# Representing soundscapes? Situating sound maps and their methodologies in the context of a student-led course

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## Introduction

Mapping an ephemeral phenomenon such as sound is a methodologically challenging endeavor. Facilitated by new technological developments and the rise of internet cartography, today there are numerous novel approaches and proposed methods for visualizing sound. The history of sound mapping reaches back centuries, a relevant fact as it has shaped common taxonomies and 'structuring orders' of sound studies up to this day (McMurray 2018). Amongst these, the conceptual relationship between 'soundscape' and 'cityscape', a term coined within Urban Studies. In this essay, a very brief state of the art of sound mapping will be conducted, highlighting the relevance of phenomenological approaches that either can inform sound mappings or conduct a sound mapping. Later, a series of sensorial maps conducted by the author in a public square in Berlin will be discussed in order to present an outlook on potentials and limits of replicating this approach at the TU Berlin campus. This discussion is situated in a specific context of the course, which, amongst others, is the study of spatial geographies of sound within the student-led project "SoundscapeTUB" at TU Berlin and to reflect on the prevalent challenge of representing sound.

## Mapping sound: history and current projects

Today, sound mapping is most commonly associated with mapping practices aiming at a 'literal cartography', in which recordings are complemented with geodata and appended to a map and their frameworks (McMurray 2018: 2). While this technique seems to be the most widespread practice today, its principle of 'mapping of' is only one of many possible principles, such as mapping 'in', 'by' and 'about' (ibid: 3). Technologies widely used across industries such as hydrophony and SONAR as well as techniques commonly studied in linguistics and ethnology, such as linguistic atlases and inscriptions in language (e.g. through accents) can be considered as mapping 'by' and 'about' sound (ibid: 7). Large archiving institutions such as the Berliner Phonogramm-Archiv complement the efforts to preserve sounds and facilitate further research (Koch et al. 2004).

A large sector of research on sound has focused on sounds in cities and concretely, the contribution of sound to the dimensions of urban experience, activity and form. Often inspired by the seminal *The Image of the City* by Kevin Lynch (1964) and subsequent contributions, many urban scholars research the spatial geographies of sound in urban settings and their changes over time. When it comes to visualizing findings in a cartographic way, the challenge of appropriate ways of representation inevitably needs to be addressed (McMurray 2018: 11). The most influential writing dealing with the challenges of representation and offering a heuristic and method for urban sound mapping was written by R. Murray Schafer (1977) in *The Tuning of The World*. This work incorporated the concept of 'soundscape', understanding the perception and influence of the acoustic environment on how humans understand and interpret their surroundings. Schafer's work greatly influenced techniques of acoustic data visualization and attempts at systematically representing sound environments in different urban spaces. Today, thanks to readily-available mapping platforms and geospatial data, sound mapping is a well-established field. In order to make sense of the sound mapping landscape, it can be analyzed as a "discursive system of practices, representations, values and power." (Droumeva 2017: 4). Several projects, many of which can be understood to be in the cultural heritage of Murray Schafer and the World Soundscape Project. These are often collaborative online platforms. The oldest and one of the most prominent platforms that need to be mentioned is Aporee. It features thousands of recordings of sonic environments contributed by a large 'community' – regardless of their nature yet avoiding large portions of music within the recordings (Fargier 2020: 84).

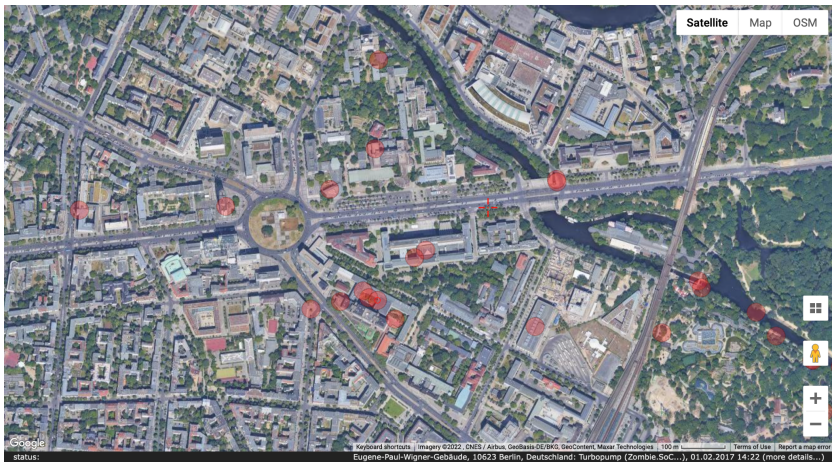



Fig. 1: Screenshot of Aporee map website. The frame shows the extent of the main campus of the Technical University Berlin, red dots indicate recordings and their location.

