

The relationship between noise sensitivity and soundscape appraisal of care professionals in their work environment: a case study in Nursing Homes in Flanders, Belgium

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Summary

Noise sensitivity is known as a stable effect modifier for environmental noise annoyance at home. In this study, we investigated its effect on the appreciation of the soundscape in the work environment by care professionals. For this purpose, in the context of the AcustiCare project, we conducted a large-scale online survey with care professionals working at Nursing Homes in Flanders (Belgium). The questionnaire contained two main parts: (1) a reduced version of the Weinstein's Noise Sensitivity Scale (WNSS) and (2) a Soundscape protocol, which included the assessment of overall soundscape quality and its dimensions, the perceived dominance of sound sources and the annoyance they induce. Through a k-means cluster analysis, we then used the WNSS scores to create a *Noise Sensitivity* variable and to sort participants into three groups, corresponding to different "degrees" of noise sensitivity ("quite tolerant of noise", "moderately sensitive to noise" and "very sensitive to noise"). The relationship between *Noise Sensitivity* and overall soundscape appraisal was investigated, as well as potential associations between *Noise Sensitivity* and the staff role. Results showed that no statistically significant differences emerged for soundscape variables, or the perceived dominance of sound sources. However, the "very sensitive to noise" group tended to be more annoyed by human sounds (both vocal and non-vocal), installation sounds and operational sounds. Furthermore, no associations were observed between *Noise Sensitivity* and the staff role. These results suggest that care professionals who are more sensitive to noise are also potentially more likely to be psychologically distressed in their work environment, so their acoustic comfort should be carefully taken into account at a management level.

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1. Introduction

Nowadays care facilities are being studied in a number of different aspects, because of the increasing importance that ageing-related issues are gaining worldwide. The research interest for these facilities covers both the physical (e.g., functional design, visual settings) [1] as well as intangible part (e.g., thermal and acoustic comfort) [2–6] of their built environment. In particular, acoustics is now regarded as a crucial topic in defining the everyday experience of such spaces [7]; this applies to well-being and quality of life of the residents, but also to the staff members, due to the considerable amount of time they spend in these (work) environments [8,9].

This study builds on the findings of previous research conducted within the AcustiCare Project [10], with Nursing Homes (NHs) in Flanders, where it was shown that the interviewed staff members were slightly- to moderately sensitive to noise (at a personal level), but their soundscape appraisal at work was relatively positive [10]. This raised the point that other personal factors (e.g., self-reported noise sensitivity or type of typical work duties) might play a role in determining their perception of the NHs' sound environments.

Therefore, this study aimed at further exploring two particular aspects, namely: (1) potential associations between self-reported noise sensitivity and soundscape appraisal; and (2) potential associations between self-reported noise sensitivity and staff role. For this purpose, data coming from an online questionnaire conducted in [10] will be used to define noise sensitivity and staff role profiles and to perform statistical analysis of these variables.

2. Methods

2.1. Participants

The study targeted people working in any non-administrative care-related capacity in Nursing Homes in Flanders. As specified in (Aletta, et al., 2018) [10], a list of all active NHs in Flanders was retrieved from the Agency of Care and Health database [11]. This approach generated a database of 786 institutions/organizations, from which the second author manually extracted 936 corresponding email addresses. The link to the questionnaire (which will be described in the

following sub-section) was sent to all these email addresses, together with some brief information about the purpose of the study and instructions about how to fill the online form. The questionnaire was meant for staff working in any care-related capacity with the NH residents (i.e., excluding administrative roles, like directors, clerical staff, cleaning staff, etc.), and this aspect was clearly pointed out in the invitation email.

Data collection took place during seven weeks, from March to May 2017, and 206 complete responses were gathered in total.

2.2. Questionnaire

The questionnaire sent to invited participants was relatively broad in scope, but for the purpose of this study, only two set of questions were considered:

(1) Noise sensitivity – was based on five items extracted from the Weinstein's Noise Sensitivity Scale (WNSS) [12], which have been demonstrated to consistently provide similar users' profiling of self-reported noise sensitivity, as the full 21-item scale [13]. These are reported in Table I.

