

Acoustics 2023 Sydney
185th Meeting of the Acoustical Society of America

Sydney, Australia

4-8 December 2023

Interdisciplinary: Paper 3pAAb1**Beyond standards: reimagining acoustic design in prisons****James Boland***Department of Acoustics and Vibration, SLR Consulting Ltd, Christchurch, Canterbury, 8011, NEW ZEALAND; jboland@slrconsulting.com***Helen Farley***Faculty of Law, University of Canterbury, Christchurch, Canterbury, 8140, NEW ZEALAND; helen.farley@canterbury.ac.nz*

Drawing insights from the emerging field of sensory criminology, this paper delves into the distinctive acoustic requirements within prisons, shedding light on the differences that exist between the acoustic needs of incarcerated individuals and those outside the prison walls. The study emphasizes the crucial role acoustics play in the daily experiences of both incarcerated individuals and corrections staff. Those in prison rely on acoustics for communication and information gathering, while corrections staff use auditory cues to assess the prevailing tension within the prison environment. The intricate dynamics of prison cultures, often overlooked by acousticians, are brought to the forefront through the lens of sensory criminology. This paper advocates for a multidisciplinary approach, suggesting that acousticians collaborate with complementary disciplines to design spaces that encourage positive communication and simultaneously address the risks associated with undesirable social dynamics. By integrating insights from sensory criminology, acousticians can create purposeful designs that benefit both incarcerated individuals and corrections staff, ensuring a well-informed and effective acoustic environment.

1. INTRODUCTION: PRISON, NOISE AND LISTENING

Prisons are noisy places. Common sources of noise include audible alarms, public address systems, people conversing loudly or calling out, personal amplified music devices, kitchen or other building services noise, noise from people moving objects about the space, clanging metal doors, and outbursts from new arrivals (Moreland, 2016). Common areas are similarly noisy with people climbing up and down metal stairs, metal furniture moved across hard floors, rattling food trays in dining halls, and vocal outbursts (Rice, 2016). Similar to occupied spaces outside of prison, internal night-time noise levels are impacted by a combination of external and internal noise from the building services plant (Cameron, 2012). Internally, music is very often a source of friction with one account reporting that, ‘at night, people would put their music on and vie for the noise space,’ leading to “pure cacophony.” Those who utilise music as a means of creating an aural connection beyond the immediate environment of their cell, frequently ‘invade’ others’ personal acoustic space (Hemsworth, 2016).

Prisons are volatile places where violence – physical, verbal, and sexual – occurs daily. The ragged soundscape can enhance or even trigger this volatility, aggravating the occupants who are already hypervigilant. Elevated noise levels in prisons precipitate stress and heightened safety and security concerns among staff and prisoners (Rice, 2016). Hence, a keen sense of hearing is cultivated by those trying to avoid harm in fractious carceral environments. Hearing is not simply a skill, it becomes a survival mechanism with well-being becoming tied to the ability to hear environmental cues (Hemsworth, 2016).

The movement of people around prison is strictly controlled, limited due to the lack of staff or conflicting operational priorities. Staff shortages in the wake of the COVID-19 pandemic meant some prisoners remained in their cells for 23 hours per day and access to visits was reduced. People typically spent much longer in their cell (effectively their bedroom) awake than people on the outside. Many people in prison in Australia and Aotearoa New Zealand have relatively short sentences of around 12 months, but still a much longer stay than typical for a health care facility in the outside world, even though standards for health care facilities are often used when designing prisons.

Given the strict control of movement within a prison dictated by security concerns, people find creative ways to communicate with each other to coordinate efforts or to make threats to others sharing their space. There are documented accounts of people in prison talking to each other, or passing on messages, through the building’s sanitary pipework (for example, see Cipriano, 2013).

2. THE NOISE ENVIRONMENT

A soundscape can be described as an ‘auditory or aural landscape which, like a landscape, is both a physical environment and a way of perceiving that environment, and emphasises a cultural dimension that incorporates scientific, aesthetic, and social circumstances that regulate the control of sound, particularly how and to what extent sound will be heard by different groups (Saher & Cetin, 2016). There exists a carceral soundscape that is unique to each prison, shaped by the landscape in which it sits, the emergent culture of that particular prison and which forms in response to the built environment, security classification, relationships with staff, and personal adaptive responses to incarceration.

