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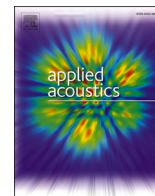
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More than noise: Lived experiences of autistic people in real-life acoustic environments

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ABSTRACT

The study of the human response to sound has typically considered the average experiences of young individuals with standard hearing capabilities and sensitivity, and although research on high noise sensitivity and its effects is extensive, practical considerations in acoustics are usually limited to specific facilities. Thus, the acoustical characteristics of daily life environments can constitute an important barrier, for example, to autistic people, who often experience high noise sensitivity. To contribute to an in-depth understanding of the impact of noise sensitivity in real-life scenarios, this study presents the results of interviews with 12 autistic adults living in the UK, exploring their lived experiences with sounds, spaces and society. Four themes were developed in the thematic analysis of the interviews: 1) High sound sensitivity affects every aspect of life; 2) Lack of understanding and acceptance – sensory gaslighting; 3) Agency is crucial; 4) Positive impact of music and natural environments. The findings suggest that challenges associated to high noise sensitivity can be the result of a heightened response to sound, but are significantly aggravated by social attitudes to sensory differences and pre-conceptions of what is “normal”. Failing to consider diversity in auditory experiences can have important negative consequences for personal and professional life, financial prospects, health and overall well-being. This study calls to observe these experiences under a human rights lens to guarantee the full participation in society on an equal basis, and to continue the work in aural diversity and auditory accessibility in acoustics and soundscape research and practice.

1. Introduction

The built environment can be inaccessible and disabling for people with sensory differences, for instance, autistic and other neurodivergent people. Numerous studies show that autistic people often present a higher prevalence of auditory hypersensitivity [1–4] which can result in heightened annoyance and reduced tolerance to loud sounds or specific frequencies [3,5,6].

Noise sensitivity has long been considered to be one of the main non-acoustic factors influencing individuals' responses to sounds [7,8], and introduced as a moderator in numerous studies through different tests [9,10], usually showing significant differences in the results for level of annoyance and other responses independently of the noise levels [11–15,7]. In addition, noise annoyance and high noise sensitivity have been associated with higher stress levels, anxiety and depression [16],

hypertension, cardiovascular diseases, and poorer health and well-being in general [17–19,12]. Although the detrimental impact on health from noise exposure is not exclusive to people with higher noise sensitivity and this impact can occur even at relatively low levels [20,21], noise sensitivity can lead to individuals feeling overwhelmed, struggling to cope with changes and having control over their lives [22].

There is a need for adequate consideration of these findings in guidelines and standards, as well as for the inclusion of variations in sensitivity and responses to sound in research and regulations in environmental and building acoustics [23–25]. Requirements and recommendations are usually based on metrics and average values that represent *standard* hearing, sensitivity and response [26–28]. Thus, the psychological and physiological impact of noise on people with higher sound sensitivity, for example, are often not appropriately considered in practice, especially regarding the design of non-specialised

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environments that include adults [29]. Recent initiatives from charities and governmental organisations have addressed sensory comfort for autistic and other neurodivergent people, including auditory aspects. Some of these projects have focused on housing [30] or mental health settings [31]. While not a standard, the UK's PAS 6463 "Design for the mind – Neurodiversity in the built environment" from 2022 aims to provide recommendations considering neurodivergent people's needs for the design of "buildings and external spaces for public and commercial use, as well as residential accommodation for independent or supported living" [32].

Perceptual studies in acoustics, as well as research on sensory differences in autistic people, have tended to focus on quantitative approaches and statistical analysis that can miss the significance of some experiences on the person and their life on one hand, and misrepresent the variety in the results on the other. Indeed, several studies have explored perceptual abilities such as superior pitch perception [33], precise representation of auditory events [34], or identification and memorisation of musical notes [35]. Research on sensory sensitivities in autistic people has included children's responses in laboratory settings [36], with potential generalisability issues given the complexity of real-life scenarios, the representativeness of experiences in controlled laboratory settings, and applicability of laboratory-based design solutions in real life [37]. Other research has prioritised caregivers' reports thereby excluding direct perspectives from autistic people [36]. There is also limited research on the auditory experiences and preferences of autistic adults in non-educative settings, although reports to date suggest that the sensory challenges are common and highly disabling in many different environments [38–42]. It is therefore important to understand the autistic person's lived experience of auditory sensitivity across a range of environments, so that we can fully understand their experiences across a range of settings, what is enabling and disabling in the acoustic environment, what coping strategies are employed, and what actions may be taken to support accessible sound environments.

Under the framework of the human-rights model of disability [43], disabilities and impairments are a part of human diversity, and as such, while recognising the impact that sensory differences may have on autistic people, discrimination and exclusion are regarded as a societal rather than an individual problem. It is therefore of vital importance to understand the lived experiences of autistic people in the sensory environment. This knowledge can be used to inform policies and practices so that everyone can have "full and equal enjoyment of all human rights and fundamental freedoms" and can be guaranteed "full and effective participation in society on an equal basis with others" [43].

The aim of the present qualitative study is to better understand the lived, daily experiences of indoor and outdoor acoustic environments in a group of autistic people, highlighting both, positive and negative aspects of their experiences. The objective is to contribute to the research field with knowledge and understanding that addresses challenges felt within acoustic environments and suggestions of how to improve the acoustic environment. To our knowledge, this is the first study exploring the lived experiences of neurodivergent people not only looking at challenges with sound, but also at positive facets that can be considered for improvements. The thematic analysis of interviews to 12 autistic adults is presented herein. The interviews sought to explore responses, common challenges, coping strategies, and preferences, in addition to both the impact that the sound environment has on different dimensions of their lives, capturing this from their own perspectives.

2. Methodology

2.1. Participants

Twelve autistic adults living in the UK participated in the study (seven women, four men and one agender person), in age brackets from 25 to 64 years old. Half of the participants were over 45 years old. The interviews were designed between late 2020 and 2021 (with adaptations

and delays due to COVID-19). Interviews took place from March to August 2022.

Participants were recruited through social media, universities, and organisations supporting autistic people. Inclusion criteria required living in the UK and a formal diagnosis or self-identification as autistic, with volunteer or convenience sampling as the sampling method [44]. Ten participants had a formal diagnosis (in adulthood), one was in the assessment process, and one self-identified. Three participants disclosed during the interviews having hearing loss, and five mentioned experiencing tinnitus. Table 1 summarises the demographic information obtained through the questionnaire with the addition of the disclosed hearing conditions. All participants volunteered without financial incentives.

It was decided not to create participants profiles using pseudonyms associated with demographic data as done in some similar studies, with the intention of avoiding associations of quotes and experiences to particular profiles, in order to minimise biases.

2.2. Noise sensitivity test

Participants completed the short form of LEF (LEF-K) [45], which was used to assess the level of sensitivity in a form that allows for comparisons with the results from other studies using this or similar tests in acoustics research. This test comprises nine statements related to daily life circumstances with a minimum potential score of 0 and a maximum potential score of 27. The mean and median value in this case (min = 10, max = 27; mean = 20.7, median = 21, s.d. = 4.36) were higher compared to the outcomes from other studies such as [45], which evaluated two groups (mean = 14.06, s.d. = 3.95 and mean = 15.08, s.d. = 4.5, respectively). Participants' scores in noise sensitivity tests often follow approximately a Gaussian distribution, with the high and low sensitivity groups split considering the mean or the median value and containing similar number of members (e.g. seventeen in each group in [13] using Weinstein's questionnaire [46], oriented to situations more suitable for students). However, the separation into high and low sensitivity groups following this method would not be appropriate in this study, firstly because the scores obtained do not follow a Gaussian distribution (see Fig. 1), and secondly because all but one participants would be considered highly sensitive to sound according to the scores in other studies. The sensitivity scores obtained match with the self-reported sensitivity, since only that particular participant declared not being especially sensitive to sound.

