between staff groups for soundscapes in the NHs

A set of one-way analysis of variance (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'
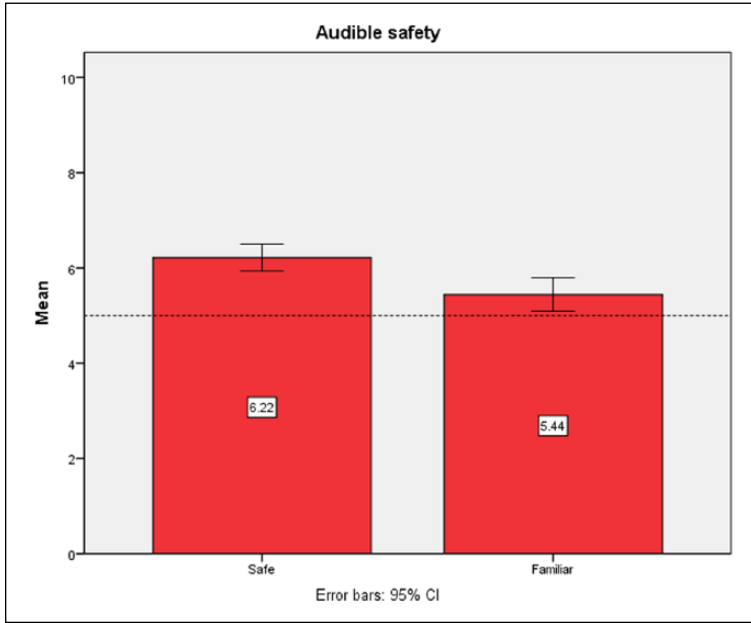
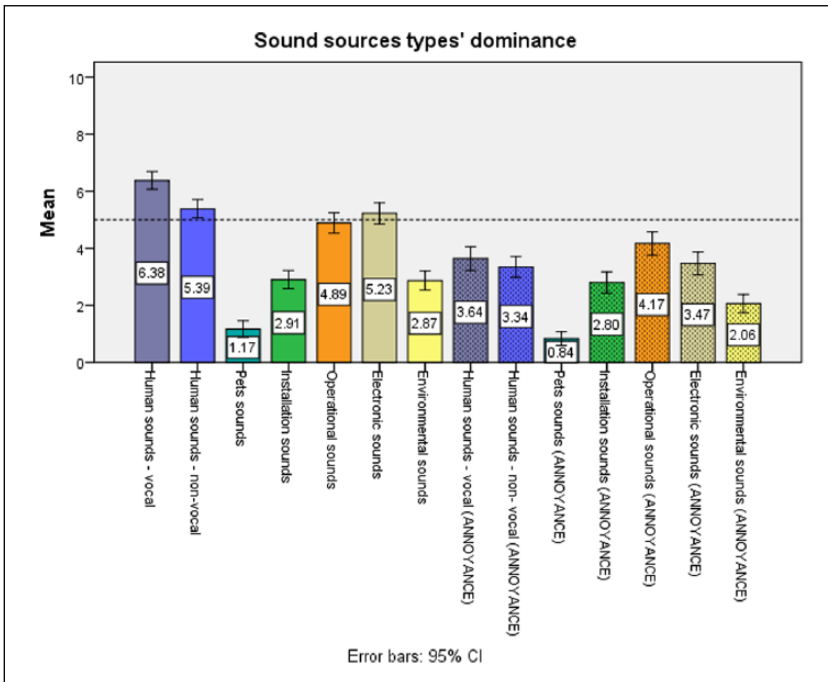**Figure 5.** Mean scores and 95% confidence intervals of the items of the 'Audible safety' category.

