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Moving past the sound-noise dichotomy: How professionals of the built environment approach the sonic dimension

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Abstract

Debates on the sounds of cities have focused on the often-used dichotomy of noise versus sound; yet for the decades of debate, few examples of policy, procedures, or case studies have made motions in acknowledging the diverse roles that sound plays in shaping our experience and understanding of the city: orienting us, creating memories, fostering healthy restoration, etc. To better understand the challenges that professionals of the built environment face in their everyday practice, we interview 22 professionals across six countries to understand how they interact with sound.

Building on a substantial corpus of transcriptions using a multi-layered coding process, three approaches of how sound is considered and prioritized in practice emerged: policy, public health, and city user experience. These three approaches are operationalized according to the key concepts, decision criteria, and evaluation methods that frame what motivates each professional to consider sound in the context of individual projects. Finally, these considerations were heavily influenced by contextual factors including individual, locational, and organizational.

Classifying the ways in which professionals consider sound in practice into these three approaches may serve as a better starting point for future communication and collaborations between research and practice. Further, it may better accommodate the inclusion of other types of artists and experts into the conversation on urban sound.

Keywords: Noise policy, Soundscape, Professionals of the built environment, Public health, City user experience

Highlights

• Professionals of the built environment (PBEs) face challenges in integrating sound in everyday projects.

• Sound is considered using three approaches: policy, public health, and city user experience.

• Each approach is context-dependent (individual, location, organization) and can rely on human- or object-centered evaluation

• The identified approaches could guide future communication and collaboration between sound experts and urban professionals

Introduction & Review

The relationship between sound and the built environment is complex and two-way. The built environment accommodates a multitude of uses that make sounds (think of a market or a park), while influencing how those sounds propagate and further reinforce or, on the contrary, impede those aforementioned possible uses (for example, when there is "too much noise"). Besides an effect on the use of spaces, "too much noise" has tangible consequences on public health and can impact the shape that the built environment takes on, ranging from erecting noise barriers to establishing zones protecting sensitive users from noise. It has been known since at least the 1960s that noise exposure poses a public health risk for its ability to cause, among others, hearing impairment, hypertension, heart disease, annoyance, sleep disturbance, and decreased school performance (see Passchier-Vermeer and Passchier (2000) for a review). Consequently, **policies** guiding urban sound considerations typically focus on a narrow type of sound: 'unwanted' sound i.e. noise, favoring a strict controlling of noise deemed a nuisance to those with enough political power to shape the laws. A relatively recent branch of these laws, some stemming from the 2002 European Noise Directive (Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 Relating to the Assessment and Management of Environmental Noise., 2002a) and its subsequent implementation in local and national policies, treats noise from a **public health** perspective, as an environmental pollutant from which the whole population should be protected. The focus in the aforementioned policies[1] and in public discourse in general remains on **noise**, on its sound pressure levels (in decibels) and its deleterious effects on health and everyday life. However, the question of addressing sound in an urban setting is usually more complicated than just determining if the sound level is too high and if that is unhealthy. A parallel body of work focusing on the auditory **experience** of urban space users has been growing, driven mostly by academics in the field of soundscape research. This approach advocates for considerations that reflect sound as not just a nuisance or pollutant, but rather allows for more complex representations including both positive and negative outcomes. These two coexisting - and sometimes at odds – approaches have led to debates (e.g. Schulte-Fortkamp, Brooks, and Bray 2007) on whether sound as measured or experienced in the built environment should be characterized as a planning and design resource or as a waste i.e. noise to be limited. This debate has led to the emergence, in practice, of a mainstream strategy whose goal is the latter – i.e. 'noise control', and, decades later, to a more complex strategy of 'soundscape design' that emphasizes the opportunities that sound can offer (Bild et al., 2016). While soundscape design may build on noise control considerations, some of the key difference in these strategies lie in the extent to which they consider the context in which sounds are experienced, the attention given to the experience of 'city users' subjected to sounds, and the emphasis placed on quantifying the sound environment, particularly through decibels (dB) and its various calculations and indices.

With extensive (and justified) research attention paid to the experiences and contexts of the 'city user' (defined broadly) in the sound of the built environment in order to account for their needs, knowledge, and desires, we argue that scant attention has been paid to the complementary and similarly broad perspective of 'city makers', and especially the subset of urban built environment professionals; such professionals shape cities and ultimately decide what kinds of sounds cities will make through designs and

[1] With the notable exceptions of London and Wales, which have released the world's first "soundscape plans" attributed to governmental entities, see https://democracy.cityoflondon.gov.uk/documents/s74433/CoL%20Noise%20Strategy%202016%20to%202026%20FINAL%2010.1.16.pdf and https://gov.wales/noise-and-soundscape-action-plan-2018-2023-0.

plans; the decisions made today will be built into the concrete for decades to come. If sound is an afterthought for those intervening in urban spaces, those decisions will make poor sound outcomes permanent. It is critical to shift the focus to the Professionals of the Built Environment (PBEs), defined here as those who plan, design, or enact interventions, either physical or policy, at a range urban scales – and we focus specifically on the PBEs that intervene at scales relevant to the sound-noise question.

The question then becomes: how do professionals of the built environment approach the sonic dimension? Further, does the sound v. noise dichotomy described in the research also reflect the considerations of urban sound by the actual professionals who shape our urban built environments through everyday interventions?

This paper emerges from debates in the scholarly literature from both architecture, planning and design theory as well as soundscape research, asking PBEs to better consider sound, through "sound awareness" (Maag et al., 2021) as well as "sound literacy" (Radicchi et al., 2020). Often this literature emphasizes the importance of designing for sensory experience in general, as well as encouraging the integration of sound considerations in the early process of design and planning (Bild et al., 2016; Guastavino, 2020). Similarly architectural theorists have asked that their field do more to consider sound (e.g. Pallasmaa 2012; Zumthor 2006); and interestingly, Lynch et al. (Lynch et al., 1984) identified, already in 1984, two design strategies for "sensory" design: environmental protection and design. With these bodies of literature suggesting the presence of a gap between sound research and urban practice (Aletta & Xiao, 2018), we refocus our attention to the practitioners on the other side of it. A handful of previous studies have emerged that engaged with PBEs as part of sound-oriented pilot projects (Kropp et al., 2016; Lavia et al., 2016; Ouzounian & Lappin, 2014), but without documenting the conceptualizations and motivations for using sound by the various actors involved in the process. Meanwhile, a growing number of studies intentionally present their work from a practice-oriented perspective and to a practice-oriented audience (in specialized journals), presenting in detail how their academic findings can contribute to sound-aware urban design (see work ranging from Brown and Muhar (2004) up to (Steele et al., 2020).

Despite these multiple calls and attempts, spanning decades, the bridge over this gap never quite reaches the other side, raising questions about the effectiveness of ongoing knowledge mobilization from sound research. Kang (2006) explains the situation as a policy problem rather than a scientific problem, focusing on how noise abatement has established the many harms of noise, but not the ways to solve it. The previously cited works share the assumption that PBEs would do more about sound if they knew more[2]. However, this assumption has not been substantiated, to our knowledge[3], with an actual in-depth exploration on how PBEs actually conceptualize sound in their everyday projects, considering the different types of policy frameworks and other constraints, individual or project-related, under which they have to function. A handful of studies have isolated how various PBEs deal with sound by looking at specific professional groups: urban planners, (Adams, Davies, and Bruce 2009; Raimbault and Dubois 2005 - to an extent), landscape architects (Cerwén et al., 2017), and urban designers (Pijpers-van Esch, 2015) while one has looked across stakeholders, including planners/designers, users, and politicians (Yildirim & Arefi, 2020). We argue that the crux of the challenge is to first acknowledge the complex ecosystem within

[2] For example, Cerwen's (2017) thesis identifies a history of calls to landscape architects to begin considering sound, but concludes that these calls remain short, scattered, ad hoc, and presented in relation to the visual.