2.3. Semi-Structured interview schedule

Semi-structured interviews centred on experiences in common settings, at home, at work, outdoors and in indoor leisure environments, identifying which sounds and situations had a positive or negative impact on participants' lives.

More specifically, interview questions aimed to identify:

- Situations where the acoustic environment impacted on the individual either positively or negatively
- Coping strategies
- Contextual factors
- Potential actions related to the sound environment that could improve daily life

Follow-up questions were asked in each session mostly to clarify things said by the participant or to provide more information about a specific situation, feeling or environment described, or to ensure that the participant had fully responded to the question asked. The interview was piloted by 2 participants to ensure understanding, that the research questions were being explored, and that the follow-up questions appropriately probed this exploration. The questionnaire is included in Appendix A.

Table 1
Participants' self-identified demographics and hearing conditions disclosed. Noise sensitivity according to results in the test filled in after the interview.

Age range	Gender	Hearing conditions	Noise sensitive	Employment status	Ethnicity		
35–44 years	5 Female	7 Tinnitus	5 Yes	11	Employed	7 White	4
45–54 years	5 Male	4 Hearing loss	3 No	1	Self-employed	2 Other white	3
25–34 years	1 Agender	1			Not working due to health	2 White Scottish	2
55–64 years	1				Working and studying	1 Other British	2
						Spanish/Arab	1

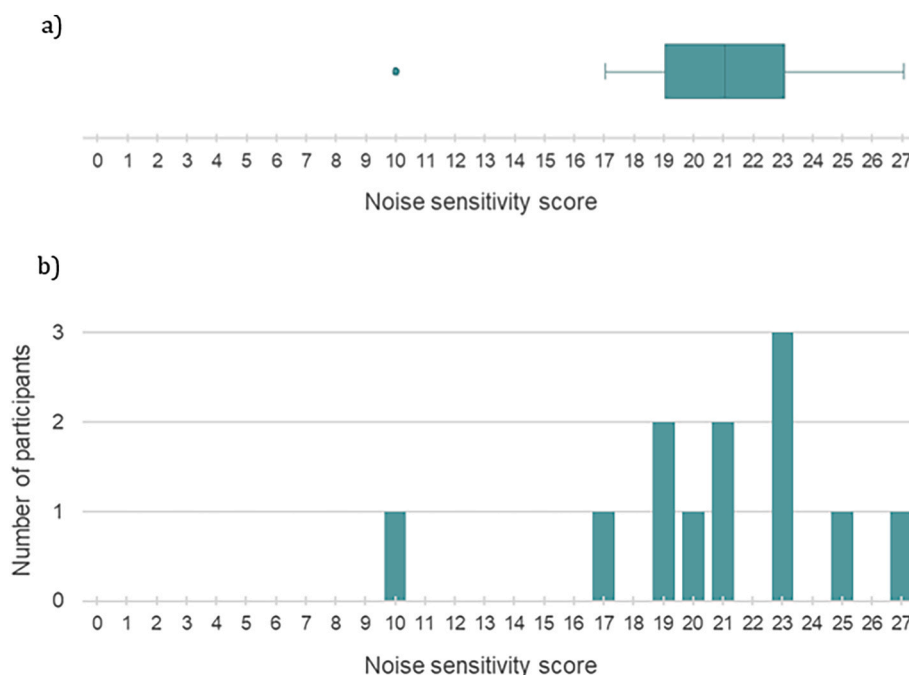


Fig. 1. a) Box plot of the noise sensitivity scores on the LEF-K test. The coloured box represents the interquartile range (i.e. 50 % of scores), the left and right of the box indicate, respectively, the upper and lower quartiles, and the whiskers show the top and lowest 25 % of scores. The line inside the box marks the median value (21), and the circle on the left constitutes an “outlier” (noise sensitivity score=10). b) Histogram of the noise sensitivity scores on the LEF-K test.

2.4. Procedure

Participants were sent the interview questions a few days before the interview, allowing them to familiarize themselves with the topics and specific questions and have them for reference during the session. Participants received an information sheet and signed a consent form before the interview. They also filled the LEF-K noise sensitivity test [45] in after the interview.

Eleven interviews were conducted using Microsoft Teams, and one interview was done by sending the complete questionnaire via email and receiving it with the participant’s answers. Mixed methods in data collection have been used with success in qualitative research with the substance of interviews being similar across methods [47]. The response via email was comprehensive, resulting in it not being necessary to send follow-up questions. These methods of interviewing were selected in order to enhance inclusion (e.g. [48]). It is important to include both synchronous and asynchronous methods to allow for participants to choose the method of communication which best suits them. This is particularly important when working with sensitive topics and for neurodivergent participants. All responses were written or oral communication. There can be challenges in analysing data obtained through varying techniques if different data sources provide different amounts of depth (e.g. [49]), however, the responses via email were similar in depth, substance and codes to those conducted via Microsoft Teams.

Interviews ranged 30–150 min, with a mean of one hour. Ethical approval was granted by the School of Energy, Geoscience,

Infrastructure and Society at Heriot-Watt University.

2.5. Thematic analysis

Reflexive thematic analysis was chosen as the method to explore participants’ experiences with acoustic environments. This qualitative approach enables the development of rich, multifaceted themes and the identification of influencing factors, while it also recognises the role of the researcher, their background and subjectivity in the process [50–52]. Subjectivity and personal and cultural biases are not only considered unavoidable as a researcher (in both, qualitative and quantitative research), but a strength in reflexive thematic analysis, bringing a unique perspective for the interpretation of the data [51,53].

The decision of using a qualitative methodology responds to a need for in-depth, first-hand accounts of experiences with sounds and acoustics in real-life settings, sharing the view highlighted by Ratcliffe et al. that “prioritising quantitative research negatively affects our understanding of human–environment relationships, especially among seldom-heard populations” [54]. This study was designed from a research positioning situated in a contextualist epistemology and critical realist ontology [51].

2.6. Positionality

In this case, the main researcher is a middle-aged, southern European white autistic woman with ADHD from a working-class environment, multiple times migrant, with formal education in electronic engineering,

building and environmental acoustics, and architecture, and with an approach on accessibility and diversity based on the social and the human-rights model of disability. Her experiences of disabling acoustic environments supported rapport building with participants. Many participants expressed their comfort in discussing the topics as a result of the researcher disclosing this shared diagnosis with them.

2.7. Data analysis

CRP collated the interviews and email data following completion of the interviews, listened to them and corrected the automated MS Team transcripts. The analysis process followed the recommendations made by Braun and Clarke for reflexive thematic analysis [51]. The transcripts were downloaded into Microsoft Word documents for each participant, and were read several times for familiarisation with the data and in-depth reflection on the content. Then, they were uploaded to the NVIVO software package, and initial codes were created. The codes were refined through further engagement with the data outside NVIVO, and the content from the refined codes were read once more with the purpose of sense-making and the development of preliminary themes and subthemes. The themes and subthemes were discussed with LG, MS, SP and AD around their relevance, nuance, and demarcation until agreement was reached. Examples of codes used during the analysis and excerpts from the data are provided in Table 2.