(2) Soundscape appraisal – which included questions about the overall quality of the acoustic environment [14,15], soundscape dimensions [16], audible safety [7], sound sources types' dominance and their corresponding induced annoyance [17]. These are reported in Table II.

At the beginning of the questionnaire, participants were requested to specify their staff role in the NH. While the Noise sensitivity items address personal beliefs and/or preconceptions (individual-related), the Soundscape appraisal items refer to real-life experience (related to the work environment); thus, for these questions, participants were asked to “*think of a typical working day, in the place where you are most in contact with the residents*”. This approach is commonly accepted in social sciences and helps reducing socially expected answers and keeping them focused on a specific situation. The reason for asking staff members to think about a specific moment is that caregivers usually follow a quite regular routine in their duties, which are related to the overall functioning of the facility. NHs are typically organised into departments which host 15-30 residents. The residents have their own (single or double) bedrooms and share a living room where most of common activities take place. Often residents have breakfast together in the

living rooms. Before and after that, staff members would offer morning care to residents who need it (usually in their bedrooms). Lunch and dinner are typically served in the living rooms, where also social activities (e.g., soft gym, watching TV, playing games, receiving relatives) take place during the afternoon. At nights, the living rooms are unoccupied and residents sleep in their bedrooms.

Table I. Questionnaire used for the Noise sensitivity part of the survey. The information about the questions' category was not available to participants.

Question category	Question	Scale (0 – 10)
Noise sensitivity	"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"	

3. Results

In order to define a *Noise sensitivity* variable, a *k*-means cluster analysis was performed on the WNSS scores, forcing the algorithm into a three-cluster solution, which was assumed to be reasonable, considering the sample size and the number of input variables. This resulted in the sample's distribution reported in Figure 1.

Subsequently the mean scores of the five WNSS items were analysed as a function of cluster membership, as reported in Figure 2.

Considering the Noise sensitivity questions, the first four items are "positive" (i.e., the higher the score the more sensitive to noise), whilst the last item is "negative" (i.e., the higher the score, the more tolerant of noise). From Figure 2 it can be observed that the trends of the five items are consistent, thus the three clusters were interpreted as: (1) "quite tolerant of noise", (2) "moderately sensitive to noise" and (3) "very sensitive to noise". These were then considered as categorical (and ordinal) levels of the *Noise sensitivity* variable.

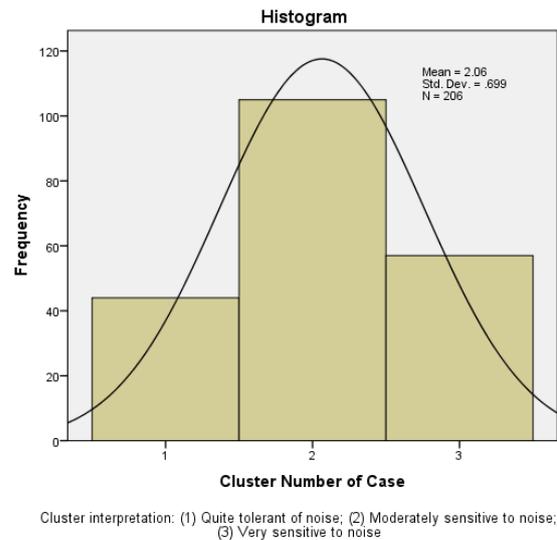
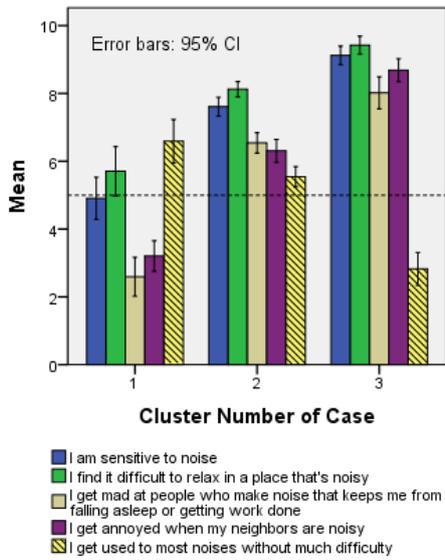


Figure 1. Distribution of the 206 participants across the three groups of the cluster analysis' solution.