Displaying some continuities with historical and ethnological efforts of sound archives such as the Berlin library or the British Library, Aporee aims at crowdsourcing unfiltered and unedited, professional-grade recordings that are geo-located or 'pinned' on the Google Maps platform. While this is a particular framing that enables a dialogue between the situatedness of the recording and the 'detached' birds-eye view from the satellite imagery processed and represented by Google, its aim is not to offer an alternative cartography (ibid: 86). Moreover, the "geographic representations of sound become *de facto* documentary archives of place" using data visualization as a form of "popular tool for communicating sociopolitical information to the public" (Droumeva 2017: 4).

Several scholars have highlighted issues that potentially undermine the 'participatory' and 'democratizing' ambitions of these projects, such as knowledge and access barriers – contributors need a certain level of technical skill and have access to quality recording equipment and so on –, the digital divide and lack of perspective diversity (Droumeva 2017; Fargier 2020; Samuel 2018). In any case, these examples do not explicitly address a dimension that is at the core of a course dealing with the social and perceptual dimensions of sound, although there is a growing field that is attempting to approach sound maps differently (Siepmann et al. 2020). For the purposes of this essay, the focus shall be put on the issue of 'how to represent sound environments' and discuss a possible path for 1) approximating sonic environments through (partially non-sound related) data and 2) by implementing a digital questionnaire for assessing the soundscape. This is based on a phenomenological tradition of approaching sound and mapping: instead of the audio signal itself, the focus lies on the perception of audio signals (in relation to other types of signals, e.g., visual ones). This argument is inspired by the insight that "the signal alone cannot explain in depth and quite clearly the richness of sound perception." (Schaeffer 1996, cited in Vogiatzis & Remy 2014: 422). This signifies a clar shift from the approach of locating sounds and recordings on a map, towards a more sensorial cartography which accounts for several dimensions of perception, acknowledging the interplay of senses shaping the overall perception. This is a dimension that is tendentially overlooked in planning, as the standards adopted by authorities usually focus on sound modeling as well as quantitative indicators and methods (Radicchi 2021). The mappings shown in the following section adopt a hybrid position between (a) the more traditional, Euclidian approach to map-making and (b) atmospheric mapping. The latter is more informed by a not strictly representational approach to audiovisual cartography. These forms of maps should be considered in a process of methodological refinement, yet they are assumed as appropriate to the specific context for which this essay is written for. The maps shown are

based on a pilot study conducted by the author during the spring and summer 2022 at a public square in Berlin-Kreuzberg.

**Context of SoundscapeTUB course and goals**

The SoundscapeTUB course is a student-led, multidisciplinary course aiming to understand, represent and improve the soundscape of the TU Berlin campus, located in a central area in the West of Berlin. Its overall goal is to "explore the concept of acoustic ecology, the relationship between people and their environment mediated by sound. The interaction environment of the TUB campus can be used as a social and sonic commons model; as a space where many people share an acoustic environment and can hear the effects of each other's activities" (SoundscapeTUB semester report 2022). Spanning over 4 semesters and including students from multiple disciplines, ranging from Acoustics and Physics to fields such as Environmental Studies and Urban Design. The course's aim is to document the soundscapes of the university campus, developing methods to analyze and assess sonic environments of different types present on the campus, thus combining theory with practical implementation projects and interventions by students. At the time of writing, the first semester was dedicated to preservation design while the second semester focused on measurements and interventions. Hence, this essay's discussion of cartographic sound representations is thought as a direct contribution to the body of knowledge that may facilitate an implementation on campus at a later stage.