[3] Except for one Dutch-centered study outlining the using of noise-related policy instruments (limiting noise sources, insulation of dwellings, and zoning) for environmental noise planning (Weber et al., 2014),

which PBEs must conduct their work, where sound is but one of many other challenges. We therefore ask, in this context: how do PBEs think and talk about urban sound? *How do they approach sound in their projects and what methods do they use?*

To answer those questions, we conducted semi-structured interviews with different PBEs, active in six European and North American countries. We analyzed the resulting rich written corpus of qualitative data using an inductive, grounded theory coding process and identified three approaches that frame PBEs' work with sound: the policy approach, the public health approach and the city user experience approach. The inductive coding process was inspired by the insufficient coverage that a strictly deductive, literature-informed approach offered to adequately explain the subtleties of the motivations for considering sound. These shortcomings included dealing with the distinction between soundscape and noise mitigation, for example a designer was working on a project with both an indoor and an outdoor component, the outdoor component having a music stage – the project thus had to simultaneously consider the sound as "good acoustics" and "recreational noise". Similarly, the literature did not account for situations that blended physical measurements with the perceptions of city users, such as residents who were satisfied with the furnishing of triple-paned glass to mitigate the noise modeled from a future lumber yard. In this process, we placed particular emphasis on identifying the *whys* i.e. what motivates their integration of sound in their projects, the *whats* i.e. the key concepts defining their approach, and the *hows* i.e. their subsequent methods for evaluating the sound outcome of their projects. We also describe in detail the factors that influence why a PBE might take a particular approach in a particular context. We conclude with a reflection on how this newly articulated knowledge of sound approaches can be used to address gaps and inspire knowledge mobilization.

Method

The present study was conducted to identify and document the various motivations that professionals of the built environment (PBE) relied on when engaging with sound and how their motivations may be operationalized in different approaches in the context of their everyday work. Given the exploratory nature of these research objectives, a semi-structured interview format was chosen.

Research instrument – interview guide

The interview guide was comprised of three main sections, aimed primarily at collecting insights on participants' ecosystems - namely their individual and broader professional context, the way in which they engaged with sound considerations first in general and then in particular projects. In the introductory section, we asked participants to speak about their role and its function in the municipal, regional, or national context; they were also asked to elaborate on their daily tasks. The second section, focused on concepts, allowed participants to go in depth in their conceptualizations of sound, including questions on expectations of knowledge, the role of experts in making decisions, the priority that sound takes among other factors, reactions to poor outcomes and envisioned positive or best outcomes. In the next section, focused on sound in the context of projects, we invited participants to identify challenges and compromises that changed their engagement with sound when constraints from real projects are introduced, such as budget or political situations. Participants were asked to come prepared to discuss two projects in which they were involved – one project that was recently completed, and one that was currently in progress, based on which we asked questions related to how sound was considered (if at all).

The interview was the main data collection strategy for a broader doctoral thesis project (Steele, 2018) addressing additional aspects besides those summarized here. In this paper, we report only on the

questions and answers pertinent to the ways in which PBEs think of and use sound in practice. The corresponding questions of the interview guide are presented in the Appendix.

Participants

In total, 22 participants were interviewed for this study, based across North America and Western Europe, active in six countries (see Table A). Participants were contacted using e.g. cities' local hotline (e.g. Montreal's 311), PBEs' individual or team contact information found in public documents about recent projects, as well as personal contacts. We relied on theoretical sampling based on the emerging theories to maximize variations (Glaser & Strauss, 1967; Strauss & Corbin, 1998) in terms of planning and design systems, as well as public and private sectors ensuring a variety of perspective from different professional fields.

Table A: Table of Participants. Some columns are binary (if marked in dark grey – the participant had that feature).

Participant	Country	Years of Experience	Urban Planner	Urban Designer	Architect	Landscape Arch.	Manager (M) Executive (E)	Graduate Ed.	In Academia	Sector	Org. Size (S,M,L)
1	Belgium	30	■		■		E	■		Public-Private	S
2	Belgium	8	■		■			■	■	Public	L
3	Belgium	15	■		■		M	■		Private	L
4	Canada	7	■	■						Public	L
5	Canada	30	■	■				■		Public	L
6	Canada	34	■		■		M			Public	L
7	Canada	17	■	■				■		Public	L
8	Canada	25					M			Public	S
9	Canada	6	■							Public	S
10	Canada	1		■	■					Private	L
11	Finland	6	■					■		Public	M
12	Germany	8	■					■	■	Public	L
13	Germany	25	■				M	■		Public	L
14	Germany	0	■					■		Public	L
15	Netherlands	10	■				M	■		Public	L
16	Netherlands	32	■							Public	M
17	Netherlands	30	■					■	■	Public	M
18	Netherlands	7	■					■		Private	L
19	Netherlands/ Canada	16				■	M	■		Private	L
20	USA	15		■	■		E	■	■	Private	L
21	USA	30			■	■	E	■	■	Private	S
22	USA	2	■							Private	M

Procedure

Interviews were conducted in English (N=18) or French (N=4), the latter with the help of a research assistant, and lasted up to two hours. Interviews took place face-to-face, in PBE's offices, where they had access to all of their devices and files. All interviews were recorded on a single portable device (with the consent of the participants) and transcribed in full.

Analysis

The resulting bilingual corpus was subjected to a multi-layered process of constant comparison (Strauss & Corbin, 1998), making use of the open coding procedure to allow for data not belonging to existing

categories to lead to new categories of responses in relation to conceptualizations of sound in general. We focused our analysis on understanding:

1. the *whys*– the motivations that drive their way of thinking about sound and their further engagement with sound in their projects
2. the *whats* – the key concepts defining how their motivations translate into practical strategies. This includes the broader lexical fields that they rely on to describe their ways of addressing sound considerations in their projects.
3. the *hows* – how exactly they operationalize and measure the sound outcomes, especially in terms of predominant decision criteria and evaluation methods of the sound outcome of their projects (including perceived agency to change). Two additional categories of method emerged from this data, labeled based on current debates within the soundscape domain: the object-centered methods (focusing on the physical properties of the sound, or the sound source/agent producing the sound) and the human-centered methods (focusing on the effect of sounds on people)[4]. An additional aspect we report on, that further influences participants' engagement with different *hows* in a project, is the *when* i.e. the moment(s) in a project when sound is considered, if at all.

We also investigated the factors contributing to sound considerations, be it in terms of prioritization, desired outcomes or evaluation. Across the 22 participants, a number of variables emerged framing the way in which professionals thought of and used sound, grouped according to individual, locational, and organizational factors. Education, field of work, years of experience and knowledge expectations fall under the individual dimension; geographic region is the primary locational factor; management level, city size, organization size and especially type of project fall under the organizational factor.