In a visually bereft environment, the soundscape becomes more prominent, with much being heard that is not seen. Rather than being a ‘captive audience’ to the noise environment within which they find themselves, research indicates that people in prison actively and intentionally utilise listening and noisemaking in a variety of ways. The ability of people in prison to exercise control over the sound environment causes conflict between individuals and groups (Rice, 2016). The perception of noise by individuals is impacted by the background sound level, the type of sound and its origin, an individual’s experience with that type of sound (Schreckenber, et al., 2017), the loudness, frequency, duration and variance, information content and relative importance. The perception of noise is also impacted by the temperament and tolerance level of the person receiving the sound (Moreland, 2016).

3. NOISE CAN HAVE HARMFUL EFFECTS

Many of the world's jurisdictions limit the amount of noise in the community through legislative methods, often strongly influenced by the World Health Organisation Guidelines for Community Noise (WHO, 2018), most recently updated in 2018. Within buildings, local regulatory compliance frameworks often require the consideration of controlling noise between residential spaces to acceptable levels, and limiting the overall level of noise which is experienced inside occupied spaces at different times of the day depending on their usage, such as inside bedrooms during the night-time. These regulations are in place to mitigate the harms caused by long term exposure to noise.

The potentially adverse effect of noise on populations has been well researched and documented in the literature. This has influenced the implementation of regulatory control of noise worldwide. Although noise regulations may vary by country and setting, long-term exposure to noise has been shown to cause adverse health outcomes in populations, and may include:

- Annoyance,
- Sleep disturbance,
- Fatigue,
- Hearing impairment and loss (Handley, 1987),
- Immune deficiency,
- Hypertension,
- High blood pressure,
- Heart disease,
- Elevated cortisol and adrenaline, and
- Vertigo (Moreland, 2016).

Beyond the deprivation of liberty as their punishment, people in prison have the right to adequate living conditions (Dogbeh et al., 2015), and as demonstrated, noise can cause adverse physiological effects for people in prison including staff (Moreland, 2016). Further, the WHO guideline states that noise exposure alone is not believed to be sufficient to produce aggression, however, in combination with provocation or pre-existing anger or hostility, it may trigger aggression (WHO, 2018). Heightened annoyance, combined with elevated blood cortisol and adrenaline levels, precipitates aggressive behaviour, which may create further health problems for prison occupants and additional noise. Sleep disturbance and fatigue reduce an individual's acceptance around compliance with rules and their tolerance of noise and the behaviour of others (Moreland, 2016). Confusion and disorientation are responses commonly articulated by people in prison when describing experiences of prisons, especially for newcomers or people with varying psychological and mental health challenges and this is further exacerbated by the more tangible aspects of prison audio environments (Hemsworth, 2016).

4. UNDERSTANDING THE PRISON COHORT

This section highlights some of the characteristics of people in prison ('the cohort') to demonstrate why an approach to regulating noise should be informed by an understanding of the cohort itself and their interactions with the prison soundscape.

The WHO guideline recognises the need for special consideration for vulnerable groups, whose situation or physiological state could make them more susceptible to harm from unwanted noise (WHO, 2018). Even so, this special consideration is not exercised when designing for prisons even though the population is highly vulnerable by any definition. In Aotearoa New Zealand and Australia, and the situation is similar in most correctional jurisdictions, some 50 per cent of the adult prison population are neurodiverse (Harmes, Hopkins & Farley, 2019). Traumatic Brain Injury (TBI) is four times more prevalent in the prison population, but nearly all women in prison have had TBI. People in prison are more than seven times more likely to have significant hearing loss (usually due to untreated otitis media) and 50 per cent have ADHD (75 per cent among youth offenders) (Lambie, 2020; Pender, et al., 2023). Most neurodiversities are significantly overrepresented in the prison population.

The way sounds embody memories from both past and present traumas, adds to the emotional impacts of sound, even if brief (Hemsworth, 2016). According to a study conducted by Ara Poutama Aotearoa Department of Corrections New Zealand, over half of prisoners have experienced sexual and/or family

violence, with the rate being higher for women at 75 per cent compared to 56 per cent for men. The study also found that 52 per cent of women in prison and 22 per cent of men in prison have a lifetime diagnosis of Post-Traumatic Stress Disorder (PTSD) (Bevan, 2017). The loud and jarring sounds in a prison can retraumatise individuals, and corrections staff often carry their own trauma from the job, making them vulnerable and hypervigilant.