Figure 6. Mean scores and 95% confidence intervals of the items of the 'Sound sources types' dominance' category (and corresponding noise annoyance).
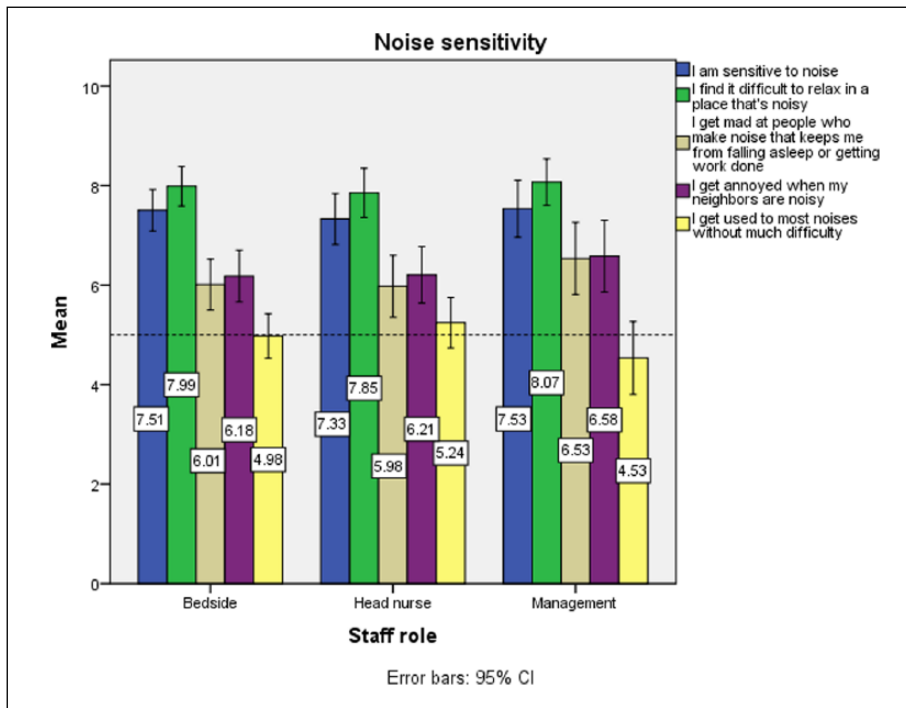
Figure 7. Mean scores and 95% confidence intervals for the five items of the reduced Weinstein's Noise Sensitivity Scale, as a function of the staff role variable.

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 and reference persons for dementia). 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 and group leaders).

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' $F(2, 211) = 0.419$, $p = .658$; and 'I get used to most noises without much difficulty' $F(2, 211) = 1.401$, $p = .249$.

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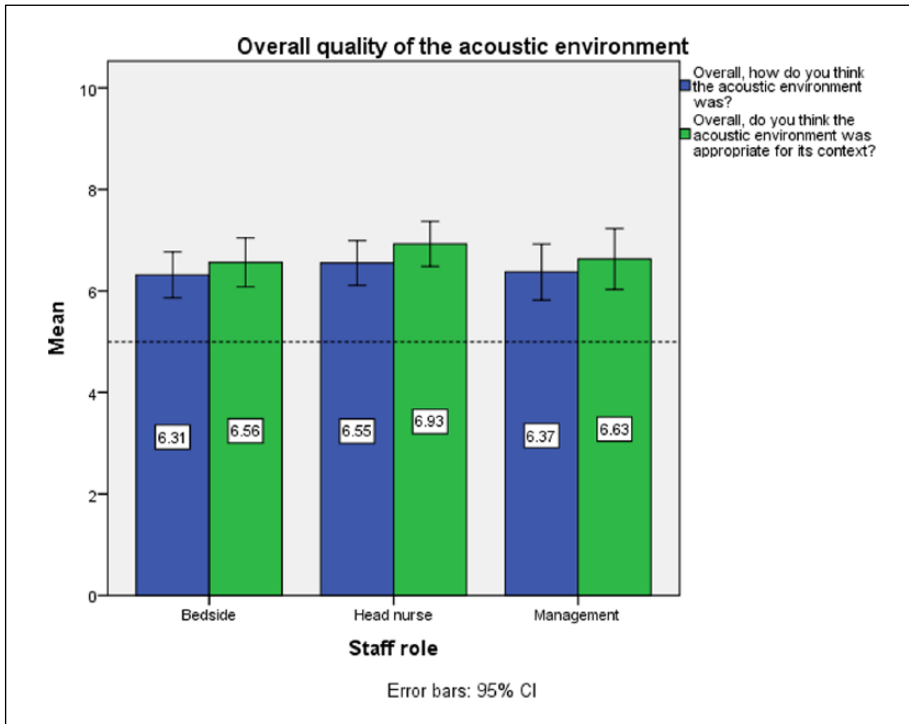
Figure 8. Mean scores of the items of the 'Overall quality of the acoustic environment' category, as a function of the staff role variable.

scores ($M = 2.78$, standard deviation (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 sound-scape items of the questionnaire.

Effect of context on soundscape in the NHs

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 NH.