Results

In this section, we outline three approaches, each including a primary motivation for dealing with sound, key concepts used in association with the approach, decision criteria framing their engagement with sound and the predominant evaluation methods for how the approach is operationalized (Table B). Each approach is labeled using the same label as the motivation. The three approaches are: policy (A1) – concerned with satisfying legal limits and avoiding complaints that require action; public health (A2) – considers overall sound levels and their effects on population health, healthcare system costs, and even housing prices; and city user experience (A3) – drawing on the relationships between the user, the context, and the sounds made by sources. Within each approach, participants described both human- and object-centered methods for evaluating their sound-related outcome. The section that follows details how participants often used multiple approaches (see Section: Switching Approaches), while we maintain a theoretical distinction between the three. To contextualize the approaches, in the closing section of the results, we report on the various individual, locational, and organizational factors underlying the participants' reasons for using each of the three approaches.

[4] We include sources in the "object-centered" category though others have made it a unique category; "human-centered" has also been called "subject-centered" in other literature (see Guastavino et al. 2005; Dubois et al. forthcoming). These labels also conveniently avoid yet another unhelpful dichotomy, namely subjective-objective, which is laden with value judgments and epistemological consequences, see Dubois (2000) and the aforementioned references.

Table B: The three identified approaches to sound used by PBEs.

		Whys	***Whats***	***Hows***	
		Motivation	**Key concepts defining the approach**	**Decision criteria**	**Evaluation methods**
Approaches	A1	Policy	Laws Regulations Procedures Limits	Binary • above – below legal limit • go – no-go • complaints – no complaints	**Object - Centered:** Ensuring sound levels are below the legal limit **Human - Centered:** Anticipating and responding to complaints
	A2	Public Health	Environmental Pollution Cost to health systems (risks and harms)	Continuum • high – low level of pollution • good – bad for health	**Object - Centered:** Achieving sound level reduction, Protecting housing prices **Human - Centered:** Reducing annoyance, Reducing costs to healthcare system
	A3	City User Experience	Quality Perception Environmental (interdependencies with other environmental considerations like air or soil) Comfort	Complex • quality • interactions • evaluations from "city users" (e.g. questionnaire)	**Object - Centered:** Achieving balance between sound and other factors in a "good" plan or design, Encouraging or discouraging the presence of certain sound sources (sound makers, sound-producing agents) **Human - Centered:** Achieving experience outcomes (e.g. pleasantness), Planning/Designing sound environments that respond to activity and space use

Approaches to sound

For the sake of clarity, we present the different approaches as distinct ways of engaging with sound. But it should be noted that the most participants rely on multiple approaches illustrating the multitude of contexts, considerations and stakeholders (moving between the columns and rows of the table to satisfy

various project-related needs, as required) that PBEs must simultaneously satisfy when integrating sound considerations into a larger plan or design in practice.

In the sub-sections below, we unpack each of the approaches from a number of perspectives, including the key concepts defining the approach, the detailed decision criteria and evaluation methods, when in a project the sound considerations would usually take place, how a successful sound-related outcome is described and the perceived agency of the PBE in influencing the outcome.

Approach A1 – Policy

Table C: The Hows of A1: the Policy Approach – concerned with satisfying legal limits and avoiding complaints that require action

	Decision Criteria	Evaluation Methods	Sample Quotation
Approach A1 – Policy	Binary • above – below legal limit • go – no-go • complaints – no complaints	**Object - Centered:** Sound level limits	*"Those are just the rules you encounter in the **law**…we have **noise levels**, which we need to taken into consideration **by law**. And the actual considerations are in the law, so it's **noise levels**."* (P18)
		Human - Centered: Complaints	"*You **can't** bring residential [zoning] to the industrial park. I need a buffer, because if not, I'm going to get **complaints**.*" (P8)

The first motivation to work with sound is driven by policy and other legal considerations. Approach 1 – Policy (A1) is usually operationalized through a binary (yes-no or go-no go) option that requires that a rule be satisfied in order for the rest of the project to move forward. A1 is heavily guided by the need to satisfy metrics – various values, usually centrally set in regulations, that must remain below a specific threshold, measured using set procedures and tools. Unlike the other approaches, this type of sound concern can be 'solved', in that achieving satisfactory levels or avoiding complaints usually results in no further actions being necessary. The decision criterion is thus binary and the 'sound success' of a project is quantified with a tick off a checklist:

- ✓ sound levels measured to be under [xx] dBA limit (xx: whatever local values and weighted level calculation scheme applies),
  - can be checked off either during the project (through modeling) or after a project has ended (actual measurements), depending on the project context
- ✓ no (or a limited number of) noise complaints (either anticipated or received),
  - the threat of noise complaints is constant, especially once a project has been finalized

Failing to satisfy either of these conditions could lead to postponing or canceling a project or open the PBE to litigation. This approach was often reinforced by decision-makers (like developers and politicians), who paid "no extra attention beyond satisfactorily meeting the law" (N=3). The go-no go ethos of A1 is summed up by P17, a planning advisor for a Dutch city, who said "you can have a discussion on urban quality, but not about noise", basically arguing that noise is not one of the *complex* urban considerations that requires discussion or compromise. It must be solved according to the laws, and failure to do so could

spell major trouble for projects that are well underway. Somewhat implicit in the explanations from participants was the idea that their considerations about sound were obligatory, as being a 'part of the standard workflow' (N=7).

Key concepts: Outside of the word "noise", which was used by every participant, "level(s)" was the most frequently used word (N=13), usually as "noise level" and "legal levels"). Terms like "laws" (N= 4), "bylaws" (N=2), "regulation(s)" (N=1), and "planning law" (N=2) also justified this approach.

Evaluation methods: The **object-centered** methods rely heavily on sound pressure level measurements using acoustic indicators (e.g. dB, dB(A), LA_{eq}, L_{den}), see Murphy and King (2014) for a comprehensive introduction and review. These indicators could be either modeled (i.e. before the project is in place) or measured (i.e. usually after the project is completed) at a certain time and certain point in space. These indicators are compared to limits specified in policies or regulations that inform the adjustments that need to be made for the project to continue; for example, a participant showed how modeled sound levels would determine features of the project's design: "*We have levels you can't exceed by law. So you have to calculate if you do or do not. And if we exceed these levels, we will build barrier walls to reduce the noise for the surrounding houses*" (P16).

The **human-centered** methods center on another metric – the number of noise complaints, both actual and anticipated. Complaints tend to spur the PBE to action, as they are either the precursor to further legal action or they attract the attention of politicians and other decision-makers. P8, the lead planner of a small town adjacent to Montreal, considered it a priority to deal with resident complaints quickly with "solutions", referring to a range of technical and commonsense interventions. Complaints can be anticipated based around proposed projects (e.g. P8 would not allow a dog kennel because of perceived neighbor fears) or construction projects, or they can be submitted by residents about ongoing situations (e.g. night noise complaints due to bars or other commercial uses). Importantly, these complaints are almost entirely conceived of as concerns from property owners about interior spaces.

Interestingly, despite stemming from a human-centered concern, in most municipalities, noise complaints lead to inspections by a technician who measures the sound levels to determine if the complaint warrants an intervention (often at the expense of the violating 'offender'). Thus, the **blending of human- and object-centered metrics**, is not uncommon: "*In [our city], you call…and complain about noise. You complain enough and enough people complain, they'll send an inspector there with a monitor to see if the noise level is higher than you're permitted*" (P20).

