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Safe and Sound: Soundscape research in special needs care

Kirsten VAN DEN BOSCH[13]; Tjeerd ANDRINGA[23]

[1] Department of Special Needs Education and Youth Care, University of Groningen, The Netherlands

[2] University College, University of Groningen, The Netherlands

[3] SoundAppraisal, The Netherlands

ABSTRACT

During the past four years, we conducted research on the role of the auditory environment in special needs care. People with severe or profound intellectual and multiple disabilities are characterized by a high degree of vulnerability and lack of autonomy, making them dependent on others for the gratification of their daily needs. Despite their limited cognitive capacities and high prevalence of visual impairments (making them depend relatively more on sounds to make sense of their surroundings), research on the role of sound for this group is limited. To start, a theoretical framework was constructed based on soundscape and emotion research. This framework was tested with a focus group and three observational studies. For the observational studies we developed a smartphone-based in situ experience sampling method called MoSART. Furthermore, we used ambisonic techniques to study the effects of natural versus non-natural soundscapes. We demonstrated that the quality of the auditory environment is related to moods and (problem) behavior in this target group. We hypothesize that audible safety, as estimated by subconscious processes, plays an important role in the quality of auditory environments. Our main recommendation is to increase awareness throughout the entire organization on the role of sound for people with profound intellectual (and multiple) disabilities.

Keywords: soundscapes, healthcare, core affect; 62.5

1. INTRODUCTION

Despite the well-established body of research on the acute effects of noise, little is known about the effects of sound in long-term healthcare settings. This is especially true for special needs care, including residential care and day service facilities for people with profound intellectual and multiple disabilities. Using an interdisciplinary approach, the doctoral research by Van den Bosch (1) summarized in this paper explored two research questions:

1. What is the role of sound for people with severe or profound intellectual and multiple disabilities in residential facilities and day care services?
2. How can the auditory environment be analyzed, documented and improved so that concrete interventions can be taken?

To answer these questions, we adopted an applied exploratory research approach, including qualitative and quantitative methods. We started with the formulation and validation of a theoretical framework. This was followed by the development and implementation of an assessment procedure, which we subsequently used to create controlled positive and safe auditory environments for people with severe or profound intellectual disabilities.

[1] k.a.van.den.bosch@rug.nl
[2] t.c.andringa@rug.nl

2. THEORETICAL FRAMEWORK

2.1 People with profound intellectual and multiple disabilities

In the DSM-5 (2), intellectual disabilities are defined as neurodevelopmental disorders "*with onset during the developmental period that includes both intellectual and adaptive functioning deficits in conceptual, social, and practical domains.*" According to the APA, people with severe intellectual disabilities require support for all daily activities and constant supervision, while people with profound intellectual disabilities are dependent on others for all aspects of daily physical care, health, and safety (2).

This last group, also described as people with profound intellectual and multiple disabilities (PIMD), is distinguished by two defining key characteristics: a profound intellectual disability (an IQ not exceeding 40 points) in combination with a profound motor disability. These disabilities are often accompanied by additional severe or profound secondary disabilities or impairments (3).

The prevalence of visual disabilities in this group increases with the severity of the intellectual disability, with an estimate of 70-85% of people with a profound intellectual disability experiencing visual disorders. In most cases these are caused by impaired development of the visual cortex in the occipital lobe (cortical blindness) (4,5,6). Auditory problems, although common, appear to be less prevalent, with estimates between 30-80%, in people with PIMD (4,7).

Due to the combination and severity of their disabilities, people with PIMD make up an incredibly heterogeneous group. They are characterized by a high degree of vulnerability and lack of autonomy, with a great dependence on others for the gratification of their daily needs. Due to the high prevalence of visual impairments among these individuals, they depend relatively more on the sounds in their environment than non-disabled people to make sense of the world surrounding them.

2.2 Soundscape research

Research on noise (defined as unwanted sound) shows that it can have detrimental effects, such as cardiovascular disease, sleep disturbance, tinnitus, cognitive impairment in children, and annoyance (8,9). Considering that people with severe or profound intellectual disabilities already have reduced cognitive capacity as defined by their intellectual disability and that they often experience visual impairments, we argue that the effects of noise are likely exaggerated in these people (10).