A preliminary version of the analysis was sent to all participants to check that they felt that they were being accurately represented. All participants that replied were appreciative of the work.

3. Results

3.1. Interviews

Four main themes were developed during the analysis: 1) High sound sensitivity affects every aspect of life; 2) Lack of understanding and acceptance – sensory gaslighting; 3) Agency is crucial; 4) Positive impact of music and natural environments. Fig. 2 displays the themes and subthemes identified.

Since many participants worked or had worked in education, the experiences related to educative settings were extensive, as students and also as educators, and had particular aspects that were considered to be significant enough for the publication of an independent piece [55].

Theme 1. High sound sensitivity can impact and be impacted by everything.

All participants but one considered themselves highly sensitive to sound. They described numerous situations where the sound environment posed significant barriers, illustrating how they became aware of their sensory differences at different life stages.

Participants reported realising that their sound sensitivity was higher than others, observing that sounds and acoustic environments had more pronounced effects on them than on others. Loud sounds, such as alarms, sirens, hand dryers, or noises in cinemas, triggered intense reactions, and caused particular discomfort and pain for some participants with hyperacusis (reduced tolerance to loud sounds). Conversely, other participants reported enjoying some loud sounds like music and fireworks.

“The sound of hand dryers hurts my teeth and my fingers. That’s actually painful, not just annoying and difficult, it actually hurts.” (Participant 5)

Many participants also mentioned sensitivity to certain sounds, such as quiet humming from boilers, fans, fridges or projectors, or electricity sound in plugs and walls, lights. The participants reported that others did not appear to notice these sounds nor understand the impact on them. These quiet sounds were usually highly annoying and distracting, and could lead to sensory overload and meltdowns, which effects could

Table 2

Examples of codes and associated data excerpts.

Code	Examples data excerpts
Accommodations usually involve privileges	“So I am so where we are at the moment is just sort of geographically quite quiet. And socioeconomically quite privileged. And we’re afforded a level of luxury in that we’re detached, we’re on the ground floor.”
Avoidance is a common coping strategy and has consequences	“Now I have a garden office that’s been newly built intentionally for me.” “Actually, in extreme cases, I’ve left my job, you know, because I couldn’t cope in that environment. I couldn’t do my job properly because of the environment.”
Negative emotions are context dependant	“The strategies that I do is avoiding the weekends. I usually prefer to work in the weekends and if possible, to have a free day in the week because it’s much better, although it’s not always possible.” “For example, babies crying more probably there. There is something psychologically. If baby is crying, you know that it’s. It’s the unavoidable. So you put up it, but the grown up man watching videos on the phone... I don’t know. I got really angry towards it. 2 h trip, and I had other plans. I wanted to read, or to sleep.”
The level of control modifies perception and capacity to cope	“If I put on the natural sounds and I’ve chosen them... But then what will probably happen is I’d end up listening to them, you know, so I probably wouldn’t be able to concentrate on my work because I’d be too interested in the natural sounds if they’re just there, someone else has put them on, I think they’ll just be a bit irritating.” “I love loud. I am loud and I love noise. I love loud music. [...] There’s a level of control to do with that because it’s my choice of what I’m listening to and my choice of what volume I’m listening to it.” “If someone’s hovering... If I’m doing it, it’s fine, which to try and explain that to another person like my partner it’s really hard because he’s like “well, you can’t choose, can you? Cause if you’re doing, it’s fine.” I’m like, no, no, it’s not. It’s because I have control over it because I’m the agent. I’m the agent of that sound. I know I can stop it.”

last for days or weeks sometimes.

“There is often the case that other people don’t hear it at all, because I should feel it inside me, the vibration and sound. And some people can just hear it, but then actually really don’t get it because yeah, ‘Why is that bothering you? I can’t even hear it!’, whereas some people can’t hear it at all.” (Participant 10)

Subtheme 1.1. Sensitivity is variable

Participants observed variability in their sensory sensitivity, noting that what might be tolerable one day might be unbearable the next. The most commonly reported factors triggering heightened sensitivity were: accumulated level of stress, being tired, daily amount of physical and mental energy available (or number of spoons using the spoon theory [56]), engagement in stressful or mentally demanding tasks, the need to focus on work or conversations in person or on the phone, and recent exposure to other sensorially intense environments.

“It’s worse when I’m tired. It’s worse if I’ve had a really busy week or a busy time, or I’ve been very stressed, I’ve been dealing with something very complicated, or I’ve been in crowded rooms. [...] When I try to get to

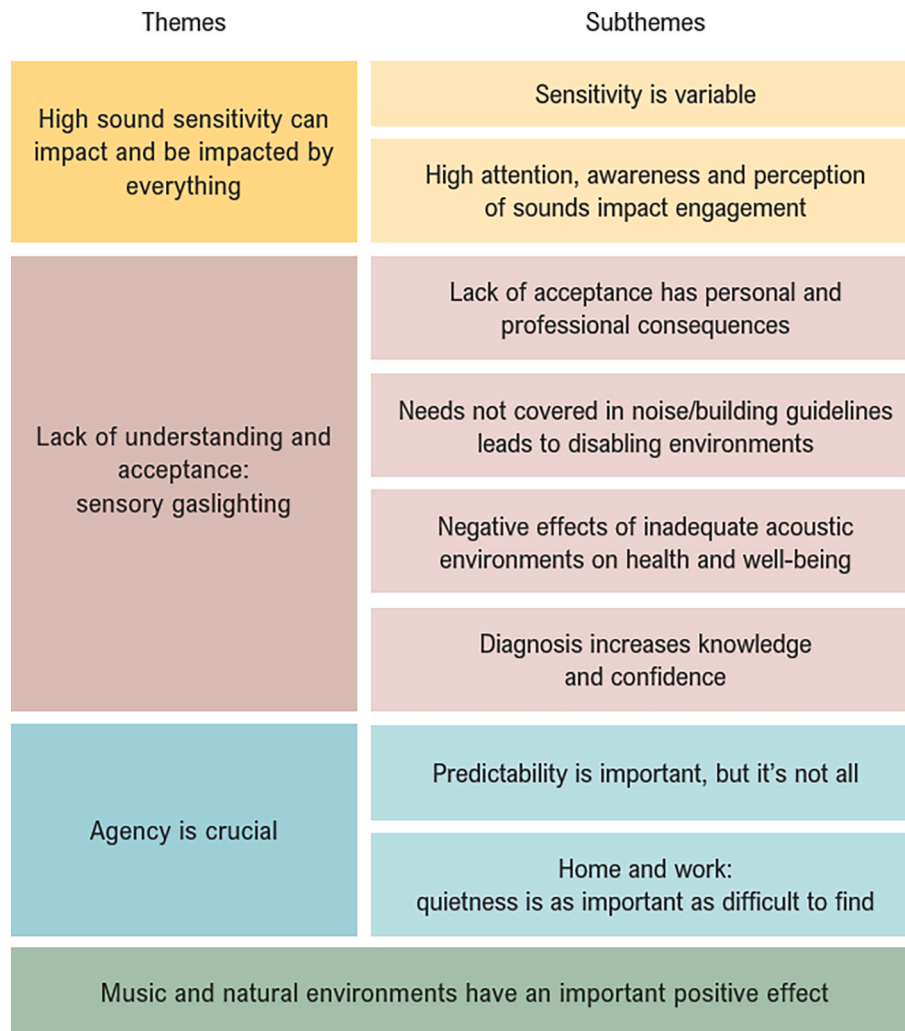


Fig. 2. Themes and subthemes developed during the reflexive thematic analysis.

sleep I can hear the electricity in our room. So if I'm really overwhelmed, that is too loud for me and will keep me awake." (Participant 5)

For people with hyperacusis, however, certain environments could be overwhelming every day.