A set of independent-samples *t*-tests was run to determine whether 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).
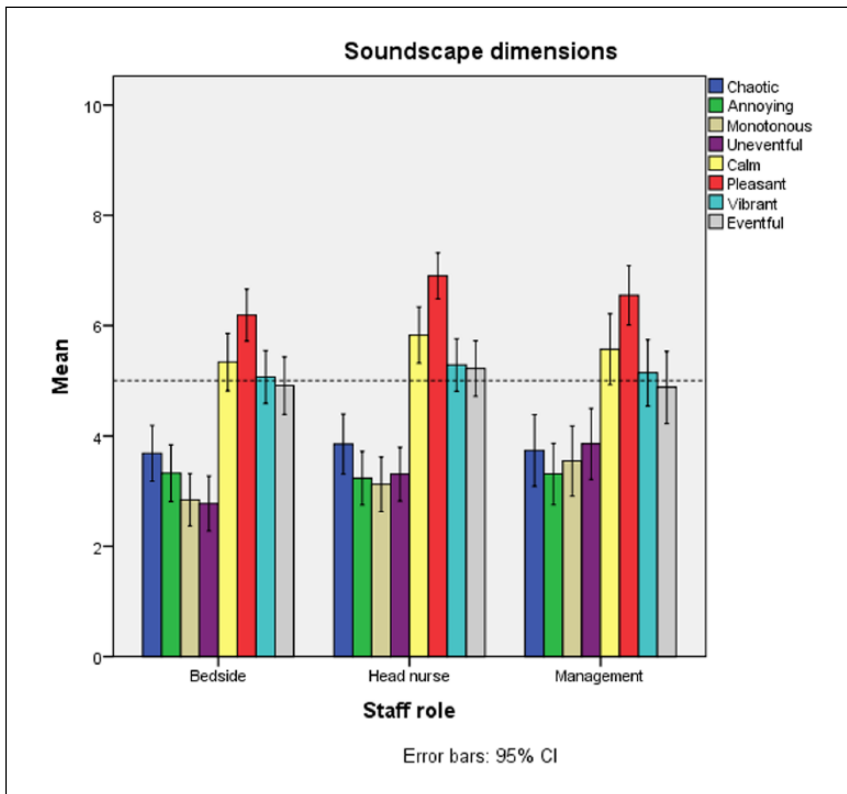
Figure 9. Mean scores of the items of the 'Soundscape dimensions' category, as a function of the staff role variable.

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 ($M = 5.38$, $SD = 2.39$); $t(83) = −2.566$, $p = .012$. However, 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.

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 the item *safe* between bedrooms and living rooms. Mean scores are reported in Figure 14.
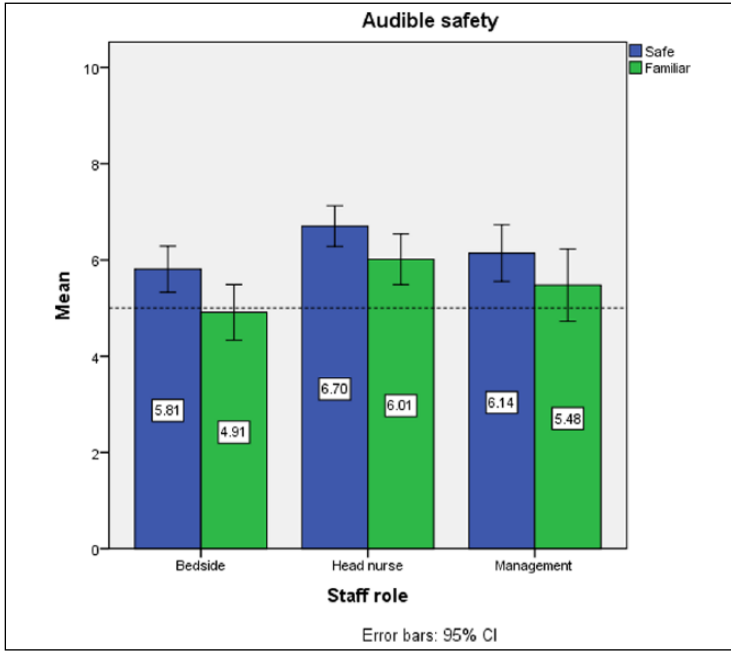
Figure 10. Mean scores of the items of the 'Audible safety' category, as a function of the staff role variable.
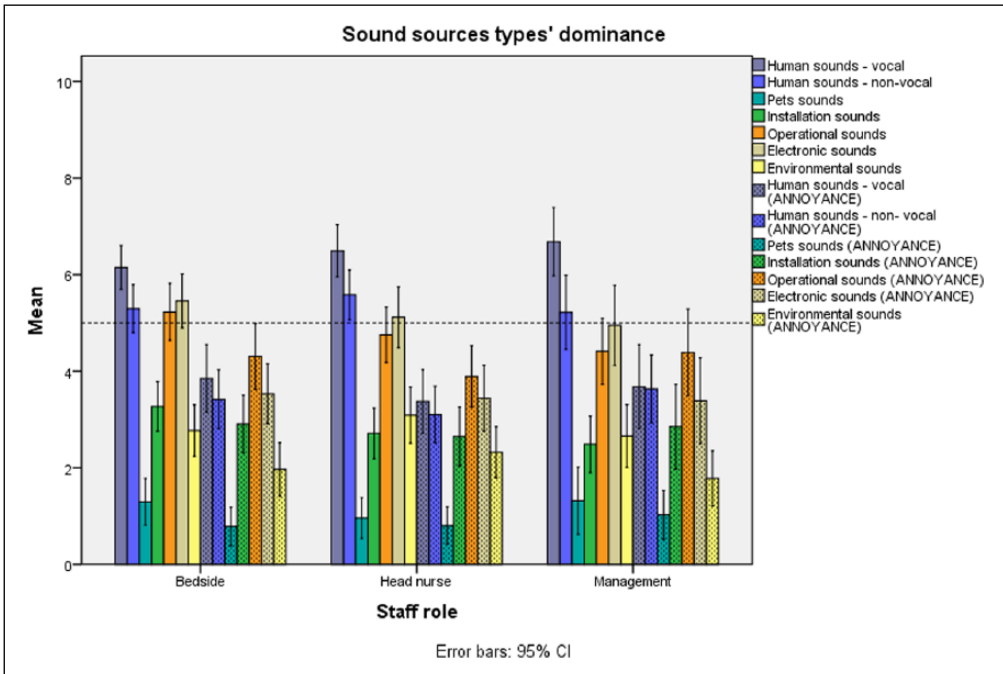