5. WHAT ROLE DOES DESIGN PLAY?

Historically speaking, prison design has prioritised safety and security, with aesthetics and acoustics being secondary considerations. Modern design briefs for prisons often include criteria regulating noise from mechanical plant or break-in, partition performance and reverberation times. So, the importance of acoustics is at least acknowledged, yet fails to recognise the differences between different cohorts (those inside of and those outside of the prison) and the length of exposure. To actually provide acoustic amenity for people in prison, a compromise must be found to ensure that the building can comply with minimum health and comfort standards (Dogbeh, et al., 2015), taking into account the especially vulnerable nature of the cohort (see, WHO, 2018).

The following list shows some examples of guideline documents which are employed to inform prison design:

- Department of Health – Specialist Services – Health Technical Memorandum 08-01: Acoustics 2013 (UK). This provides a comprehensive acoustic design guideline, with no specific mention of health care spaces inside prisons.
- Australian and New Zealand Standard AS/NZS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors (Australia and New Zealand). This is a widely used guideline for building projects throughout both countries, yet with no specific mention of spaces inside prisons.
- National Construction Code (Australia) and New Zealand Building Code (New Zealand). Prisons are assessable buildings under both codes. The building codes generally aim to control noise between adjoining spaces, such as for multi-level apartment buildings where separate tenancies share a common wall or floor/ceiling.
- American Correctional Association Noise Standard (US). This forms part of a suite of mandatory and non-mandatory guideline documents used to rate and classify prisons in the United States. The in-cell noise limits contained in this standard are higher than typically used for residential projects, and at the upper end for healthcare projects.
- The U.S. Environmental Protection Agency has defined acceptable levels for noise outside of correctional facilities as 40 dB(A) for classrooms, 50 dB(A) for general office areas and 58 dB(A) for light industrial spaces (Moreland, 2016).

Guideline documents such as these provide performance standards and high-level background information about acoustics, however, there is typically an expectation that the guideline would be used together with advice and support from an acoustics specialist where the intention is to use the guideline to inform the design of a project. The specialist acoustics input would generally be provided by a suitably qualified and experienced consulting firm, with their services being offered to the project owner through a competitive tender process. To enable the consultant to prepare a bid for the work, the project owner will provide some level of guidance around the acoustic design goals as part of the tender brief. The consultant will prepare a fee proposal which aims to show the project owner that they have the skill and capacity to help the project team navigate the regulatory framework in the most effective and efficient manner. If allowed for in the tender brief, the acoustic specialist may offer to provide additional work around achieving a level of acoustic quality which goes beyond compliance with the nominated criteria, however, more usually their involvement is limited to achieving regulatory compliance.

Where the local regulatory framework is not clear or prescriptive (for example, has no performance standards) about certain elements of the acoustic design, the acoustic specialist will nominate a reasonable approach based on previous experience with similar projects. At the early regulatory approvals stage for large building projects, there can be a round of technical peer review which further reinforces the inclination of the acoustic specialist not to deviate from the accepted practice when nominating performance standards.

6. BRIEF OVERVIEW OF GENERAL ACOUSTIC DESIGN ISSUES

Acousticians use a range of engineering and design methods to control, manage and influence the acoustic properties of internal spaces, and they provide input to the design of the building envelope construction element types to manage noise break-in or break out as required. A detailed explanation of the acoustic principles is beyond the scope of the paper, however, that information is readily available in the literature.

Those general acoustics issues which can be addressed at the design stage include:

- **Reverberation time:** Controlling acoustic reflections inside a space, possibly to improve speech intelligibility and reduce the vocal effort required by speakers when addressing an audience.
- **Partition performance:** Providing the required amount of noise insulation to stop noise passing through a partition which separates two spaces, either side by side, or above and below.
- **Facade construction build-up:** Modify/upgrade a proposed facade wall or roof system build-up to provide the required level of noise insulation from outside to inside. Typically, more mass in the build-up will provide better performance, but also be more expensive.
- **Internal noise level:** Manage the overall level of noise inside spaces, depending on their planned use and deemed sensitivity to noise.
- **Noise from mechanical plant:** Locate, mitigate, or select mechanical plant items to manage their noise within the building, or at adjacent spaces in other parts of the building or in a different building.
- **Noise from building services:** Controlling noise caused by water and waste systems, including pipework and risers.
- **Rain noise:** Managing the level of noise generated inside the spaces, caused by rain on the roof.
- **Vibration:** Manage the level of vibration received inside spaces, from outside the project building or from sources within the building.
- **Construction noise and vibration:** Consider the effects of noise and vibration from construction activity on the existing activities.