"Everything is always loud. I think is always loud. I can be more sensitive on bad days where I'm overloaded, but I am never not hypersensitive to it." (Participant 10)

Other important factors that could substantially change participants' responses were context and meaning of the sounds, appropriateness for environments and activities, and whether sounds were perceived as necessary (e.g. a siren) or avoidable (e.g. a neighbour *showing off* while tuning his motorbike, or people chatting at the cinema). For example, irritation and annoyance were more likely if noise was a result of *"poor implementation or poor execution of a poor design"* (Participant 7) or inconsideration, such as loud music from a pub or a stadium that can be heard at home, or loud videos on public transport. A child crying on the other hand could generate worry but not irritation in some participants.

"If I've chosen to go to club, I know it's a club, I know it's going to be noisy and that's the point of it. That's a noise that I have chosen to subject myself to. And I can leave the club when I feel like I want to do it. Knowing that there's going to be noise, and what kind of noise, and the fact that the noise exists in there, that makes sense, whereas a concert happening in my room doesn't make sense." (Participant 1)

Some participants had developed hearing conditions, such as hearing loss and tinnitus, in adulthood, as well as an increase in sound sensitivity and a higher degree of sensory challenges during pregnancy, perimenopause, and menopause.

"Something has changed, and I don't know whether this... As from the impact of menopause, and the age that I'm at, something has changed within my sensory... I am so much more easily overloaded." (Participant 11)

Participants noted that, rather than decreasing due to habituation, their sensitivity and negative reactions to sound could intensify with prolonged or consecutive exposure. This cumulative effect heightened irritation, disturbance, distraction, and pain, potentially leading to sensory overload and traumatic experiences.

"In a nutshell, the time of day is less of a trigger than the build-up of bothersome noises – there's a tipping point, I suppose, where I can't ignore or handle them all anymore." (Participant 12)

Subtheme 1.2. High attention, awareness and perception of sounds impact engagement.

Many participants experienced challenges caused by the presence of several simultaneous sounds, that can create annoyance by themselves or interfere with a particular activity. Some of the sounds mentioned were other people chatting or having calls at work, background music in workplaces, supermarkets or public spaces, whispers or eating sounds

while watching TV or a movie in a cinema, dogs barking, or music or any other background sound while having a conversation. Participants described their experience as not being able to choose what sounds they pay attention to, to “filter out” sounds, as if all sounds held equal priority in attention for their ears (“*attention-grabbers at the same time*”). These experiences entail a great cognitive demand.

“Auditory streams are a big factor. I can usually cope with one, maybe two or even three auditory streams at a time. But any more than that and it becomes... And it doesn't matter what it is really. Even if it's pleasurable stuff. Like if I've got birdsong, water, somebody talking and the radio. That's one too many for me. I can't deal with that amount of strength in information streams, if you like.” (Participant 3)

However, participants also described multiple positive experiences that they associated with having a higher sound sensitivity, and several of them noted they would not change this sensitivity (none of them expressed they would), since they considered that it allows them to greatly enjoy music and sounds they like, and leads to experiencing autistic joy.

“I am oversensitive to it. And you know, it can be in a positive way. The way I experience music that I like is through my whole body, is through my skin, like waves of music. It's very intense and it's really positive. Sometimes it's so incredibly moving that I feel like my whole body's listening to it. And that's an amazing experience. When that happens, you know, that's really, really special and I'd hate to lose that.” (Participant 5)

Theme 2. Lack of understanding and acceptance: sensory gaslighting.

Understanding and acceptance both from oneself and others can impact positively or negatively on experiences. Lack of understanding from others has been reflected in the lack of adequate environments and negative outcomes in the participants' daily life.

Participants frequently experienced dismissal, with others questioning their perception and coping abilities regarding sounds. This can be considered a form of sensory gaslighting, which can lead to masking of needs. Many were dismissed (“*It's not that loud*”), and received accusations of exaggerating, being unreasonable, manipulative, childish or just seeking attention. In reality, participants were trying to cope and mask noise as much as they could, without wanting to be noticed or having to ask for help, accommodations, or changes. They also expressed not wanting to bother anyone, and not wanting to be the special person in the room.

“They just think it's ridiculous or I'm being a toddler on being over dramatic. [...] I think they just think that people like me are just being hypersensitive, silly and ridiculous. The attitude that you often get is, 'Well, it doesn't bother me and I can't see it, so it doesn't exist and I don't need to do anything about it.’” (Participant 10)

The dismissal of their experiences with sounds occurred since childhood, and affected their self-esteem and identity, creating feelings of shame and inadequacy. This led participants to habitually ignoring and doubting their own experiences and perceptions.

“When you were a child you're just told to kind of get on with stuff (sensorial distress), and other people denying what you need makes you deny it for yourself, doesn't it? It makes you go 'Well if everyone's saying I should be alright with this then I just need to get on with it.’” (Participant 9)

Participants reported being unable to safely share their experiences with other people, or to ask for accommodations, when they were apprehensive of the reaction they might face. Many feared other people's reactions, especially when there was a perceived power imbalance,

“[While a man in a train played a loud video on his phone] Other people around me were absolutely unbothered, couldn't care less, it was really

just me. I am not capable of speaking up and saying to someone 'Can you please turn that sound down?' Also because it was a big man, I was a little bit scared.” (Participant 4)

These situations made them respond in ways that exposed them to loud or stressful sounds.

“Depending on who the friends were, I might not speak up and go 'Actually, this is a bit noisy. Can we go somewhere else?' Whereas with some friends I might do so. I still do stuff that I know is probably not good for me sometimes.” (Participant 9)

Subtheme 2.1. Lack of acceptance has personal and professional consequences.

Participants reported numerous negative interactions trying to make other people understand their experiences, and stressed the urgent need for a better understanding of autism and sensory differences, particularly in education and healthcare.

“They can't just take someone's experience as just 'That's your experience. I accept it.' It's very difficult. It's always the fight.” (Participant 8)

They emphasized this understanding was “*more than awareness*” (Participant 10), and should lead to societal changes, noting that fully empathising with their experiences should not be a requirement for acceptance.

“It's actually 'Well, OK, I don't understand it, but that's absolutely fine. I understand that it's really difficult for you and it's a problem for you, so let's do something about it.’” (Participant 10)

Some participants have received accommodations and experienced acceptance and changes upon request (and justification). In some cases, however, accommodations were not granted, resulting in challenging experiences at school and university, quitting jobs and moving houses and country, and affecting participants socially, professionally, and financially. Many experienced anxiety due to reduced life prospects because of disabling acoustic environments, and grief over missed opportunities.

“I aspired to be an architect. I didn't have the right qualifications. Would I have had the right qualifications if I'd been in a better learning environment? I don't know. Maybe yes, maybe no. But I think children, not just children, everybody needs the best environment to learn and to experience life. Nobody should be detrimented because of the environment that we're in and because people want it to be the norm.” (Participant 10)

Some participants encountered resistance to accommodations based on the argument that it wouldn't be fair to others or that it might lead to more requests (somehow implying that this would be detrimental, disruptive or not possible). This hindered their performance and well-being, preventing them from engaging in certain activities under the same level of comfort as everybody else.