Figure 11. Mean scores of the items of the 'Sound sources types' dominance' category (and corresponding noise annoyance), as a function of the staff role variable.
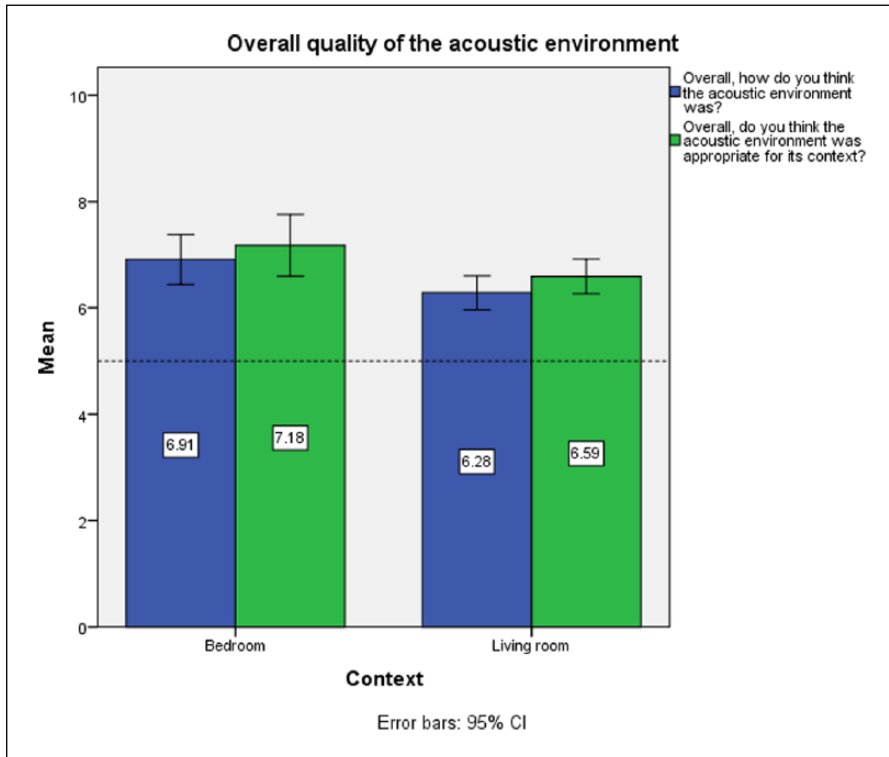
Figure 12. Mean scores of the items of the 'Overall quality of the acoustic environment' category, as a function of the context variable.
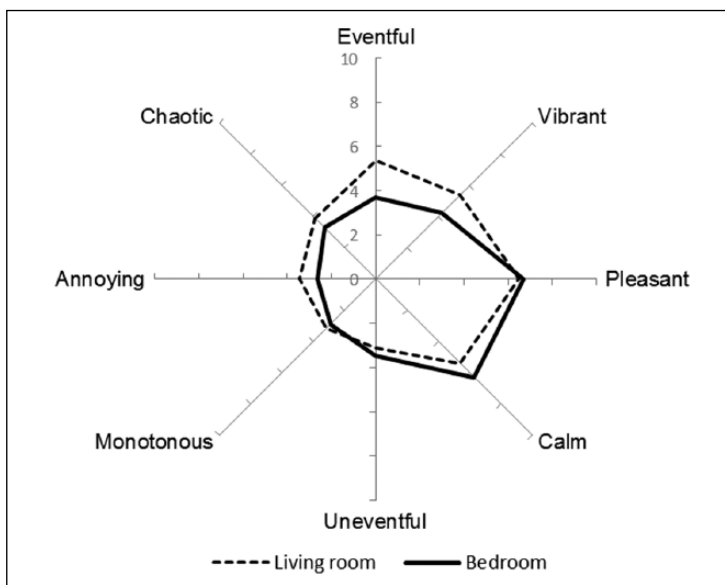