**Approaching soundscapes through (open) data**

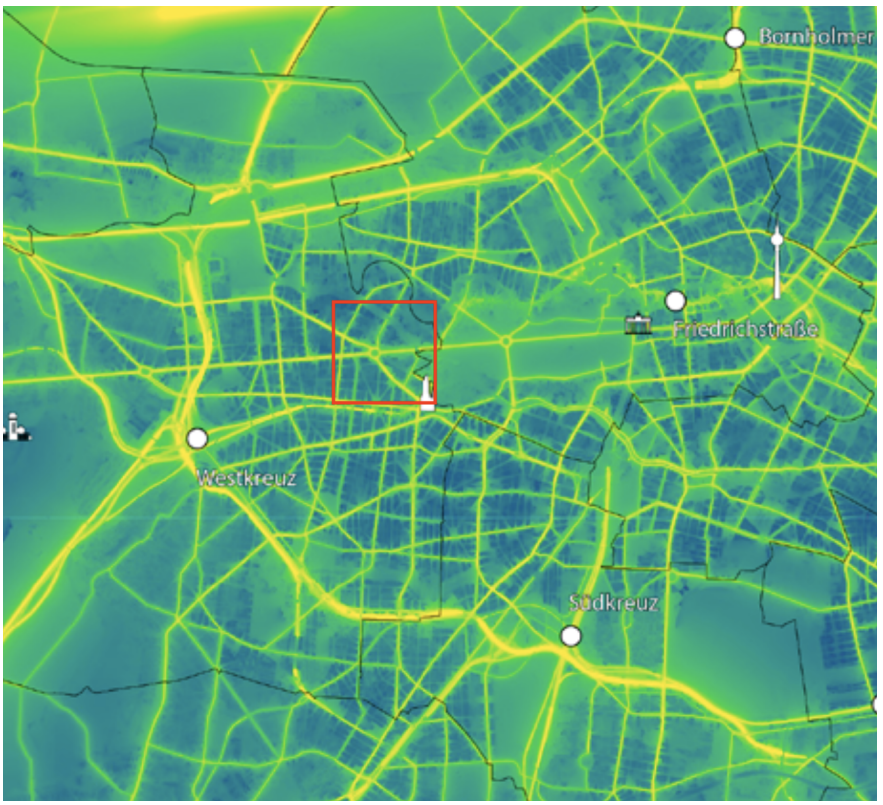
A phenomenological approach to understanding urban experience and soundscapes in the city offers the benefit of expanding the scope of study from sound 'itself' to other material dimensions that influence sound. Sound can only act within a certain environment and as an ephemeral physical phenomenon, it will be influenced by a multitude of factors (Radicchi 2021: 78). The assumption that was followed in the process of creating the following maps is that open data – and to a certain extent, proprietary data – can offer possibilities to visualize these influencing, interrelated factors. Hence, the maps take advantage of the high availability of geodata and to conduct exploratory data analysis. Additionally, the maps benefit from the comparably developed Open Data strategy and infrastructure of the city of Berlin, which made it possible to access a wide range of relevant data (raster images, vectors, text-based, tabular data) through the Berlin-owned tool "FISBroker". This data allowed the creation of basemaps, access demographic data and information regarding the built environment of Berlin. The data was downloaded or accessed through the WFS/WTS/XYZ protocols that allowed users to visualize and collect

the data directly through the open access mapping software QGIS. Another prime source was the vast, open-source spatial database of OSM (Open Street Maps). This data visualization process resulted in more than 100 individual mappings of Berlin, which in some cases show 'raw' data, and in others relied on extensive data processing and data correlation. The following maps are a selection of the maps created and categorized as indicative of or, respectively, showing factors that may influence the soundscapes of Berlin.