“They won't let my daughter wear headphones in her classroom, because they don't want they all wear headphones and it's like, no, let her have one earbud in so she can still hear the teacher if the teacher calls her name. [...] We need her to lose herself in her piece of work for you to get a piece of work out of her, so that she can actually stay in her classroom.” (Participant 11)

Subtheme 2.2. Needs not covered in noise/building guidelines lead to disabling environments.

All participants expressed the importance of affordable, high-quality housing. The home environment was considered the most vital space for recovering from sensorial stress (“*Our home is the sanctuary*”, Participant 10). Noise-related issues have prompted many to relocate from apartments and houses. Some participants have had positive experiences in well-insulated flats, suggesting that the desire is not for isolation from people but rather for a reduction in external sounds within their environment.

“Not everybody is in the position to be able to move. [...] I realize how privileged we were to be able to make the move that we have done. To be able to have a home environment that it's not just... rather than being detrimental to my mind, it's absolutely vital. Now how you do that? If you're living in a small, terraced house or in a flat? Is very, very difficult. But for the neurodivergent well-being, it is absolutely vital, or else they have no quality of life or very little quality of life.” (Participant 10)

Participants who have been tenants experienced stress and frustration due to issues beyond their control. Landlords unwilling to address these issues negatively impacted their sense of safety at home significantly.

“My flat is very badly insulated. I could say something to my landlord but he is not going to do anything. [...] These are all things that other people have control over and I don't. So that's also really frustrating. It feels like I got my hands tied behind my back.” (Participant 1)

Participants generally felt that public spaces, healthcare settings, schools, and workplaces lack adequate acoustic design, causing disablement. They urged greater consideration by designers of sensorial aspects impacting those with sensory differences.

“More needs to be done to promote acoustic. It's just an awareness of the impact that acoustics can have on workplaces, not just schools, but workplaces and other things as well. [...] I kind of think back now to certain places that I've worked and there was absolutely no sound science or no acoustic planning [...] Like... Who designed them?” (Participant 11)

Many participants educated themselves about noise guidelines and potential solutions, such as using absorbent materials, minimizing or eliminating background music to reduce distractions, and lowering noise sources and the volume of beeping sounds in places like hospitals or public transport. They expressed frustration at being neglected by regulations and governmental institutions. Some participants requested actions from organizations and councils but received unsatisfactory responses (*“Numbers are fine, so we won't do anything about it”*, Participant 1). Overall, participants perceived that existing limits and guidelines did not effectively ensure well-being and rest at home.

“I will write reports over several days of ‘This noise happened at this time, it continued until this time, these are the effects it had on me...’ And I send them that, and they don't even really... They're like, ‘Unfortunately, the guidelines say that we can do whatever we want. So goodbye.’ I think like... You just don't care?! You just don't care what it does to people. It's so frustrating.” (Participant 1)

Subtheme 2.3. Negative effects of inadequate acoustic environments on health and well-being.

Participants reported numerous adverse effects on their health and well-being due to certain sounds and inadequate environments, including diminished concentration, headaches, migraines, fatigue, ear pain, restlessness, stress, irritation, anger, frustration, and palpitations. Additionally, negative consequences linked to coping strategies were mentioned, like feeling anxious using noise-cancelling headphones due to disconnection from the environment, and resorting to smoking or drinking alcohol in stressful situations. Several participants shared experiences of being bullied or harassed due to their heightened auditory sensitivity, significantly impacting their mental health. This occurred in different contexts, including with family, friends, teachers, healthcare staff, colleagues, managers, landlords, council staff, and society in general. Participants expressed that these events have had profound detrimental effects, heightening feelings of helplessness, frustration, insecurity, and estrangement.

“Sometimes other staff would ring my mobile to watch my reaction as they found it entertaining to see me lose my composure.” (Participant 12)

Subtheme 2.4. Diagnosis increases knowledge and confidence.

Many participants explained that, before the diagnosis, they could not understand their own challenges or how others could cope with certain sounds and situations related to sensory stimuli. The belief that others had the same perception was common since childhood. Some participants remembered thinking that they were “weaker” or less adequate than others for instance to work in the job they were doing, or study at the place that they were in. Common environments like schools, parties or offices could prove to be challenging (*“the sense that I am expected to be working but can't focus”*, Participant 12). Participants reported that understanding that their sensory profile was different, and that this possibly shaped many aspects of their lives, improved their self-image and self-esteem.

“With the autism diagnosis I realised I actually was different, that the reason why they all thought I was trying to be different was because I actually was. And now I can accept that and it's OK. I heard things differently to other people at the time. I just thought I heard everything the same as everybody else, and that they were better at kind of processing it than I was in some ways. But I was better at certain other things that they weren't so good at.” (Participant 3)

The diagnosis increased their knowledge and confidence to improve their acoustic environment if the means were *within* in their hands, to request accommodations, or to avoid some environments and situations. Most participants reported, that since their diagnosis, they advocate more and better for themselves, and other autistic people, in relation to sensory needs.

“Neurodivergent teachers, who maybe don't realise it yet, have to be able to support divergent children. They have to be able to work out how to support their sensory needs if that's what's actually causing them stress without realising it. That's been the biggest revelation for me.” (Participant 11)

Many highlighted the necessity to identify and accept the diversity of experiences, and that what was helpful for one person may not be helpful for another one.

“It just seems to me so obvious that people are different from one another and yet there's this assumption that everybody's the same.” (Participant 5)

Theme 3. Agency is crucial.

With a predominant lack of accessible environments and understanding, agency, predictability and control over the sound environment are deemed as fundamental. This theme summarises participants' perspectives on these two elements, which are among those with higher influence on their responses to sound.

All participants stressed the strong need for a sense of agency and control over their acoustic environment. This agency can significantly moderate the perception and responses to some sounds in certain situations. Inability to address intense disturbances led to notable stress, annoyance, and lasting irritation, fostering a heightened sense of unrest and fear of encountering similar situations and sounds. Frustration and stress were often aggravated by negative experiences attempting to resolve conflicts independently or through authorities. Common disruptive scenarios reported included neighbours or roommates partying, road works, barking dogs or neighbours shouting or slamming doors. Irritation arose when the expectation of a quiet environment was disrupted. For many participants, agency sometimes meant being able to be in silence when desired, which was preferred by most participants over music or background sounds for activities that need concentration. Agency could also mean listening to chosen music at the chosen volume (sometimes very loud).

“I feel like a lot of it is about control and it's not about, for me, necessarily loud noises. And it's about... I can put my music on as loud as I like, and it's not painful to me to listen to loud music, but it makes me anxious if there're loud sounds that I am not generating.” (Participant 9)

Many participants found it helpful to choose when and where to work, for example late in the evening or on weekends to avoid a busy office, deciding when to talk to people, or when not to be disturbed.

“Working from home is good because I can control the noise. I think, in all, working from home now is preferable.” (Participant 8)

The option of leaving a place offers reassurance, avoiding feeling “trapped”, as it may happen at home or at work when there are unwanted overwhelming situations. Some participants also found it helpful to restrict the number of sensorially demanding events in a day or week.

“To balance my days. If I know I’m going somewhere noisy, if I know I’m doing something social, if I’m at a conference for a couple of days, I won’t plan anything for the next few days that involves any noise or too many people.” (Participant 5)

When agency was limited, participants tended to resort to avoidance, preferring not to participate in certain activities, like going to social events, as well as living more isolated. However, participants expressed desire and efforts for socialising, even if this involved stressful environments like pubs, with subsequent exhaustion and negative aspects of coping strategies, like drinking alcohol.