Figure 13. Mean scores of the 'Soundscape dimensions' category on the circumplex model by Axelsson et al.,[16] plotted separately for the living rooms and bedrooms of the nursing homes.
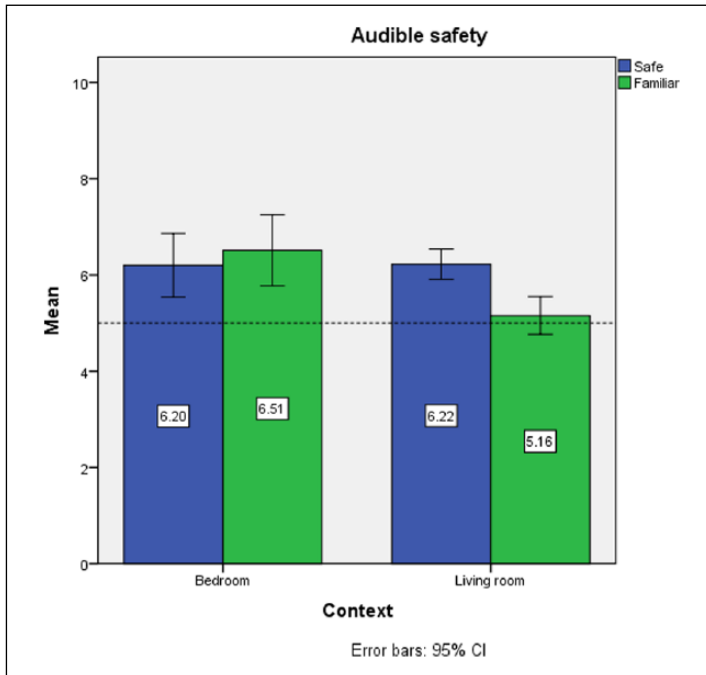
Figure 14. Mean scores of the items of the 'Audible safety' category, as a function of the context variable.

Discussion

This study aimed at performing a large-scale survey on sound perception and, more generally, 'awareness about sound' for staff members working in NHs 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 NHs 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.[19] 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.

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

The first aim of this study was mainly a descriptive one. Data were presented as aggregated scores for all participants from all NHs included in the survey. To the knowledge of the authors, this was

the first study of its kind – a large-scale soundscape survey in NHs 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 NHs, 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.[7,8,20,21] However, 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 NHs.

Effect of staff role on noise sensitivity and differences between staff groups for soundscapes in the NHs

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, that is, the noise sensitivity is 'induced' by one's work type,[22] 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 an NH, that is, they move often within the facility, change a lot of workspaces 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.

Effect of context on soundscape in the NHs

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.[12] 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.

Conclusion

In this study, a soundscape survey was circulated to the staff members of 786 NHs 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 NHs 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 NHs, 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 and age of service) of staff members, which could turn out to be important in determining the individuals' perception of the sound environments. Finally, these findings show that there is a potential to re-think the management of the sound environments in the NHs using the soundscape strategies (e.g. masking of unwanted sounds or creation of "calmer" soundscapes) for different situations and contexts.

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