When: As indicated above, sound can be considered in different stages of a project for PBEs using A1, for example before or during the construction phase of new projects, when the acoustic environment can be modeled by experts for potentially exceeding legal values, allowing for adjustments in the design phase of the project, and anticipating potential complaints. Complaints on completed projects can also trigger inspections, which often lead to on-site measurements being taken to check compliance with regulations.

Outcomes: The sound outcome in A1 often factors little in overall evaluations of the whole project, as it is often understood as simply having to satisfy a binary criterion. A positive outcome is, from the object-centered side, an overall sound level that is below the requirement (N=5). From the human-centered side, a positive outcome is the absence of complaints (even if this is an unstable equilibrium). Conversely, a poor outcome is when the sound level is too high and a project cannot proceed, or if it results in lawsuits (P20) or regular complaints. Despite these considerations, roughly half (N=12) of participants expressed that poor outcomes for sound would have little or no effect on the overall outcome of the project, and 5

participants did not believe sound warranted further consideration after satisfying the legal conditions (N=6). A participant summarized this binary understanding of sound from a policy perspective, when discussing a completed project: "*No one congratulated us for the noise but neither did anyone lash out as us for it*"[5] (P4).

Agency: The underlying motivation behind using A1 is not related to concerns for the sound environments or its effects on people per se, but rather on satisfying a rule – one of many considered to ensure the success of a project. "*I think it's usually forgotten in the beginning of projects. And it's mainly considered to be annoying, but in the end it is part of the law, so you need to take it into consideration, so it grows*" (P8). Echoing this sentiment, 7 participants would not allocate more resources for anything sound-related once the conditions were met. While some acknowledge the limitations of the approach, saying that bylaws aren't useful tools for foresight (N=3), it is worth remembering that the policy approach is the most common one, and to some extent, the most reliable in terms of methods and documentation of success.

Approach A2 – Public Health

Table D: The Hows of A2: Public Health - an approach motivated by public health considers overall sound levels and their effects on population health, healthcare system costs, and even housing prices.

	Decision Criteria	Evaluation Methods	Sample Quotation
Approach A2 – Public Health	Continuum • high level of pollution – low level of pollution • good for health – bad for health	**Object - Centered:** Sound level reduction, Housing costs/sales	"*You know, they say that you should keep a 40 dBA level in order to live **quietly** and **healthy**, in a healthy way; but the ambient noise, even at night is 50*" (P6). "*You check the map for noise pollution and then formulate recommendations for how to manage that noise problem. Maybe to build a wall, or don't build anything in that area*" (P2).
		Human - Centered: Annoyance, Health effects and Healthcare burden	"*We are convinced that most of the noise that's **annoying** is noise coming from traffic*" (P1).

In this approach, some of the vocabulary is shared with A1, such as the use of "noise level"; however, noise concerns are operationalized differently. A2 differs from A1 because, while relying mostly on the same acoustic indicators (i.e. dBA), it shifts the focus from satisfying a rule to minimizing harm on populations. It thus concerns itself with the *who* – the affected populations and the *where* - the (usually indoor) spaces that the population occupies. For this approach, "noise" is conceptualized as pollutant, in that it should be minimized; the noise levels should be below a threshold value, namely those specified in policy, but the values in themselves are no longer the exclusive goal. The pressure for PBEs is for "more quiet", associated with more health-conducive environments and further linked to quality of life. Two

[5] *"personne ne nous a félicité pour le bruit ou personne ne nous a lâché des roches pour le bruit."*

separate participants directly explained that noise regulations emerged from concerns about public health.

Key Concepts: Key concepts centered around terms that described the (mostly harmful) effects of noise, most commonly referring to the idea of "pollution" (N=6), as well as referring to how noise "impacted" (N=5), "affected" (N=1) or "influenced" (N=3). Sound also affected "health and well-being" (N=1) or it was a "safety issue" (N=1). In addition to the pollution connotation, participants spontaneously listed 'noise' as an environmental consideration (N=7), together with others such as air, soil, and water pollution.

Another cluster of concepts focused on what precisely noise affected, ranging from "people" (N=5) to the various activities that users conduct and that can be affected by noise: the generic "living" (N=4), "activities" (N=2), as well as the more specific "work" (N=3). Directly related, participants mentioned the places where sound has an effect, particularly a negative one, including abstract place terms: "building" (N=8), "area" (N=7), "place" (N= 4), "the city" (N=5) or more localized areas like residents' "houses" (N=2), "backyard" (N=2), "outside" (N=2), "apartments" (N=1), "bedroom" (N=1), or "balcony" (N=1). Related to where the sound would be a problem was the issue of the type of zone that was being dealt with; seven participants mentioned some sort of zoning, such as "housing", "residential", "industrial", "business" (N=2), "schools" or "quiet area". We again observe an emphasis on indoor spaces as the exposure sites to 'noise pollution'.

Evaluation methods: While A1 provided a binary (yes-no) way of assessing the sound-related factor in a project, A2 relies rather on a continuum: the range of possibilities on the object-centered side could be summarized from quiet to noise. On the human-centered side, it ranges from not annoying to annoying, and from healthy to unhealthy.

Despite A2 necessarily being motivated by a concern for the affected populations, a number of the metrics and criteria used are **object-centered** and focus on evaluating individual sound sources or simply the overall sound environment. For example, one participant described the inevitability of rail noise and its negative effects on the environment as well as their project: *"the rail tracks itself, you could perhaps make a bit more quiet, but rails are rails, so they produce noise, so the best thing you can do is to build the [noise barriers] to protect the environment, the houses, and so on" (P13)*. While the negative effects on the environment were explicit, the effects on users was implicit. Note that these concerns were largely based on modeled sound levels.

This approach also relies on **human-centered** methods, focused as it is on populations. A2 also considers the categories of activities the populations might be conducting (sleep, being at home, work, etc.), suggesting that annoyance arises from conflicts between uses, such as residential being too close to a highway. While remaining focused on the environmental protection aspect of the problem, ("*we have to protect the environment, so noise has to be as low as possible for every user and people and animals, everything living around a project*," P3), participants also considered those effects on users, particularly referencing the word "quiet" to refer to the ideal sound environment: "*It's important because the quietness, the peacefulness. You are living; you have a house, you want to have some quietness*" (P6). The most commonly discussed negative health impact of noise, presumably from lack of quiet, is considered to be annoyance[6], which can be addressed through broader planning and design measures, reinforcing this notion of noise as an environmental problem: "*With the motorway, we plan certain traffic amounts.*

[6] Annoyance is a public health concept in that it is characterized by expressing the percent of the population that is annoyed by a sound source or a sound environment.

Sometimes, we try to downscale that because of the noise at the existing dwellings along this road" (P17). Ideal solutions include separating conflicting uses and users with distance (N=5).