Some of these issues can be addressed after the construction and commissioning of a building, however, achieving the required level of performance or quality using retrospective interventions can be more challenging and costly if implemented retroactively. For example, retroactive interventions might include adding more absorptive materials to exposed walls, floors, or ceilings, or replacing hard furniture with furniture made from softer materials. Furniture in prisons can be highly durable, secure and may come with sound dampening qualities (Hughes, 2023).

7. DESIGN CONSTRAINTS AND CONFLICTS

The emphasis on acoustic design can come at the cost of visual control, where architectural features enabling visual surveillance often fail to prevent people in prison from talking and noise making (Yeung & Somashekhar, 2016). Designing quiet spaces presents a problem for architects, as most materials seen as being safe and durable, reflect sound, creating echoes and loud, harsh environments (Elton, 2007). Acoustic treatment of visits spaces should permit privacy and conversation without the need for raised voices. The transfer of sound from neighbouring areas needs to be minimized and, if possible, excluded through the provision of appropriate sound insulation or the application of sound-absorbing material – deadening the spaces and reducing reflected sound.

Overall internal noise levels can be reduced through the use of sound absorbing materials which enable a corrections staff member to reinforce control as their voice becomes more audible. It is crucial to note that too much noise can be exhausting for both people in prison and staff, potentially worsening their worries about safety and security (Christoff, 2007). In a quiet unit, a corrections officer's voice can be easily heard and responded to. However, if an officer must shout due to poor acoustics, it can strain the relationships between officers and incarcerated individuals (Elton, 2007).

Quiet units have been shown to be less stressful and facilitate rehabilitation for people in prison, in contrast to loud units where every sound carries and echoes (Elton, 2007). However, even though softer surfaces help to mitigate noisiness, they are also easier to destroy, conceal contraband in, and use to craft weapons. Anything that can be done to soften or substitute hard surfaces will decrease the noise and make the accommodations more pleasant for both staff and people in prison. Ideally, the unit's ceilings would be constructed with acoustic blocks commonly found in lecture halls and cafés. The walls would feature a

concrete block core, layered with sound-absorbing material, and then covered with perforated metal sheets. This design allows noise to pass through to the sound-absorbing layer while deflecting any attempts at damage (Elton, 2007).

Though noise levels can be accurately modelled prior to construction, that process does rely on certain assumptions around building use and construction methodologies. However, noise levels cannot be measured until the prison is completed and occupied. Post-construction funds are generally not available for acoustical mitigation through the addition of sound absorbing materials (Christoff, 2007).

8. BRIEF INSIGHTS ABOUT NOISE IN PRISON FROM SENSORY CRIMINOLOGISTS

The study of sensory criminology explores criminological issues in context with the sensory experience, such as through the control of individual and group behaviour, the restriction of movements, the struggle to maintain a sense of self, and during the range of social interactions.

The literature generated by researchers in this field contains insights into noise and acoustics inside prisons which could readily evade the purview of acoustical consultants. Their studies investigate how people in prisons use and experience the acoustic qualities of spaces, in affirmative ways, in their efforts to protest against their situation, or in torturous ways which can lead to emotional and mental harm. The evidence is compelling, and examples shown in the following section will highlight the opportunities for more collaboration between disciplines.

A. KEEPING SAFE

In Canada, frontline corrections officers call it 'feeling the range.' These officers observe that they can discern the prison's atmosphere by listening to conversations or raised voices (or their absence). Spending significant time among a group enables them to pick up on subtle emotions conveyed through tone. In prisons, the 'range' usually denotes a shared area accessible from individual cells, where people congregate during the day when they are not in their cells (Hemsworth, 2016). It seems reasonable to assume that the ability of the corrections officers to sense these things based on acoustic cues, may depend on their level of experience in a particular prison environment and perhaps their hearing health. Consideration should be given to an individual's different auditory capacity and experience. It could reasonably be deduced that unless these subtle indicators are pointed out by more experienced staff, they may go completely unnoticed by new staff.

B. SOUND FOR ORIENTATION

An individual confined to a cell may attentively listen to discern the whereabouts of corrections officers, employing finely tuned auditory awareness skills. Meanwhile, frontline officers remain vigilant, relying on their ability to sense the atmosphere within the range, and take precautionary measures if the sonic environment or rhythm indicates potential danger (Hemsworth, 2016).