Traditional research on sound (and noise) has a strong focus on the acoustical properties of sound. In contrast to the traditional research, we focus on the soundscape approach, which emphasizes how auditory environments are understood by the perceiver (11). Soundscape research goes beyond the focus on noise and its adverse effects on health, but takes a more holistic approach, focusing on the (subjective and attributed) meaning in sound (12,13,14).

In general, soundscape researchers argue that the acoustical properties of a certain place are far less important than understanding how that place influences a person emotionally. This entails that the properties of soundscapes should describe the affective experiences from the listener, as opposed to describing the physical properties of the sound itself (13). The variance in emotional meaning appears to be largely explained by two main factors, namely, pleasantness and arousal (or alternatively, calmness and vibrancy) (13,15,16,17).

Since people with severe or profound intellectual disabilities have more difficulty in processing and understanding the world around them, it is fair to assume that they experience difficulties in attributing meaning to certain sounds. This increases the probability of them appraising soundscapes as unpleasant, as compared to the non-disabled population.

2.3 Core affect

The concept of core affect allows for a more principled understanding of human perception of soundscapes. Russell (18) describes core affect as the heart of all affective experiences. Core affect does not have one specific stimulus (unlike emotions). Instead, it changes gradually over time, and is shaped by many different influences (19,20), some of which are beyond human awareness, such as environmental changes or subliminal stimuli (21).

The dimensions of core affect, pleasantness and arousal, closely resemble the dimensions of soundscape appraisal, pleasantness and eventfulness. Furthermore, Russell's (18) model shows that interactions with the environment can change a person's core affect, which is supported by in vivo research showing that peoples' appraisal of their environments reflects their mood, and vice versa (22). It is, for example, difficult or impossible to relax in an unpleasant environment and therefore people

actively seek a quiet and pleasant environment to recover from stress (23). So it seems that the way people describe their inner state is coupled to the way they describe the state of their surrounding world, and one could say that our moods serve as attitudes towards the world (24).

2.4 Audible safety

We propose that sounds inform us about our surroundings, and help us form a sense of place ("Where am I?" and "What is going on?"). (25) Furthermore, we define a taxonomy of soundscapes based on the dynamic interplay between how people appraise their auditory environment and how they describe their mood, or core affect, and the concept of audible safety. By combining the main properties of soundscape appraisal and affective experiences (pleasantness and eventfulness), a taxonomy of four qualitatively different types of soundscapes arises: Lively, Calm, Boring, and Chaotic. (25)

Audible safety is an important component of auditory environments, because sounds serve a crucial role in warning for potential danger. If an auditory environment is not indicative of safety, people become more vigilant and alert, which results in stress and appraised unpleasantness. For people with severe or profound intellectual disabilities in a long-term care situation, such as in residential facilities, these consequences may be amplified due to their reduced cognitive functioning and presumably high reliance on sounds. The constant process of determining audible safety in complex auditory environments and the accompanying arousal could dominate or even exceed their cognitive resources. If not paid particular attention, the home environments of these people might be structurally deprived of (for them) meaningful indications of safety. The resulting stress and arousal affects their overall psychological well-being and quality of life, and possibly contribute to challenging behaviors. Ideally, the home environment should always provide ample indications of safety. If the overall situation is abundantly indicative of safety through audible activities, even distinctive and unpleasant sounds may not be so disturbing because they occur in a reassuring environment (24, 25).

3. A focus group study on the role of sound in residential facilities for people with profound intellectual and multiple disabilities

To test the validity of this framework, we designed a focus group study for healthcare professionals working with people with severe or profound intellectual disabilities. We included 34 professionals from three different organizational levels (executive, context providing, and strategic). The latent knowledge of these professionals regarding the role of sound for people with severe or profound intellectual disabilities was consistent with our theoretical framework, and affirmed the hypotheses that sound is important in establishing a sense of place and that indeed sound influences the behavior of people with severe or profound intellectual disabilities. The results emphasized that raising awareness among the staff (in all layers of the organization) about the role of sound in the homes for people with severe or profound intellectual disabilities is a necessary first step in improving the auditory environments of these people. (25)