When: Approaching noise as a threat to health largely takes the "when" variable out of the equation as it is conceived of as being a constant threat, especially to projects in sensitive zones, and extra care may sometimes be taken during the period when a project is under construction. One participant spoke of very long-term planning and the persistent threat of noise pollution:

> *"If you check the map, you can see if there's no green, or you see ugly buildings, but you don't see noise pollution. It's quite important, you have to consider it all the time. With our highway, we have a lot of noise. It's a problem for, I think, half of the city. So with new plans you always have to check how the building is positioned. We also decided to build no schools or nurseries in the neighbourhood. What is in the plan for 2050? We dream about covering the highway. But that's a dream…But then maybe there will be no noise pollution anymore because all the cars will be very quiet" (P2).*

Outcomes: Under A2, a poor sound outcome will be "*not good for health*" (P18) and a good outcome is that the project's envisioned users or uses would not be harmed. However, what is meant by avoiding health-related harms was not straightforward; one participant stated that their outcome was mixed because, despite achieving "good" outcomes internal to the project, adjacent noise sources were still present and somewhat problematic for the future:

> *"on the one hand, yes, it looks like the neighborhood will be a quiet one. On the other hand, the noise protection from the airport, that's a question. That's something that we will see in the future if the people who build there had followed our advice. Then I think we won't have any complaints. If they haven't followed it, perhaps in the future, we will have some complaints from people who are annoyed by the planes passing by night"* (P1).

Participants often implied that their project did not necessarily make sound that required consideration, but rather that their project was (negatively) impacted by "outside noise" – sound coming in from outside of the physical envelope of their project (N=11).

Agency: Unlike A1, those using A2 could more easily articulate possible investments in their ongoing project should more resources become available: completely remove a railway (P10), purchasing land and moving sources far away (P16) or covering a submerged highway and improving public transport (P2). Nevertheless, participants using this approach largely saw the noise pollution as coming from outside of their project, so they did not feel that they could change much beyond protecting their space's users.

Approach A3: City User Experience

The third approach, A3, is oriented around the experience of the city-user and relies heavily on evaluating and understanding the physical, cultural, and built environment (i.e. context) in which the project is situated before determining the quality of an outcome. It is by far the least referred to of the approaches and proves to be the most difficult to disentangle from the previous two. City user experience entails a complex relationship between user, context, and outcomes; and this relationship suggests that a fuzzier boundary is needed to operationalize the way the differences between the object- and human-centered

methods are operationalized in a project. Nevertheless, we still attempt to make the distinction to draw parallels between the different approaches.

Table E: The Hows of A3: City User Experience - an approach motivated by the experiences of city users drawing, necessarily on the relationships between the user, the context, and the sounds made by sources.

	Decision Criteria	Evaluation Methods	Sample Quotation
Approach A3 – City User Experience	Complex • quality • interactions • evaluations from "city users"	**Object - Centered:** Achieving balance between sound and other factors in a "good" plan or design, Encouraging or discouraging the presence of certain sound sources (sound makers, sound-producing agents)	"*The best outcome is a balanced approach. That's also part of sustainable design, finding a way, the project as a whole is a strong project, that's giving an appropriate answer to every aspect...For acoustics, it depends on the moment of the day. When people are all sleeping, it has to be quiet… During the daytime, you do want some noise, for instance, on the shopping street with people shopping, but you don't want the noise of the car, of the bus passing by because that's impacting the environmental aspect of the quality of the shopping street. So, yes, you'll want to have some noise at certain times*" (P3).
		Human - Centered: Achieving experience outcomes (e.g. pleasantness), Planning/Designing sound environments that respond to activity and space use	"*That everyone is happy. Noise levels are just numbers*" (P8).

Explanation: In this approach there is an underlying assumption that cities make sound and that "no noise" wasn't possible (N=6), unlike what was observed in A1 and A2. In A3, the focus shifts from away from the noise encountered by users in indoor and private spaces towards a broader understanding of the environment, with public space taking a central role in mediating experiences. Thus, A3 was the only approach where a participant would explicitly refer to the relationship between the designed space and its surrounding environment in framing experiences: "you need to think about what you're doing in the space and how that will impact the neighboring programs. So if you create a place where there are going to be rock concerts, how does that impact the businesses that are right next door. It's reciprocal. You need to think both ways" (P21). A3 was also the only approach to regularly articulate sound experience outside of dwellings.

More nuanced aspects like temporality and a deeper understanding of activities (compared to A2 which only relied on broad categories like residences and offices) is also clear (see P3 quotation in Table D above). Participants using A3 sought a vaguer desire for 'quality' rather than quantitative assurances that they had succeeded in considering sound.

Key Concepts: Participants often stated goals that expressed the relationship of the sound-related factor to other non-sound factors or the project as a whole, such as wanting the space to be "well designed" (N=8). Other key concepts also reflect overall evaluations of the sound environment by the user (e.g. "pleasant"), or feelings that the user has while experiencing the space (e.g. "happy").

Evaluation Methods: As A3 is necessarily centered on the user experience, purely **object-centered** methods were less common. In this sense, when referring to sound levels, two participants stated they should be "acceptable"; in general, however, in this approach, object-centered methods referred less to exclusively physical measurements of sound, but rather to on describing the sound sources that would be suitable or unsuitable in certain contexts: *"attracting positive noises [like] fountains"* (P22). One participant spoke of seaside wind noise and seasonal bird calls as technically louder than airplane and highway noise, but stated that residents don't mind it because attitudes towards individual sound sources can modulate people's annoyance to them (P1), acknowledging that the methods should go beyond focusing exclusively on sound levels. Another method referred to evaluating the extent to which a sound environment (in its totality) would or would not distract users who were trying to use the space: "It's important that either residences or bars have outdoor spaces, that they be oriented in a way that will not be harmful to others, in terms of space use. So, to allow for noise, but placed in a way that will not bother others"[7].

The **human-centered** evaluation methods were described in terms of perception and experience: "I want people to be able to have a conversation" (P21). Participants also expressed a desire to achieve their goals in a way that showcased their creativity and the individual features of their project. Related to these concepts, some participants implied the potential for positive outcomes, such as the audibility of positively perceived sources ("*if you hear birds singing*," P11; "*it could be that [airplane] noise is a positive thing for certain people. You need to give people that possibility as well*," P19). Other themes were based on the satisfaction of the users ("*That everybody's happy*," P8), and for the appropriateness of the sound environment for the setting or activity:

> *"The best outcome is that you've managed the acoustics to achieve whatever goals you set at the beginning of the project, and that's very vague, but, acoustics can mean lowering the noise or they can mean creating a place that's really good for projecting noise or music. So it depends on your criteria" (P21).*

Even more than in the other two approaches, participants **blended their evaluation methods** between object- and human-centered. This blending usually reflected the strong relationships between the space, its users, and the specific activities they were conducting ("*A balanced, sustainable approach. It's quiet when people are sleeping, good noises for shopping*," P3), while also leaving room for positive evaluations of the space that go beyond nuisance and annoyance reduction ("*Not too quiet, full of good noises. Make people smile, human interaction*," P22).

Outcomes: Within A3, outcomes arise from more diverse criteria, as seen in the above quotations. "Good" outcomes include the desire for the space to be pleasant for users, or for people to *"enjoy living at home"* (P15) as well as ensuring that the resulting sound environments did not detract from a project's stated

[7] « *C'est important qu'il y ait des espaces extérieurs, sur les résidences ou les bars, tout ça, qu'ils soient orientés d'un côté qui ne soit pas nuisible pour les autres. Sur l'usage. Donc, de permettre du bruit, mais qui soit placé de façon pour pas déranger les autres.* »

design or planning goals. However, when compared to A1 and A2, there were fewer ways to confirm that certain criteria had been met and participants often acknowledged this themselves: *"but how do you measure…being able to hear the birds?"* (P11), or in reference to the intense resources required to determine if users are "happy".