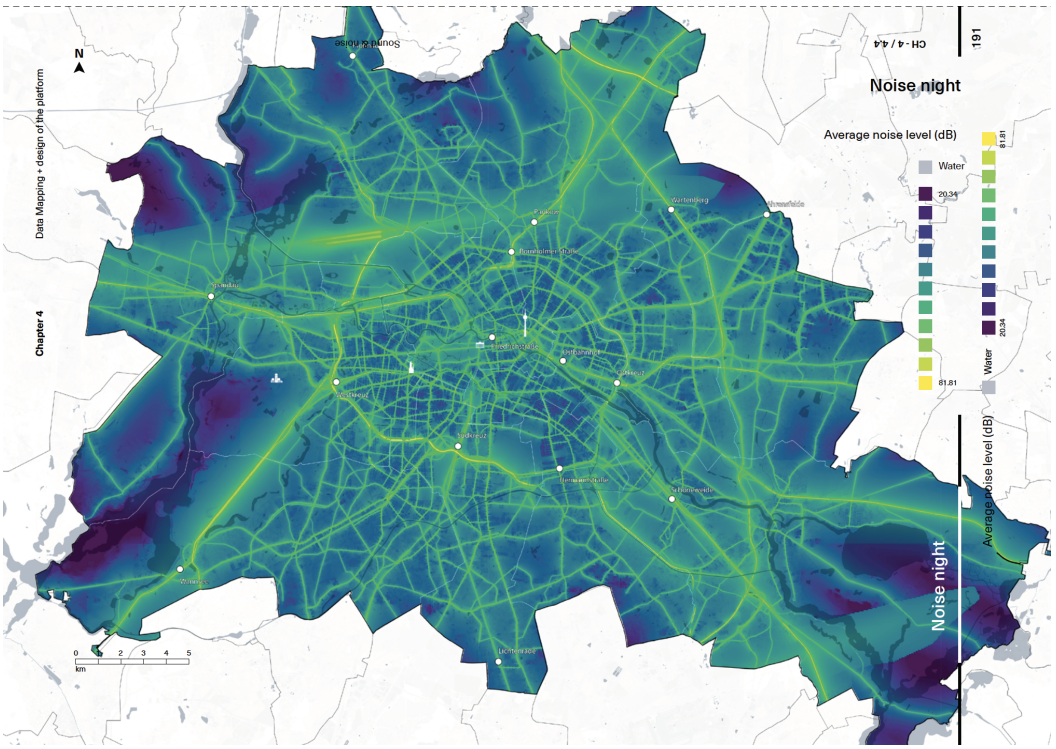
### 1) Noise maps

Many important contributions from environmental psychology have informed planning decisions and are based on a "basic assumption e.g. that the signal is the reference to any assessment of perception" (Vogiatzis & Remy 2014: 422). The following noise maps are based on modeling data commissioned by the Berlin municipality. While the data is in a sense 'hypothetical' and limited to traffic, rail and industrial noises, they give a city-scale outlook on where people may be exposed the most to undesired noise that has been proven to affect human health negatively. This information can be useful for anticipating certain sound levels in individual places, but on their own, they cannot inform soundscape creation and improvement.