At Saydnaya Prison in Syria, listening becomes a survival tool, providing the people incarcerated there with a sense of control amid extreme deprivation. By relying on their keen sense of hearing, prisoners navigate life behind bars: they mentally map their environment, stay vigilant against potential threats, and break through their isolation by gathering information about their detention, deciphering indistinct voices, and piecing together the events both within and beyond their cell walls. (Ristani, 2020).

Sonic orientation extends beyond merely recognizing sounds; it involves a keen sensitivity to nuances such as the interpretation of echoes or shifts in rhythm. Within prison communities, listening and producing sounds facilitates gathering information. Indeed, utilising sound for navigation can be a deliberate and cautious endeavor, as visual explorations as with looking into another person's cell could provoke violent repercussions (Hemsworth, 2016).

C. SOUND AS PROTEST

By way of contrast, listening to music in prisons can be a communal activity when sharing a radio or collaborating in making music. Additionally, it be a personal means of connecting with external environments and those beyond the constraints of prison, underscoring music's role in creating 'transcarceral' spaces (Hemsworth, 2016).

An example of sound as resistance was found in Kingston's Prison for Women in Canada. Women would sing or scream as a form of protest while in lockdown. Despite this leading to further punishment, the idea

was that it was difficult to trace noise back to a single person, and that controlling the soundscape allowed for acts of solidarity and resistance. Participants believed that even these fleeting moments of resistance were worth the punishment. In this context, sound is a weapon that protests the reduction of incarcerated people to 'bare life' (Hemsworth, 2016). The use of this 'sonic resistance' contributed to the humanization of women in prison and the creation of an alternative space for envisioning a future without those prisons (Russell & Carlton, 2020).

D. SOUND AND SELF

Human groups have always marked and defended their territory through the emission of sounds (Hayward, 2012). In prison environments, it is no different; sound plays a crucial role in the dynamics of power (Ristani, 2020). The notion of 'control of sound' inherently implies control over power, determining who can hear what. This power dynamic inevitably creates an opposition between those who benefit from it and those who oppose it (Saher & Cetin, 2016).

Acoustic dystopias, such as the traumatic events of childbirth in prisons exacerbates the suffering inherent with incarceration and dehumanizes imprisoned populations (Hemsworth, 2016). In this situation, the challenge of navigating a sonic environment becomes apparent: there's a tight connection between a prisoner's sense of personal space and their auditory perception. However, expecting individuals to define clear boundaries regarding which sounds belong to them, particularly within prison settings, is unrealistic. Seeking 'mediated isolation' through radios and other devices enables them to exert some influence over their auditory surroundings. Nevertheless, such behavior may be viewed as anti-social, provoking feelings of hostility (Hemsworth, 2016).

It is unsurprising that much of the conflict arising from expression through sound in prison revolves around issues of power and control rather than a desire for disconnection. Those who may perceive themselves as holding similar levels of power use sonic devices in ways that disrupt power dynamics among their peers (Hemsworth, 2016). Unfortunately, the reality of prison life may present those accommodated there with a choice between two unfavorable options: Solitary confinement with its associated sensory deprivation and isolation, or the noisy and overwhelming soundscape of the general prison population (Hemsworth, 2016).

9. BETTER ACOUSTIC DESIGN

In this paper, it has been demonstrated that the noise environment within prisons is significantly more complex and nuanced than that of typical residential or healthcare buildings, and the allocation of acoustic space is often fiercely contested. Consequently, the conventional approach to acoustic design may fail to improve the auditory experience for those individuals utilizing the facilities as intended, thereby unintentionally leading to unforeseen adverse outcomes.

E. DESIGN GUIDELINES

Specific design guidelines for acoustics already exist for residential, educational and health care buildings in many jurisdictions. In the case of educational buildings, the guidelines are often developed by acoustic specialists based on evidence, and in consultation with users, with the aim to give the learners and staff the best possible environment to maximise their potential for success. While spaces inside prison are used for sleeping, teaching and healthcare, the characteristics of the cohort and the particular use of sound in this environment, mean that the acoustic design of prisons should be considered differently.

A specific guideline for the acoustic design of prisons, based on specific evidential research, using the existing relevant guidance from other sources as a starting point, would provide a significant improvement in the lived experience of people inside prison and the staff. A guideline of this type would provide certainty for regulators and be an invaluable tool for the project design team specialists.

Given the additional requirements around controlling illicit communications between people in prison, guidelines would also include recommendations for controls specific to the prison setting. By way of example, a parabolic reflector could be added to ventilation pipes to prevent prisoners from communicating with one another through the pipework. The sound would be reflected to its source in this case (see, Elson, 1921).