More so than in A1 and in A2, participants acknowledged the relationships with other design and planning considerations, with one participant pondering how poor sound experience outcomes could even be bad for the local economy:

> *"if you can't have a conversation in a public open space, then you don't really want to be there...if you can't read a book, or if you can't just have some quiet, it's a problem. And then the other issue is, if there's too much noise happening in an open space, and there are too many voices reverberating around, maybe that's having a bad impact on the neighboring businesses" (P21).*

Finally, relating to the previously mentioned interest in achieving multiple design goals, one participant offered their perspective about blending acoustic expertise with their own expertise in landscape to achieve a better outcome than what individual, isolated considerations would have achieved:

> *"I designed basically a big dike and put big cuts in it. Where I needed my help from noise engineers was to find a certain angle that would take away the noise. If you build it up that high and compensate it this way, it created a very pleasant park landscape that not only reduces the noise that also creates a space for people to go and just be outside. So, it wasn't a noise barrier, but it became a park because of the way we designed it, because of the way it interacts with the environment and the way it interacts with the negative elements, turning it into something positive. Not only do you have the noise engineer, but also an engineer that tells you how high you can build up a hill. Me, I know that I can plant grass on it, but there's only so many grass species that will grow, for example, on a northern slope on an angle" (P19).*

Agency to change: Despite the difficulty in ensuring a desired outcome, participants using A3 reported having a high agency to change it. Some touched upon how the relationships between other planning and design considerations like program, function, zoning, human behavior, local ordinances, transportation, materials, and aesthetics allow for many simultaneous ways to address sound (P3). Participants found it easy to be creative about ways they could use resources to move them toward their experience-related goals: putting a buffer between activities (P1), reducing unpleasantness and other residential impacts (N=3); using extra resources to have fewer streets and "better outcomes through good planning" that wouldn't require technical interventions (e.g. noise barriers) (P12); "create a quiet zone" and implement strategies to "lessen impact on the neighbor", especially using integrated landscape architecture solutions (P21); and intentionally using or accentuating "positive" or "attractive" sounds like sea sounds and other natural sounds.

When: The time dimension of this approach was the most flexible, a flexibility that in itself posed challenges in terms of resource-intense considerations and that couldn't necessarily be solved in one go. Take P19, who had chosen "soft, absorbent materials" to achieve a quiet space, in particular dampening the sounds of a tram line, only to later have the materials change because of a fire safety concern. The change necessitated a revisit of the sonic dimension of that space, but ultimately the sound-related factor did not get priority.

And despite it not being necessarily part of the outcome of the project in itself, reflecting on user experience was also necessary during the project construction phase:

> *"We recently changed our hours during which we can do work. A contractor can't start construction work before, I believe, 7 a.m. […] So, it's still just ensuring a quality of life. So we always reflect on the noise level"* [8] (P4).

Switching approaches

The same participant could be found going between all three approaches in different moments of their discourse, especially when it came to the vocabulary and metrics on which they relied. Further, as we make clear in the discussion, the switching between approaches may serve as an explanation for the persistence of the noise-sound dichotomy. Thus, we suggest that one participant does *not* correspond directly to a row in Table B but can rather be inspired by the various approaches as their projects and work contexts allow or require, often even switching between approaches within the same project.

As an example of our coding and classification, take the following participant, who described almost all of the approaches and methods while explaining typical problems in their district:

> *"Airplane noise, I wouldn't say we're not involved, but all the control is managed by the airport authorities. They have a lot of* complaints from citizens ***(A1 - human-centered)*** *about flight hours, the number of planes coming in. But we don't have any influence on that. The only thing that we can change about noise, is what the neighbors are using like* heat pumps, pool filters ***(A1 - object-centered)****, and things like that. All the noise that is caused by construction – we have limitations about the fact that you can't start until a certain time in the morning, you have to end it at a certain time in the evening* ***(A1)****. The ambient noise level of certain sectors of the city because of the [highways], because of the train, things like that – they say that you should keep a* 40 dBA level ***(A2 - object-centered)*** *in order to* live quietly ***(A2 - human-centered)*** *and healthy* ***(A2)****; but the ambient noise, even at night is 50. So we have a bylaw and an acoustics specialist saying that if you are exceeding the ambient noise by 5 dBA, you create a nuisance* ***(A1, A2)****. An example, suddenly your neighbor installs a heat pump and you say, "Every time I go outside with a picnic, I have to hear that. And it's causing a nuisance"* ***(A1, A3).*** *OK, you complain. So, what we're doing, we are measuring the level of ambient noise while it's off and while it's on* ***(object-centered)****. So we have certain control but it's not easy to apply. I can tell you that even if we measure at 4 or 3 dBA,* the neighbor will still complain ***(human-centered)****."* (P6, emphasis without italics ours, text in bold our interpretation of the response).

This participant touched on the many conflicting aspects that we attempt to address and organize in this paper, including a motivation to follow laws and procedures, to provide for the health of the people of the city, and to foster a positive living experience for city users, while acknowledging the complexity of living in an urban context. This information is conveyed through measurements of the sound (like sound levels in dBA) and through feedback from people (like complaints).

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[8] "*On a modifié dernièrement nos heures pendant lesquelles on peut faire des travaux. Donc on est venu limiter. Un entrepreneur ne peut pas débuter ses travaux de construction avant je crois que c'est 7 heure le matin. […] Donc, c'est quand même juste s'assurer d'une qualité de vie. Donc le niveau de bruit est toujours réfléchi.*"

Given the on-the-job nature of sound learning (see (Steele, 2018)), it is therefore not surprising that approaches are subject to mixing in practice, often driven, we contend by a disconnect between the motivations that drive PBEs to engage with sound and the methods and criteria they have available to do so. Considering that PBEs often lack a noise-related component in their education (see section below), irrespective of their motivations, they might choose to defer to the expertise of acoustic, especially acoustic engineering, professionals who tend to provide object-centered advice (see (Steele, 2018)). For example, this can happen in situations straddling the line between the policy and the public health approach: while the law is inspired by public health considerations, PBEs treat its fulfillment as an item off a checklist.

We've identified a number of explanations behind this seeming overlap between approaches and their operationalization and the fact that PBEs go between them:

1. PBEs have not been provided with clear or comprehensive goals for why to work with sound (either through legislation, in their educational background - see the Contextual factors section below - or as part of their projects' mandates):

   "[the best possible outcome for noise is] that you don't hear it…or that it doesn't bother anyone" (P20).

Another participant states, somewhat unsure: "*You [have to] meet the law. And even the law might not be good because we do not really know the long-term effects of noise on health. I mean, we do know it, but not all, I think*" (P18).

2. PBEs' practical experience can lead to confusion as to what and why they are using object and human-centered methods (e.g. the relationship between acoustic measurements & values and complaints):

   "*Annoying noise comes from lots of sources. It's like air pollution. It doesn't translate well to planning issues. One of the issues with noise also is that noise is something very, on the one hand, objective, you can measure it, but on the other hand very subjective, because your attitude towards noise can be very different. We already made some measurements of noise at the seaside, if it's quite windy, the noise level is very high there. But everyone who is living at the seaside doesn't care. But you have objectively, a noise level that's higher than along the highway. But that noise, we don't care. We think it's not disturbing us. The other one is disturbing*" (P1).