“I’ve also wanted connections with other people, but then the only connections that I could make were by going and doing all the things that other people did, which were like, ‘Oh goodness, I’ve gotta drink loads to be able to cope with this’. Which is socially acceptable because everyone’s drinking loads anyway. But yeah, it’s different sorts of harm.” (Participant 9)

Subtheme 3.1. Predictability is important, but it’s not all.

Many participants expressed a preference for predictability and having information related to sensory aspects beforehand, like sensory maps and warnings about loud sounds. This information offers an important level of agency, since it allows planning beforehand visits to new places and assess if and when they are going to be able to cope, helping to prevent stressful situations and sensory overload. Some participants noted, however, that there are environments and sounds that are hostile and potentially disabling even with this information. In these cases, predictability does not reduce disabling effects.

“Knowledge is a good thing as well. (pause) But it’s not the only thing. It’s not enough to say ‘Oh, our environment is terrible! But if you bring your independence, you’ll be fine!’ (laughs) Yeah, it’s meeting people halfway so nobody is disadvantaged.” (Participant 10)

Environments like cafes and libraries, in contrast to offices or large spaces (like party and conference venues, supermarkets or airports), generally provided a good balance of sensorial stimuli for some participants, as well as independence, which could be perceived as a higher level of control on what activity can be done and when. These places were moderately busy and noisy, but in a more predictable way, which reduced uneasiness about the surrounding environment. Participants reported that not needing to pay attention to the sounds around was helpful.

“Everyone’s doing their own thing [...] not a place where someone’s going to come and just immediately interrupt me. It’s a saturated environment and I like a saturated environment.” (Participant 6)

Subtheme 3.2. Home and work: quietness is as important as difficult to find.

Agency is also important at home and work. Those who had been able to afford it, adapted their career and housing to their needs. Some participants changed or quit jobs, and moved from a flat to a better-insulated house. Some positive aspects highlighted were being able to work from home in a private, personalised space, having flexible work in terms of schedule and tasks, and living in a quiet home with a quiet outdoor space.

“I couldn’t even contemplate working in that kind of environment (open plan office). I would not survive the day. There’s a reason why I’m self-employed.” (Participant 10)

Many participants considered themselves lucky and recognised the privilege of being able to live in a quiet home, and that they would be worse off if they could not have a home where they can have agency over what they hear.

Theme 4. Music and natural environments have an important positive effect.

Intense, positive experiences with music and natural sounds were highly common among participants and are summarised in this theme.

Many participants expressed their passion for music of all genres, from classical to heavy metal. Some mentioned using music as a coping strategy to deal with noise and stressful situations since childhood and using it at home or at work. A participant used to play classical music when teaching in a classroom to create different *moods* for different activities. In general, participants considered that music had a crucial positive role in their well-being.

“Some music – probably just certain notes or combinations – produces an ecstatic sensation, a bubbling in my chest like a positive version of rage, that will burst out in singing or shouting or laughter.” (Participant 12)

Outdoor spaces and nature were perceived, in general, as safer environments than indoor ones. Some participants mentioned they found fewer distressing sounds and characteristics, like lower reverberation, providing restoration from stress and positive experiences while alone or socialising, since they were also found to be more suitable for conversations. Moving away from noises or leaving if needed were also seen as easier being outdoors. Some participants mentioned that natural environments are not controllable *per se*, but are usually more predictable, less busy, and included sounds with positive effects for them. The sound of a stream or a river, or sea were perceived as comforting due to their rhythm and periodicity. In general, easy access to green, outdoor spaces was considered very important.

“I’m really lucky that I have like three massive parks around my house, so I will just go to all of them in a row. And I just walk and walk, and it’s extremely good because, like there’s usually no noise at all except for birds.” (Participant 1)

Natural sounds in real contexts were preferred to artificial ones in a built environment, which for many participants could be “distracting” and “annoying”, especially if they were perceived as imposed. Additionally, even when they enjoyed natural sounds and their restorative effects, most participants still sought and preferred silence.

“If I am overwhelmed by bad noises, if I spend 2–3 h in nature afterwards it kind of balances that out. I haven’t really worked out exactly like why it would be like this, but if it’s foxes, and birds and deer. The sound of water running, for example, if I’m by a river. All those sounds are fine, and they actually make me feel good. I still prefer silence over anything else.” (Participant 1)

4. Discussion

The themes presented in this study highlight that a heightened sensitivity to sound affects health and well-being outcomes and is also present across nearly every aspect of life. The experiences shared in the interviews illustrate the ubiquitous nature of the effects and the barriers that many autistic people face in their lives due to inadequate acoustic environments. Moreover, participants provided important perspectives into the factors influencing their experiences with sound and the impact it has on them. High sound sensitivity often resulted in heightened responses to present or anticipated sounds due to a range of social and

environmental factors, and this sensitivity was not static but rather was influenced by both internal and external factors. Similar to other studies, the themes acknowledge the role of acoustical factors such as volume of music and reverberation time in certain places, as well as the importance of non-acoustical factors like agency, context, avoidability, or necessity [8,57]. A widespread lack of understanding, dismissal of experiences, and sensory gaslighting were highlighted as significant moderators of responses to sound, increasing the intensity of the negative effects. The theme of lack of understanding and acceptance emphasised that autistic people's needs were not met and that noise and building guidelines often led to disabling rather than enabling environments. Common acoustical measures such as limit values and recommendations specified in standards did not address the sensory needs of the participants or were not enforced in many cases, therefore a higher level of agency was crucial in order to manage responses and support accessibility. Our approach aligned with the social and human rights models of disability, and we highlight acoustical and social aspects that could be improved.

The findings and their wider impacts are now discussed. These have been classified under five subsections depending on their nature and implications (see Table 3).

4.1. High sound sensitivity leads to a heightened response to sound

The lived experiences and perceptual processes articulated by the participants directly connect a high sensorial sensitivity to negative impact on many, if not all, aspects of their lives. It is important to note that sensitivity refers to emotional and/or physiological reaction, rather than capacity to appreciate a number or type of stimuli, and the auditory sensitivity reported in the participants' accounts generally represents a heightened response to sound. This is in line with the noise sensitivity results discussed in Section 2.2, which highlight this general heightened

Table 3
Summary of the main findings outlined in the discussion.

Subsection	Findings and implications outlined
High sound sensitivity leads to a heightened response to sound	<ul style="list-style-type: none"> – Heightened response to sound, in the presence of lack of acceptance of sensorial differences in society, leads to: negative personal, social and professional outcomes, and multiple health issues. – Need for control and agency over the environment in response to the stress and negative outcomes repeatedly experienced.
High enjoyment of music and certain sounds	<ul style="list-style-type: none"> – Positive sounds help to recover. – Access to green and natural spaces is very beneficial.
No habituation, but accumulation effect	<ul style="list-style-type: none"> – No habituation: exposure increases stress and noise sensitivity, and it can lead to harm and trauma. – Exposure to noise can increase stress and noise sensitivity in the short and long term.
Consequences of inaccessible acoustic environments	<ul style="list-style-type: none"> – Disclosing diagnosis can lead to discrimination. – Inaccessible conditions in education, healthcare, workplaces, leisure spaces, hospitality, etc. – Avoidance and social withdrawal. – Having to request changes is a barrier in itself. – Financial situation moderates environments' adequacy.
Need for improvement of building and environmental acoustics standards	<ul style="list-style-type: none"> – Neuro and aural diversity not considered in design research and practice. – Necessity of more education and acceptance of different sensorial needs. – Conflict resolution tools are insufficient and privilege-depending. – Noise sensitivity should not be used to dismiss experiences and citizens' rights.

response as well. Many participants, however, also reported experiences suggesting a higher perceptual capacity and analytic listening, where every component of the soundscape or a music piece is heard separately rather than clustered (see [58] for discussion on analytic listening). This can, nevertheless, lead to being overwhelmed more easily in certain contexts and environments, as will be explained in the next subsection.