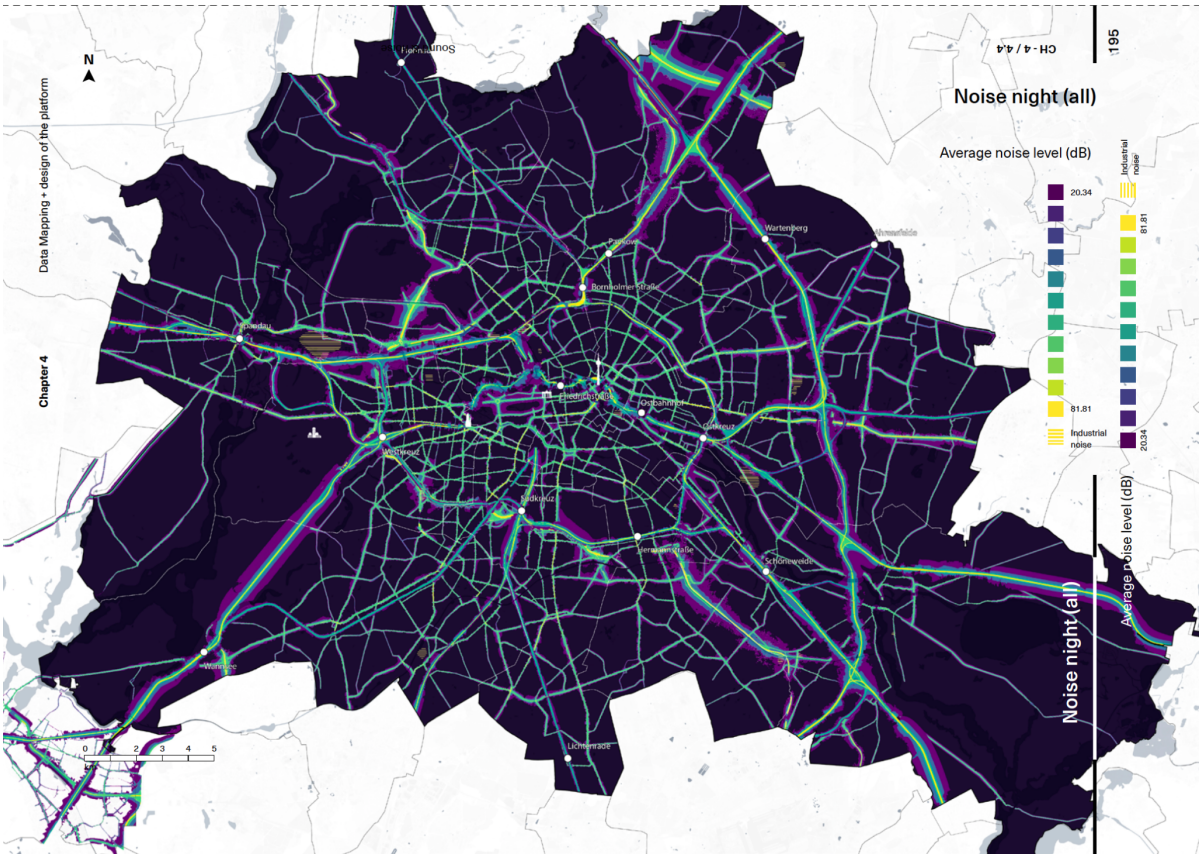

↗Fig. 2: Noise levels (Lden, combined sources in dB) in Berlin at day (2015) Source: Dilger & Kuznetsova 2022




↗ Fig. 3: Zoom-in of previous map. The red square indicates the location of the TU Berlin campus.



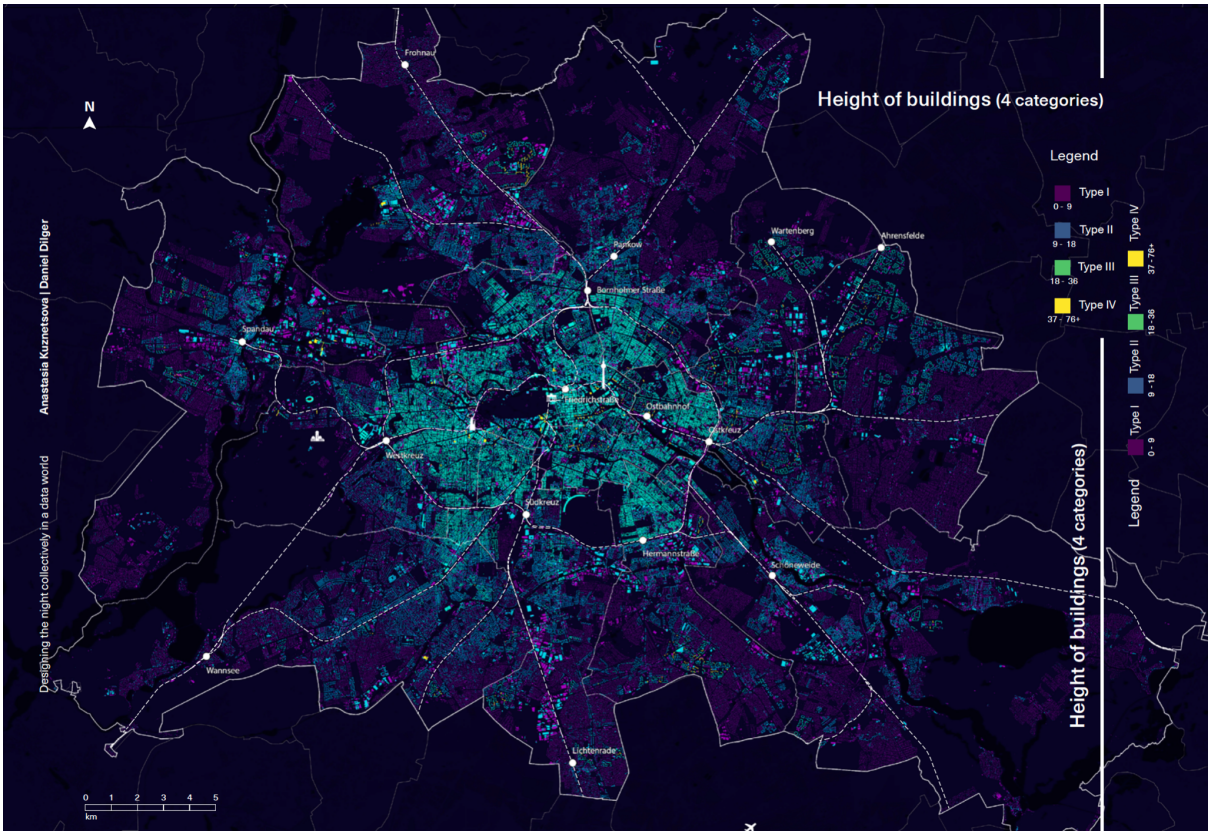

↗Fig. 4: Noise levels (Lden, combined sources in dB) in Berlin at night, comparison of 2015 data. (Source: Dilger & Kuznetsova 2022)