Subsequently, the *Staff role* was defined as a three-group categorical variable: (1) Bedside (n = 89), (2) Head nurse (n = 82), and (3) Management (n = 43). Bedside staff members typically work in direct contact with the residents (e.g., nurses, caregivers, occupational therapists, animators, reference persons for dementia, etc.). Head nurse staff members coordinate nurses and caregivers, and have slightly less direct contact with the residents. Management staff members generally have a supervision role (e.g., nurse director, quality coordinators, group leaders, etc.) with limited contact with the residents.

A set of one-way ANOVA tests was conducted to determine if the scores of the Soundscape appraisal items were different between *Noise Sensitivity* groups. This included all the 26 variables (questions), corresponding to the five variables' types (question categories), as reported in Table II.

No statistically significant differences ($p > .05$) were observed between groups for the Overall quality of the acoustic environment variables, the Soundscape dimensions variables, the Audible safety variables and the Sound source's type variables. However, for the annoyance induced by the sound source's types, differences did emerge for: the *Human sounds – vocal* item, $F(2, 203) = 4.419$, $p = .013$; the *Human sounds – non-vocal* item, $F(2, 203) = 8.169$, $p < .001$; and the *Operational sounds* item, $F(2, 203) = 5.994$, $p = .003$. Mean scores are reported in Figure 3.



Cluster interpretation: (1) Quite tolerant of noise; (2) Moderately sensitive to noise; (3) Very sensitive to noise

Figure 2. Mean scores (and 95% C.I.) of the WSNN items as a function of cluster membership. The last item is greyed, as the direction of the statement is opposite to the first four items.

For the *Human sounds – vocal* item, Bonferroni post hoc analysis revealed that the Quite tolerant scores ($M = 2.50, SD = 2.95$) were statistically significantly lower than both the Moderately sensitive ($M = 3.80, SD = 2.94$) ($p = .050$) and Very sensitive scores ($M = 4.23, SD = 3.15$) ($p = .014$). Similarly, for the *Human sounds – non-vocal* item, Bonferroni post hoc analysis revealed that the Quite tolerant scores ($M = 2.09, SD = 2.48$) were statistically significantly lower than both the Moderately sensitive ($M = 3.43, SD = 2.43$) ($p = .050$) and Very sensitive scores ($M = 4.16, SD = 2.86$) ($p = .014$). Eventually, following the same pattern, for the *Operational sounds* item, Bonferroni post hoc analysis revealed that the Quite tolerant scores ($M = 2.95, SD = 3.25$) were statistically significantly lower than both the Moderately sensitive ($M = 4.25, SD = 2.64$) ($p = .043$) and Very sensitive scores ($M = 4.96, SD = 3.10$) ($p = .002$).

Furthermore, a chi-square test of independence was conducted between Noise sensitivity and Staff role. All expected cell frequencies were greater than five. However, there was no a statistically significant association between these two variables, $\chi^2(4) = 1.374, p = .849$. This can also be

observed in Figure 4, where the distributions' shapes of the sample across the *Noise sensitivity* groups are similar between *Staff role* groups.

Table II. Questionnaire used for the Soundscape appraisal part of the survey. The information about the questions' category was not available to participants.

Question category	Question	Scale (0 – 10)
Overall quality of the acoustic environment	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	Eventful	Not at all – Completely
	Vibrant	
	Pleasant	
	Calm	
	Uneventful	
	Monotonous	
	Annoying	
Chaotic		
Audible safety	Safe	Not at all – Completely
	Familiar	
Sound source's types	Human sounds – vocal	Did not hear at all – Dominated completely
	Human sounds – non-vocal	
	Pets sounds	
	Installation sounds	
	Operational sounds	
	Electronic sounds	
Sound source's types (annoyance)	Human sounds – vocal	Not at all – Completely
	Human sounds – non-vocal	
	Pets sounds	
	Installation sounds	
	Operational sounds	
	Electronic sounds	
Environmental sounds		

4. Discussion and conclusions

In this study data from a (relatively) large-scale survey in Flanders on the perception of sound environments for staff in Nursing Homes were analysed from the point of view of personal characteristics (i.e., self-reported noise sensitivity and staff role) of staff members in their work environments. The study has, however, a number of limitations (which have been discussed in [10]),

such as the difficulty to define an exact response rate and the unsupervised methodology used for data collections.