3. Practical reasons emerged throughout the project and required adjustments to the prioritization of the sound factor.

For two participants, the priority of sound changed drastically during the project for very different reasons and in different directions. For one, sound had been playing a very minor role in design considerations until their client realized the project's proximity to industrial noise sources would mean that no one would buy a house there after it was developed; after this, sound quickly took a much higher priority (P10). For another (P19), sound had taken an important role in the design phase, leading to a choice of sound-absorbing materials that was later rejected due to fire safety, which lowered the priority of the sound-related factor in favor of a more immediate and tangible safety concern (and causing, in the participant's opinion, a reduction in the project's overall quality).

Contextual factors

The three different approaches detailed covered many types of locations, contexts, organizations and other differences. It is worth questioning whether, for example, if being a landscape architect turning a barrier into a park (Section A3) gave the participant more freedom to pursue a more 'creative' solution than those who might be more beholden to public health considerations through public sector work. In this section, we report on the various contextual factors that we've identified as underlying participants' various reasons for pursuing each of the three approaches. See Table F for a summary of these factors.

Individual factors

Along individual factors, **education** appeared to play a major role in each participant's approach: those with graduate degrees (N=13) used A2 and described object-oriented methods, particularly noise levels in decibels. They reported less need to know about factors that were outside of their primary responsibilities and tended to be more satisfied with their project's sound-related outcomes. They were more likely to express the inter-relatedness of sound with other planning and design considerations and had concrete ideas for improving the sound-related outcomes if more resources were available. Those also associated with academia (through PhD programs or teaching) (N=5) were the most frequent users of A3 and tended to report a high priority for sound, while also being less likely to believe they had achieved the best solution for sound.

Participants also reported being from a broad array of **fields and disciplines**, including urban planning (N=17), architecture (N=7), urban design (N=5), and landscape architecture (N=2). This factor played a role in the conceptualizations, presumably guided by both education and on-the-job experience. Urban planners were the main users of A1 and A2. They emphasized not needing to have "technical" knowledge (9 participants) about sound and were also were more likely to not consider a poor sound outcome bad for their project (only 3 of 17 planners). These planners were less likely to have considered sound on recent real projects (only 10 of 15[9], accounting for all but one of the recent projects without sound considered). Architects and landscape architects, meanwhile, rarely used A1 and instead relied on A3.

Those who had the most **years of experience** (mean=16.1; median=15; min=0; max=34) were the most likely to use object-centered methods on their projects, and also to assign sound a higher priority in their work. This was presumably because of real-world experience with not meeting objectives causing more serious issues on real projects. On the other hand, those with the least experience used A2 more often; we presume that those with little experience (i.e. recently graduated) had conceptualizations that relied more heavily on their education rather than experience. This appears to be reflected in the data as it is more recent educational tools and broader national and international policies framing noise as a public health problem.

Locational Factors

All the participants worked primarily in the same country where they were trained; only two were working on international projects at the time of their interviews. Participants from the European countries studied (N=12) nearly uniformly considered sound as "noise" and a sub-factor of environment (A2). These

[9] 15 of the 17 total planners had a recently completed project to discuss, see Appendix.

participants also considered it a high priority, due presumably in part to stricter laws at local, national, and international levels. Participants in Canada and the US used a wider array of approaches, in line with a more diverse range of motivations, e.g. avoiding complaints or making spaces "pleasant"; however, they also reported having a lower agency to address sound issues that arose.

Organizational factors

The **size of the organization** was strongly linked to available methods. Those from small cities and firms (urban population < 100,000 or office < 10 employees; N=4) were expected to have more knowledge about sound, while those from larger cities and firms (urban population > 500,000 or office > 50 employees; N=14) were able to rely on in-house and hired experts to advise on, measure and model sound-related problems. However, these experts were largely acoustics experts who provided object-centered advice.

Sector also played a strong role in the choice of approaches. Those from the public sector (N=14) were primarily responsible for following policies and protecting city users from harm and thus relied more strongly on A1 and A2. Those in the private sector (N=7) were responsible for maintaining their businesses and satisfying clients and were freer to use the experience-oriented approaches available in A3. A slight exception includes those like P20 who, as a private-sector executive, needed to protect the company from lawsuits and was therefore motivated to use A1.

In line with the previous example, those in **positions of management** were motivated toward other methods. Private-sector executives (N=3) especially were concerned with showcasing creativity and building their companies' reputations, and used A3 as well as human-centered methods e.g. "I just want people to be happy". Those not in positions of management were usually tasked with the details of satisfying the law or for assembling comprehensive designs and plans and thus relied on A1 and A2 as well as object-centered methods that reflected the role of sound on a checklist of legal responsibilities.

Table F: A summary of the primary users of each approach

Approach	Primary users
A1	Public sector Urban planners (conflated with public sector)
A2	Professionals active in Europe Public sector Graduate degrees (conflated with Europe)
A3	Landscape architects Architects Executives

Discussion & Conclusion

The contributions of this study are three-fold. We first identified three approaches used by PBEs to consider sound in their projects, namely policy, public health, and city user experience. We further operationalized these approaches according to the key concepts, decision criteria, and evaluation

methods that frame the motivation to consider sound in practice. Finally, we reported on contextual factors (at individual, locational, and organizational levels) influencing these different approaches.

This is an original research article, reporting empirical findings, but it also serves as a position paper. The question is not so much whether various professionals of the built environment are aware of the effects of sounds on everyday life. The fact that urban sound matters is established in policy, public discourse, and research. The question is rather how to consider sound in practice. Most urban life happens at sound levels between 'airplane taking off' noisy and a 'whisper' quiet, but those trying to handle urban sound in between these two extremes have little guidance.

Our research question was *why* PBEs think of sound in their everyday work, followed by *what* and *how*. The findings were structured into a series of motivations that guided approaches operationalized with methods: 1. policy (where sound outcomes are operationalized as a binary), 2. public health (operationalized along a continuum) and 3. city user experience (more complex to operationalize). All of these approaches function under a number of situational constraints and are influenced by individual factors. As explained, PBEs also freely navigate between all three approaches, even within the same project. Acknowledging these approaches, the fact that they are not mutually exclusive but rather allow PBEs to switch between them, and documenting the factors that encourage the use of approaches is an overdue step in paving the way for future conversations on sound in the built environment that 'meet in the middle' between the research and (built environment) professional communities.

We showed that PBEs share the policy motivation in their work, using A1 across the board and A2, to a lesser extent, thanks to a combination of work responsibilities, protection from consequences, education, sector, and other experiences. The way in which they think of sound is also influenced by their policy framing, both in national and local contexts. For example, the European Noise Directive from 2002 (Cerwén & Mossberg, 2019; Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 Relating to the Assessment and Management of Environmental Noise., 2002a) frames noise as a public health problem (A2) and requires all large municipalities in Europe to produce noise maps and make a noise plan. The use of A3 entails largely intuitive and creative purposes and is associated with a perceived high agency to change, but few clear and established *hows* are available to guide and defend PBEs in their use of this approach. A3 is complex, relatively new, and uncommon while also not being backed by existing policies, good practice guides, or even proofs of concept; hence PBEs find it difficult to disentangle it from the other two approaches to implement and evaluate. We are reminded of the academia-practice gap referenced in the introduction, with soundscape research not only lacking in uptake by urban professionals but also with researchers failing to mobilize the body of work (Aletta & Xiao, 2018). Indeed, object-centered methods using A3 are a mature research area (e.g. see Ricciardi et al. 2015), yet most of these indicators have not been mainstreamed into policies used by PBEs. PBEs however, show a need for and openness to criteria and measures that could help them use A3 in their everyday work. The bottom line is that even if PBEs have an understanding of the importance of sound for urban life, the tools and instruments available to, and particularly work-related demands required of them often limit their implementation to a checklist. Some existing methods required by policy are even confusing: PBEs are obliged to measure the sound levels of sources that cause complaints, but does that make the annoyance of the complainant any more or less valid?