F. MAKING USE OF TECHNOLOGY

The development of design guidelines for prison acoustics should highlight the potential for intervention with technology. The following sections provide some information about existing commonly used technologies which may be valuable tools inside prisons.

I. LOW-COST SENSOR MONITORING NETWORKS

Arrays of low-cost microphones could be deployed throughout the prison to continuously monitor noise, and together with the application of machine learning, could identify patterns which could alert staff to an increased risk for violence, for example. The literature shows examples where experienced staff may be able to judge the 'heat' of the yard or dayroom and pre-empt problems, allowing them to act before violence begins. However, persistent high staff turnover rates in corrections departments around the world can mean there are less experienced staff in positions of control within the prison at times. The low-cost sensor monitoring network may be a useful tool to help less experienced staff, who may be feeling threatened or vulnerable, recognise actual elevated levels of risk, and potentially enable them to feel safer at work.

Machine learning algorithms hold promise in discerning non-verbal communication patterns, including those reliant on auditory cues, utilized by people in prison to encode messages and evade detection by corrections staff. For instance, subtle variations in tone, pitch, or rhythm during phone conversations or communal activities may serve as covert signals conveying information or instructions. Through the application of machine learning techniques, such clandestine acoustic patterns could potentially be identified and deciphered.

II. ACOUSTIC MASKING OR SOUNDSCAPE MANIPULATION

In contemporary office environments characterized by open-plan layouts, electronic acoustic masking systems have become increasingly prevalent. These systems utilize customizable background noise, often in the form of specifically modified white noise, emitted at sufficient volume and coverage to 'mask' unwanted sounds originating from various activities within the shared space.

In recent years, there has been a notable surge in both interest and research surrounding the concept of soundscapes and their profound impact on individuals. This newfound attention prompts consideration for the potential implementation of noise masking systems tailored to the unique needs of individuals within different areas of a prison, during varying times of the day or year.

Imagine, for instance, a prison housing unit where incarcerated people spend considerable portions of their day. By manipulating the soundscape within these spaces, prison administrators could potentially enhance the effectiveness of existing rehabilitation programs aimed at breaking the cycle of reoffending. Given the persistent challenge of ensuring consistent access to rehabilitation services, soundscapes could offer a supplementary form of therapy or solace for inmates between scheduled sessions, as well as throughout their daily routines. Such interventions could contribute to fostering a more conducive and supportive environment encouraging positive behavioral change and holistic well-being within correctional settings.

10. CONCLUSION

This paper has underscored the imperative to reimagine acoustic design for prisons, moving beyond conventional standards borrowed from unrelated settings like residential, educational or healthcare buildings. The nuances and complexities of auditory experiences within carceral environments demand a multidisciplinary approach that integrates insights from emerging fields such as sensory criminology, psychology, and acoustics. By doing so, the complex interplay between sound, space, and human behavior within prisons can be better understood, ultimately informing the development of tailored guidelines and interventions that address the unique needs of people in prison and corrections staff.

While this paper has provided insights into the role of acoustics in shaping prison environments, there remain several avenues for further research and exploration. One promising area is the development of specific design guidelines for prison acoustics based on empirical research and evidence-based practices. These guidelines should consider the distinctive characteristics of the incarcerated population, the dynamics of power and control within prisons, and the potential impacts of sound on behavior, well-being, and rehabilitation.

The integration of technology offers promising opportunities to enhance safety, security, and well-being within prisons. Further research could explore the implementation of low-cost sensor monitoring networks and machine learning algorithms to better understand patterns of communication and behavior. By leveraging acoustic masking or soundscape manipulation systems, researchers can investigate the effectiveness of these interventions in promoting positive behavioral change and reducing violence within carceral environments.

Research examining the long-term effects of acoustic design interventions on the behavior of people in prison, their mental health, and recidivism rates would provide valuable insights into the efficacy of such approaches. The potential role of sound in facilitating rehabilitation programs and promoting social cohesion within prisons could offer novel strategies for improving outcomes for incarcerated individuals and promoting pro-social and non-violent prison cultures.

Reimagining acoustic design in prisons represents a critical step towards creating safer, more humane environments that promote rehabilitation, reduce violence, and uphold the dignity and well-being of all incarcerated individuals. By embracing a multidisciplinary approach and exploring innovative interventions, researchers and practitioners can work towards fostering environments that support positive behavioral change and contribute to the broader goals of justice and social equity.

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