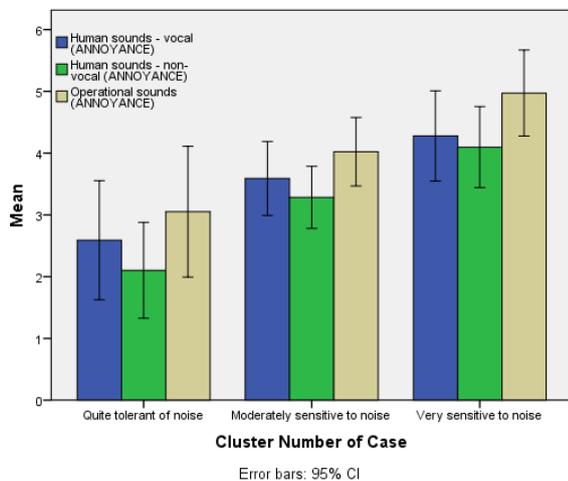


Figure 3. Mean scores (and 95% C.I.) of the three significant soundscape variables, as a function of Noise sensitivity.

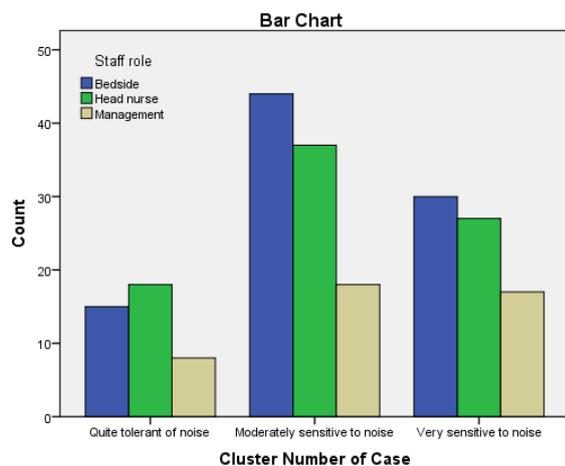


Figure 4. Distributions of the Staff role groups, as a function of Noise sensitivity.

Furthermore, regarding the items of the questionnaire, the WNNS is an already well-established protocol, but for Soundscape appraisal the situation is less clear. The International Organization for Standardization has provided a general framework for soundscape definitions, [18], but no normative protocols yet [19,20] so this is a topic open for debate. A number of questionnaires have been proposed over the years in literature [14,15], even with a clear focus on care facilities [3,4]. Thus, the soundscape appraisal part of the questionnaire used in this

paper was adapted from a number of such protocols.

A previous study within the AcustiCare project had suggested that personal factors might be influencing the soundscape appraisal of staff in NHs [10]. Consequently a few hypotheses were tested and the main conclusions of this study are:

(1) In the relatively broad range of sounds one could experience in NHs, staff members belonging to the Moderately- and Very sensitive to noise groups tended to be more annoyed by specific sources, namely: human sounds (both vocal and non-vocal, e.g., voices, laughter, sounds from individuals, and footsteps, clapping hands, hitting objects, accordingly) and operational sounds (e.g., door slamming, trolleys passing-by, kitchen functions).

(2) No statistically significant associations were observed self-reported noise sensitivity and staff roles.

These two findings together suggest that, in the context of NHs, noise annoyance for staff members is not induced by the work environment settings, but rather by personal factors. This poses the question of how to address the discomfort of more sensitive staff members which might not be necessarily dealt with by changing working patterns and routines (e.g., staff rotations between roles/functions), but should rather be oriented at mitigating the effects of specific unwanted sounds in these facilities [21], for instance by using masking strategies or other “active” soundscapes.

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