Is sound important to PBEs?

Our participants largely agreed that sound is important, but mostly for the risks that it poses to their projects. Neither A1 nor A2 emerge from an idea that projects themselves make sound, but they instead

imply that users generally require protection from sound, especially in private, indoor spaces. Only A3 users acknowledge sound as an element in a mutual relationship - I exist within an environment of sound and I also contribute and am part of it – and was the approach that emerged from an interest of the experience of public space users. One previous study, Pijpers-van Esch (2015), had shown that for Dutch urban designers, 'noise' was a high priority relative to 'other' environmental pollutants (A2) like soil and water. Another study showed differences in how sound was considered across types of stakeholders, such as how PBEs, especially compared to residents and policymakers, focused on communication and integration of sound considerations over specific technical knowledge (Yildirim & Arefi, 2020). But this is the first study documenting how PBEs specifically, address the priority of sound across multiple approaches (such as A3). Given the dearth of information about the use of sound by PBEs and based on a review of the training materials, we suggest that professionals are likely learning more about noise on the job rather than through their coursework, and then they defer to the (often limited) information and tools provided by noise and related policy, and through their peers and occasional interactions with acoustic engineers (but no other type of sound professional).

In this on-the-job context, the use of new approaches and strategies from research remains understandably scattered (e.g. see Taylor and Hurley 2015). The sound literature summarized by Bild et al (2016) established how soundscape approaches and noise control strategies are often put in opposition. Our three-approach framework partially fits that idea, with noise control tending toward operationalizing problems articulated in A1 and A2 and through using object-centered criteria, while soundscape tending toward operationalizing A3 and human-centered criteria.

Nevertheless, sound continues to be positioned as a dichotomy: noise v. sound; noise control alone v. soundscape design (Kang, 2006), noise as waste v. sound as resource (Schulte-Fortkamp et al., 2007). We propose that this dichotomy does a disservice to the complexity of the sound issue for PBEs, who are responsible for integrating multiple notions of sound into a coherent plan full of other considerations. As researchers wedge the interventions they evaluate into negative (noise) versus positive (sound) approaches, they risk sidelining the many creative experiential interventions that were enacted under the umbrella of the noise paradigm (e.g. the aforementioned dike-park project); further the forced dichotomy also ignores the reality of the policy framework to which practitioners are beholden, a framework that also protects PBEs and their projects from risk.

The three approaches outlined in this study suffice to explain that which is lacking: sufficient tools and policy to implement anything but noise mitigation through decibel reductions. Policies play a very important role both in PBE's motivations but also operationalizations of sound, and thus in their choices of approaches. Policy acts on those *whys* and *whats,* informing PBEs about the motivation for engaging with sound at a higher, conceptual level, for example in terms of health, quality or others, defining thus the orientation that PBEs should take in their work. The policy approach (A1) is obviously attractive in that it allows PBEs to check the checklist and move on to other considerations. However, as mentioned by participants themselves, policy does not always articulate the 'whys' and the 'hows' at the same time, and PBEs feel ill-equipped to work with sound beyond sound levels. It could be suggested that improving policy with research-driven initiatives may be a path to changing PBEs' approaches to sound in their work.

With this paper, we return to the academia-practice gap and argue that, besides raising more awareness towards policymakers in further establishing the role of sound as a complex factor interrelated with all the other dimensions of urban living, our attention can also be shifted towards other types of educational or creative strategies. One such avenue could be additional attention paid to developing more contextually relevant guidance for PBEs based on various individual and situational factors, outlining clear

hows to address everyday sound-related tasks. That needs to be done in a manner making the benefits of doing so immediately 'visible', measurable, and actionable. Another avenue could be integrating other well-documented approaches to sound that were not emergent from these interviews with PBEs, but that considers other perspectives on sound like those from Arts (see Guastavino et al., 2022), or Heritage (Laplace, 2019). They could be used to expand arts inclusion initiatives in order to bring sound artists to change the experience of places, and to highlight the sound heritage of places. These approaches can contribute to broader economic and cultural goals, as well as support sound awareness and public outreach. We can also expand the existing Public Health perspective to not just focus on the population level, but to also consider groups who are vulnerable and have special needs, such as children, low-vision, and hearing-impaired city users.

To conclude, this study demonstrates that professionals of the built environment have overlapping motivations for considering sound in its complexity. However, in practice, they have to rely on a limited set of methods available to them, especially those informed by policy. We propose ways to embrace the hybrid nature of the three outlined approaches, to further consider other approaches, and to articulate approaches, motivations, and methods. This line of research should pave the way for a better integration of sound considerations in urban practice.

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Appendix

Interview Guide

1. **Introduction**
   - 1.1. What is the name of your position?
   - 1.2. Can you tell me about the role of your position in the Canadian context?
   - 1.3. What sorts of things do you do on a daily basis?
   - 1.4. What's the structure of your department?

2. **Conceptualization**
   - 2.1. What sorts of considerations do you make about sound when you're planning for a new place?
   - 2.2. Is sound something urban planners are expected to know something about?
   - 2.3. What role do consultants or internal experts play in your decision-making process about sound?
   - 2.4. Can you give a realistic expectation of the priority that sound gets relative to others?
   - 2.5. If there were something wrong with any of the specific considerations regarding sound, how would it play a role in your evaluation of the whole site?
   - 2.6. What is the best possible outcome for sound? What would that look like in a city?
   - 2.7. What do you feel you have the agency to change regarding sound?

3. **Contextualization - Project 1 (recently completed project):**
   - 3.1. Intro
     - 3.1.1. What was your role in this project?
     - 3.1.2. What is the make-up of the team and its expertise?
     - 3.1.3. What were (some of) the major considerations for this project?
     - 3.1.4. Were you satisfied with the final outcome? Was your team satisfied? If they say no, follow up.
   - 3.2. Sound
     - 3.2.1. How did sound considerations get operationalized? (i.e. was it considered?)
     - 3.2.2. If sound was considered:
       - What weight did sound receive relative to other concerns?
       - Did you bring in internal or external expertise for sound?
       - Was there any element of public consultation for sound?
       - Are you happy with this specific outcome for sound?
       - What could have been better?
     - 3.2.3. If sound was not considered:
       - Should sound have been considered?
       - Was sound left out for only this site plan or rather in general in (Montreal, etc.)?
     - 3.2.4. Did the sound outcome have any role in your evaluation of the whole site?
     - 3.2.5. How did the decision-makers on this project take sound into account?

4. **Contextualization - Project 2 (in progress):**
   - 4.1. Intro
     - 4.1.1. What is the goal of this project?
     - 4.1.2. What is your role in this project?
     - 4.1.3. What are some of the remaining issues to be solved before it is built?

4.1.4. Have you consulted any experts outside of the team?

4.2. Sound

4.2.1. How is sound factoring into the decision process?

4.2.2. If you had unlimited resources to work on this particular sound issue, in a perfect world, what would the outcome be?

4.2.3. As the resources become constrained, what are the first things to be cut regarding sound?