The results of this study support the consideration of high noise sensitivity (with or without hyperacusis) and a heightened response to sound as part of what has been termed as *aural diversity* [59]. *Aural diversity* refers to the notion of natural or acquired diversity in human hearing and sound processing, and can be analogous to neurodiversity [60]. Our research brings to the fore the impact of the combination of a heightened response to sound with the neglect of aural diversity in research and society and how this leads to negative ramifications that affect daily living. Ramifications include a negative impact on self-image since childhood, low self-esteem, bullying, and other social and professional negative outcomes.

Consistent negative experiences generate the commonly reported necessity to have a higher control over the environment than people who do not experience challenges. Thus, the need for more agency over the sound environment would emanate from a desire to reduce the frequent negative outcomes. Previous research shows that when the perceived level of control of events affecting an individual (locus of control) is low due to past experiences and possibilities to influence the noise source, the perceived stress and noise annoyance further increase [39,61].

Non-acoustic factors have a fundamental role in noise annoyance; in his review, Guski [8] identified several personal and social moderators. These include noise sensitivity, expectations, personal and social evaluation of the source, anxiety and fear about the source, coping capacity, trust or misfeasance with source authorities, and history of noise exposure [8]. Information about when and for how long the noise will be present, and knowing that it can be stopped at any time if desired, have also been shown to reduce noise annoyance [62]. These moderators are in line with many of the elements discussed by participants, like context, meaning and control, although they are frequently overlooked in perceptual evaluation studies in acoustics and also in autism research.

4.2. High enjoyment of music and certain sounds

Besides the challenges and negative aspects described, participants mentioned experiencing great pleasure with music of different genres, or sounds such as the sounds in a forest, pebbles moved by sea waves, crickets, laughter of children and loved ones. These positive experiences are in line with the findings of other studies [63,64], with statements from autistic participants like "music is more important than food sometimes" [65].

They also noted the great importance of access to green outdoor spaces such as parks and natural spaces, which offer them a safer environment and help to recover from the "noise load". The restorative effect of greenery and natural environments has been widely reported in research [66] as well as the great significance of outdoor spaces and nature for well-being as recurrent topic in the autistic community [31,67].

These positive experiences help support well-being and the participants to restore from negative acoustic environments. This highlights that a higher sensitivity to sound and the heightened response elicited are not negative or positive *per se*, but rather it is the environment and experience which create challenges. Thereby accentuating that it is the environment which is the disabling factor.

4.3. No habituation, but accumulation effect

The experiences described in our study suggest a high capacity to detect the sounds around and, importantly, an absence of habituation, with participants commonly reporting increased fatigue and annoyance

over time, short term and during their lifetime. This challenges the idea that everyone “gets used to noise”, that hyperacusis can be successfully treated with exposure therapy, for example, and that protecting the ears or reducing exposure is what increases sound sensitivity. This hypothesis of habituation to noise are based on a study with non-noise-sensitive participants [68]; the findings presented here clearly contradict this and suggest an accumulation effect.

A key implication of an “accumulation effect”, as suggested by participants, is that short or long-term exposure to hostile environments can increase stress and other responses instead of reducing them. Therefore, interventions disregarding the cumulative effect of noise exposure may not only be ineffective, but also harmful, exacerbating responses, leading to sensory trauma [69]. Many autistic people, including autistic researchers, have warned against desensitising therapies, referring to them as “sonic torture” [70]. These therapies involve exposure to distressing, loud sounds that induce irresponsiveness or “shutdown” in patients (usually children) due to sensory stress. This is often misinterpreted by researchers as a reduction of distress and a validation of the effectiveness of the intervention [71].

Indeed, participants’ responses indicate that their sound sensitivity increased with age, and it was influenced not only by physiological factors or stress but also by past experiences and their impact across time.

4.4. Consequences of inaccessible acoustic environments

Our findings coincide with results found in recent research evaluating the barriers to healthcare for autistic people, where loud and chaotic acoustic environments were one of the main barriers reported [72]. Inadequate acoustical conditions in healthcare spaces are a common issue highlighted also by the general population [73,74].

Educational settings’ acoustics can pose a great barrier to their main aims, which are to be able to learn and also to teach (as discussed in [55]). Notably, all the participants who worked as teachers reported having to quit their job, in part due to sensory stress. Many workplaces choose open-plan office design mostly due to financial reasons, which are known to reduce the well-being and productivity of workers [75]. Other spaces like supermarkets or shops have implemented specific measures, like not playing background music and reducing lights intensity, to provide *sensorially friendly* environments during certain days and times of the week, however these adjustments are limited therefore they do not provide full-time accessibility [76].

Disabling acoustic environments also limit the possibilities and frequency of socialisation. Instead of providing relaxing and enjoyable experiences, the settings where participants’ friends and colleagues typically gather are characterized as noisy, stressful, exhausting, and unfavourable for conversations. Additionally, when participants have suggested alternatives better suited to their needs, these alternatives were not always accepted. Consequently, participants have had to opt out of attending social events, going to bars and restaurants, concerts and others. The negative impact of social withdrawal is a consequence often underestimated due to the misconception that autistic people do not enjoy or need socialisation [77].

Concealment of needs to reduce conflicts is frequent in autistic people [78], further consuming energy and cognitive resources, or “spoons” [56]. And as other aspects related to “camouflaging”, it has severe health consequences [79].

Some participants have been granted accommodations after their diagnosis, as organisations are legally obliged to it, although, as noted, not all of them comply, and disclosure in the workplace still presents a risk of discrimination and disadvantages in recruitment [80].

Having to request accommodations and actions to mitigate auditory stress represents a barrier itself, and can have further negative consequences, including traumatic conflicts and bullying. Accommodations can certainly help in some circumstances, but they also have limitations, some of which have been identified in this study:

- They usually depend on having and disclosing a diagnosis. This raises equality issues [81], and can have negative consequences, in addition to the barriers and biases in diagnosing.
- They can be rejected and used to harass or discriminate against the requester.
- The majority of autistic people are likely to be undiagnosed [82].
- Anyone can experience sensory needs at any time due to different reasons, temporarily or not. For example, there is an association between sensory sensitivity and autistic traits in the general population [83], and also with illnesses, hearing loss, tinnitus, exhaustion, menstruation, pregnancy and menopause [84–86], relationships found in this study as well.

Thus, while an autism diagnosis can positively impact self-image and well-being it should not be a prerequisite for full societal participation without experiencing sensorial challenges, and the focus should not be to implement adaptations upon request, but to create environments that support everyone’s well-being.

In addition, financial resources significantly influence the ability to control the sound environment, particularly in the context of housing. Tenants reliant on landlords and agencies may struggle more to secure suitable housing due to unwillingness of the latter to make necessary reforms, and living in dwellings situated in quiet areas can be more costly. This aspect has been explored in research related to the impact of noise on health [87,88], but it is often overlooked in assessments of autistic people’s well-being.