4. Examining relationships between staff attributions of soundscapes and core affect in people with severe or profound intellectual and visual disabilities

To explore and test the relationship between the auditory environments and moods (in terms of core affect), an assessment procedure (*Assessment Auditory Environment*) was developed, based on the Soundscape-Quality Protocol by Axelsson et al. (26, 27). This assessment procedure was applied in a target group of 36 people with severe or profound intellectual and multiple disabilities. The participants resided in four healthcare facilities in The Netherlands and were each observed by their direct support professionals at multiple moments throughout the entire day. A total of 149 observations of 10 minutes were included in a multilevel regression analysis. The results endorsed a positive relationship between the observed pleasantness and eventfulness of the auditory environment and the moods of people with severe or profound intellectual disabilities. Time of day did not appear to be an explanatory variable for the core affect of the participants, however the type of organization (focused primarily on intellectual or visual disabilities) did. This study suggests a relationship between soundscapes and moods of people with profound intellectual and visual disabilities, as judged by staff

members engaged in their environments. These findings give reason to believe that improved soundscapes could ameliorate the moods of the residents. (27)

5. The relation between the auditory environment and challenging behavior in people with a severe or profound intellectual disability.

Subsequently, we redesigned the abovementioned assessment procedure as a smartphone application MoSART (*Mobile Soundscape Appraisal and Recording Technology*) to make it easier to use by the direct support professionals and more efficient for research purposes (1). MoSART was used as an in-situ experience sampling method during a period of four weeks, which yielded 170 measurements by direct support professionals. Pre- and post-test measurements were administered of the moods (MIPQ) and challenging behaviors (LGP-PIMD).

Exploratory analysis revealed an improvement of the quality of the auditory environment, with an increase of lively appraised soundscapes. In turn, paired sample t-tests showed this improvement was accompanied by a significant decrease of negative moods (MIPQ) (REF?) and also of the severity of stereotypical behavior (LGP-PIMD) of 15 people with severe or profound intellectual and multiple disabilities who displayed challenging behavior. These observations are in line with the predictions by the theoretical framework. The results showed that working with this assessment procedure empowered the direct support professionals in improving in the auditory environment, in which raised awareness might serve as a mediating factor. Moreover, the results demonstrate the immediate and strong effects of the auditory environment on moods and challenging behavior, and the plausibility of success of sound-related interventions. (1)

6. The effect of natural vs. non-natural soundscapes on people with severe or profound intellectual and multiple disabilities.

Since previous research indicated that there is a relationship between the auditory environment and the core affects (or mood) of people with severe or profound intellectual disabilities, we conducted a systematic study to further explore this relationship by studying the effects of different soundscapes on the core affect of the target group. Thirteen participants with severe or profound intellectual disabilities and challenging behaviour were presented with five different soundscapes (Beach, Forest, Urban, Music, and Silence) in a dedicated room. Direct support professionals made core affect observations before and after each trial.

A trend was visible in the core affect observations, with a prominent and consistent increase in the frequency of observations of a Relaxed core affect across conditions. However, a greater increase in the frequency of observations of a Relaxed core affect and a greater decrease in the frequency of observations of an Interested core affect were associated with the natural conditions (Forest and Beach) rather than the non-natural conditions (Urban and Music).

Since the participants mostly moved to a more positive core affect state (relaxed or interested) in all presented soundscapes, it entails that these were an improvement over their normal daily auditory environments, indicating that the daily environments do not necessarily provide a positive soundscape to these people. This pilot study could serve an important role in raising awareness and stimulating further research regarding the auditory environments of people with severe or profound intellectual disability (28).

7. CONCLUSIONS

The research summarized in this paper focused on the development and refinement of an intervention-oriented assessment procedure (MoSART) to analyze and document the auditory environment of people with severe or profound intellectual and multiple disabilities. Since this is a newly developed assessment procedure, and the research mainly consists of exploratory (or pilot) studies, there is no information regarding the psychometric qualities of this procedure yet. Follow-up studies with control groups and simultaneous observations by (at least) two members of the direct support professionals, or other observers such as researchers or family members, are needed to analyze

inter-rater reliability and further psychometrics to validate the assessment procedure. We are, currently, already in the process of doing this, since MoSART is being implemented at three healthcare organizations in the Netherlands. These organizations offer residential care and education to people with intellectual and visual disabilities. The results from these studies will provide more information regarding validity and reliability.