4.5. Need for improvement of building and environmental acoustics standards

It can be inferred from the findings that designers do not take into account the breadth of many people’s experiences in acoustic environments. The results show a pressing need to improve the acoustical conditions of the built environment in the UK. Many of the issues commented in the interviews could be easily resolved with simple measures. Nevertheless, current requirements and standards followed by builders, designers and councils are not sufficient to guarantee enabling environments, especially for vulnerable groups (e.g. [24,89]). In addition, and as described in this study and the wider literature (e.g. [18,24,90]), these guidelines are often not observed nor enforced, leading to not just minor annoyance, but to serious health issues in people with or without higher noise sensitivity.

The findings highlight the need, also noted in previous work [27,91,92], to consider higher sound sensitivity and heightened sensory capacity in the design of regulations and standards in environmental noise and building acoustics, as well as other aspects of aural diversity [26,93]. Design and planning standardisation often fail to consider diversity in the population, as has been warned in research on urbanism, for example, assuming young, abled-body people as the typical citizen [94], and perpetuating the exclusion of other groups. Examples to follow include community-led reports [30,31] and recommendations from standardisation institutions [32].

The tools offered to citizens to resolve conflicts (formal complaints, suggestions forms, or talking to a manager or staff) are not always effective, and solutions end up depending on individual resources and privileges (energy, time and money). Coping strategies do not always have positive outcomes, increasing the stress and anxiety about the possibility of living similar situations in the future. This can provoke situations of helplessness with respect to the noise source, which importantly can increase noise annoyance [8]. Improved acoustics and noise standards would help mitigate some of these negative outcomes and the emphasis on the individual finding solutions to an environmental problem.

Finally, a very important consideration in situations of conflicts due to noise annoyance is that corporations and policymakers use noise sensitivity to discredit the perception of affected groups, discriminate

against them, and dismiss their suffering and requests, thereby justifying further denial and victimisation. Due to factors such as experiences and expectations, noise situates their victims in what Yıldırım denominates “spatio-temporal subsumption”, disrupting daily activities also when it is absent, and significantly reducing the quality of life [95,96]. This victimisation process warrants special consideration, particularly for vulnerable groups already marginalized in other aspects of life, such as autistic people [97].

4.6. Future research

Crucially, the acoustical characteristics of common spaces like hospitality, leisure venues, public buildings and transport or even healthcare and education settings, have a strong cultural component, and therefore there may be variations in the degree of how each environment and activity affects people from different countries and regions. There can be significant differences in standards and requirements, and also in the acoustical training delivered to designers. Some countries, for example, have a high rate of acoustic absorbers installed in hospitality venues and public buildings; others have more outdoor spaces to gather, not necessarily depending on the suitability of the weather. Similar studies in other cultures would be necessary to understand how these differences may have an impact on the experiences of autistic people around the world, and what are the positive elements that could be implemented in more places.

Research is also needed on how to increase acceptance of aural diversity in research and society, including designers, educators and policymakers, to create environments that are acoustically accessible, instead of solely relying on individual adjustments. Participants’ experiences exposed that the lack of understanding and acceptance of auditory differences is a frequent scenario and has a determinant role in the negative impact suffered. This issue is not easy to address and requires efforts from different perspectives, such as more and better education about neuro and aural diversity in schools and universities, workplaces, healthcare facilities, architecture and design training, etc. [32,98,99]. It is also important to do this from an inclusive and not pathologizing approach, to reduce the discrimination and stigma suffered by autistic people [100,101].

4.7. Strengths and limitations

Diversity in age was higher than in previous studies with autistic adults, with half being over 45 years old. This could be considered a strength in a study investigating lived experiences, especially due to the age gap in diagnosis [102]. Noise sensitivity is thought to be higher in middle-age people [103], therefore it is important to include more age diverse cohorts in acoustics research [104].

Experiences of autistic and non-autistic people are very varied, and the study, following the methodological purpose of thematic analysis, does not aim to portray a generalisable view of the perception of all autistic people, or, importantly, to suggest that all the experiences described are necessarily only related to being autistic. Many of the experiences described in this study can be shared by people who are not autistic, and not all autistic people necessarily share them. Although it is recommended not to mention lack of generalisability as a limitation in reflexive thematic analysis [1,105,106], we consider that the remarks above are meaningful in this case, since autistic people, as other minorities, are too often seen and treated as a monolith inside and outside of research.

This study did not have participants who communicate through methods different from oral or written words, nor people with learning disabilities. Noteworthy, recent research shows that autistic adults self-reported having more sensory needs compared to those reported by informants of autistic adults, especially those related to sounds and acoustical conditions [107]. This also may mean that informants can underestimate sensory needs.

Some participants mentioned having hearing conditions such as hearing loss, tinnitus, or Meniere’s, although many aspects of aural diversity are not represented. Most of the participants were white, educated, without learning disabilities, and with good access to housing and services.

5. Conclusions

This study highlights the short and longer-term reported impacts of real-life soundscapes and acoustic environments on autistic people living in the UK. These impacts have not been fully considered in acoustics research and practice. The findings highlight that many of these repercussions are a consequence of failing to consider these experiences in acoustics research and practice.

The experiences described in this study illustrate that:

- Heightened response to sound, in combination with inadequate acoustic environments and lack of understanding and acceptance, profoundly affects well-being both in the short and long term.
- Repeated negative experiences dealing with auditory stress exacerbate stress and anxiety, heightening alertness and sensitivity to specific sounds in particular situations. This leads to concerns about successfully resolving conflicts.
- Negative experiences create distrust in authorities’ helpfulness, diminishing perceived and actual control, impacting expectations and coping abilities, and intensifying annoyance.
- Low locus of control further increases stress, annoyance and noise sensitivity.
- Disabling acoustic environments represent not only a risk for health, but a critical barrier to education, careers, transport, healthcare, leisure, social connection, and personal flourishing.
- There is an urgent need for quieter spaces and enabling conditions in places like schools, universities, workplaces and healthcare facilities, as well as for a higher degree of agency.
- Research, regulations and commonly applied measures fail to acknowledge diversity in sound perception, reinforcing societal assumptions of what is reasonable and acceptable. This adds an extra barrier when seeking non-disabling spaces.

The design of this study responds to the need in acoustics research to include a wider range of human responses to sound and real-life experiences, to ensure that standards and guidelines cater for everyone and allow for inclusive environments. Creating accessible acoustic environments can potentially benefit everyone, and it can be life-changing for many people who experience sensory differences at any moment of their lives. The findings have relevance for researchers, engineers, designers, and policy makers, and suggest that many actions can be implemented with solutions and techniques that already exist.

In this paper it is argued that aural diversity and inaccessible acoustic environments should be addressed from a human rights lens, considering the Convention on the Rights of Persons with Disabilities [108], and observing “the right to access all aspects of society on an equal basis with others including the physical environment, transportation, information and communications, and other facilities and services provided to the public” (Article 9) and “the right to take part in cultural life on an equal basis with others, including access to cultural materials, performances and services, and to recreational, leisure and sporting activities” (Article 30). In order for people to access all aspects of society on an equal basis, and take part in cultural and recreational activities, sensory differences and aural diversity must be taken into account in acoustics research and the design of the built environment, and there must be understanding, respect and inclusion of differences.

CRedit authorship contribution statement

Carmen Rosas-Pérez: Conceptualization, Methodology,

Investigation, Formal analysis, Writing – original draft. **Laurent Galbrun**: Conceptualization, Methodology, Writing – review & editing, Supervision. **Sarah R. Payne**: Writing – review & editing, Supervision, Methodology. **Adele Dickson**: Writing – review & editing. **Mary E. Stewart**: Writing – review & editing, Supervision, Methodology, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.apacoust.2025.110581>.

Data availability

The data that has been used is confidential.

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