Even though research indicates that people appraise soundscapes in a fairly consistent manner, Cain et al. (13) noted that possible nuances between different demographic groups should be studied more. This especially holds for the highly heterogeneous group of people with severe or profound intellectual disabilities. Our choice not to focus on, and control for, individual differences (e.g. level of intellectual or visual disability) in the statistical analyses, was based on the nature of the target group and the facilities in which they reside. In these residential facilities a number of people with severe or profound intellectual disabilities are placed together and share one auditory environment that influences them all simultaneously. Therefore, the priority was to study and improve these environments as a whole, so that many residents could benefit from these improvements, as opposed to focusing on individual based interventions. Future research could focus more on individual differences, however a larger number of participants is needed to achieve sufficient statistical power in subgroups to conduct a more detailed analysis.

One important question that remains to be solved is how people with severe or profound intellectual disabilities actually perceive soundscapes. Given their profound disability, it is likely that they process and interpret sound in a different way than people without disabilities. People without intellectual disabilities are likely to rely more on knowledge driven (top-down) processing and can, for example, distinguish the importance of sounds. People with severe or profound intellectual disabilities might do this poorly, more slowly, or not at all. Individual sounds may appear equally important to them, because prioritizing might be difficult and they may have difficulties in attending to different sound sources effectively.

This notion gives rise to a need for potentially rotating the axes of the soundscape taxonomy (pleasantness and eventfulness), for people with severe or profound intellectual disabilities. For instance, people without disabilities might perceive a particular environment as lively, while those with severe or profound intellectual disabilities might perceive it as chaotic and overwhelming. Also the proposed role of audible safety should be examined further. Questions like which sounds guarantee audible safety and the actual effects of these indications of safety deserve further research attention.

Only by researching, in a controlled way, how people with severe or profound intellectual and multiple disabilities react to different kinds of soundscapes, will we be able to unravel the actual perceptual processes of these people. Behavioral correlates of soundscape quality, affect, and physiological measures, which are objectively observable phenomena, might offer insight into the subjective experiences and auditory processing of these individuals. The perceptual processes of people with severe or profound intellectual disabilities could be of interest to soundscape research in general, since they might inform us of the fundamental aspects of sound perception, because their (subcortical) responses are less filtered or modified by higher cognitive (and culturally biased) processing.

Currently, it is not feasible to make correct judgments on how people with severe or profound intellectual disabilities experience soundscapes. That is the main reason why in this research the direct support professionals were asked to observe and appraise the soundscapes as they themselves experienced these environments. Until we have assessment procedures that reliably and validly measure how people with severe or profound intellectual and multiple disabilities appraise soundscapes, automated soundscape appraisal can be a way to diminish the indispensable confounding variables of staff attributions. In the future we hope to use machine-learning algorithms to automatically determine soundscape quality and provide the users, whether it be direct support professionals or researchers, with a standardized result.

Lastly, soundscape research has a strong focus on outdoor settings, and the fact that we have studied indoor environments is unusual. Most people have control over their home environments, and therefore it can be assumed that these indoor soundscapes fit the need and preferences of its residents. However, people with severe or profound intellectual and multiple disabilities often do not have this autonomy over their home environment and dependent on the attentiveness, and the knowledge and skills of the direct support professionals, as they will make the choices for them. This applies to other long-term healthcare settings as well, like retirement homes or long stay hospitals. For its vulnerable residents, these healthcare settings are their home environments, so they should be able to feel at home

there. Furthermore, the main objective in these settings is to provide the best possible care to maintain and improve the well-being of its residents. As long as the auditory environment continuous to be overlooked, this objective will not be realized, because the auditory environment has a significant influence on their (physical and psychological) well-being (as set out in this dissertation). Therefore, we should invest more in research on this topic and take careful notice of the auditory environment in long-term healthcare settings to ensure it is of the best possible quality. In fact, the auditory environment should be safe and sound.

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