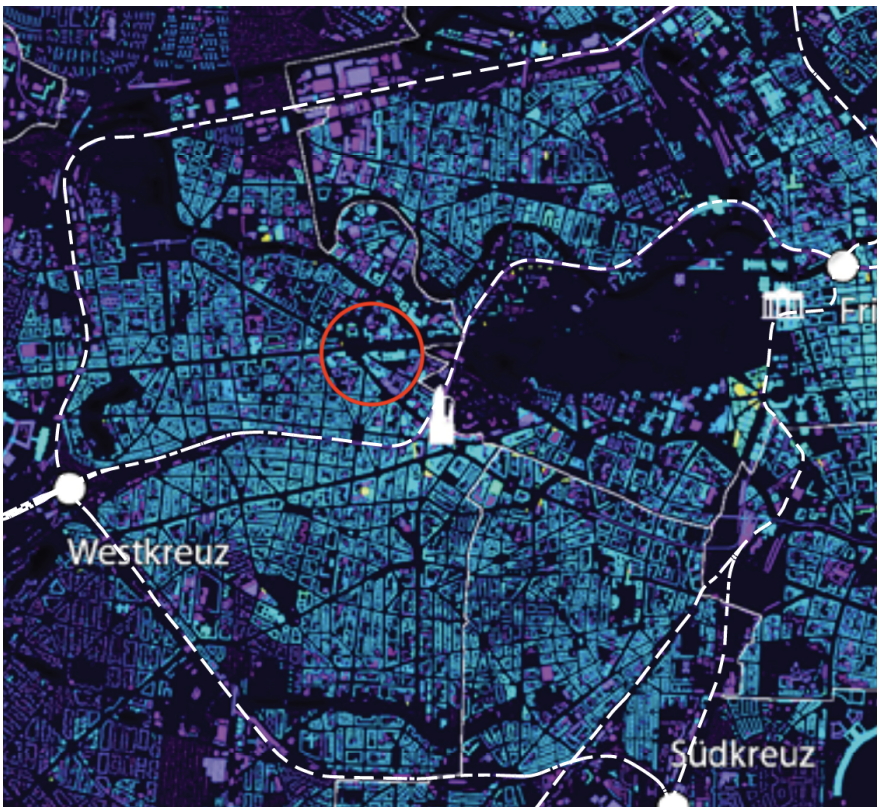

↗ Fig. 5: Noise levels (Lden, combined sources in dB) in Berlin at night (2015). In this map, air traffic noise data was not included, as the closure of Tegel airport in 2020 has rendered this data obsolete. (Source: Dilger & Kuznetsova 2022)

## 2) Scale Maps

Urban landscapes are dominated by designed and built material elements that, altogether, form the "urban morphology". Buildings, façades, fences, and other elements have their own cycles and dynamics and greatly influence the experience of urban space. It is almost peculiar that the ways in which humans engage with the material landscape on a daily basis has received comparatively little attention (Jones et al. 2017: 29). Moreover, there is a temptation to consider the material elements as a form of 'objective' or 'real' dimension that are played out against the "fuzzy and emotionally-skewed perceptions of the individual" (ibid). For understanding how sound can travel and unfold in highly designed urban spaces, it arguably can be helpful to understand the dimensions of this space. This can be, thanks to available data, be done even on the city scale. The following maps assess the approximate building height in their area as well as a more accurate calculation of the total street width. By condensing the data first into 12 and then into 4 categories, a simplified typology emerges that helps to visualize two important metrics that can influence soundscapes.




↗Fig. 6: Building Height Map of Berlin (simplified into 4 categories). (Source: Dilger & Kuznetsova 2022)




↗ Fig. 7: Zoom-in of previous map. The red square indicates the location of the TU Berlin campus.


↗ Fig. 8: Street Width Map of Berlin (simplified into 4 categories) (Source: Dilger & Kuznetsova 2022)


↗ Zoom-in of previous map. The red square indicates the location of the TU Berlin campus.

**Approaching soundscapes through digital questionnaires**

Affect – the interplay of perception and reflection that is expressed through emotional responses – is a ubiquitous element of city life, but the "affective register" does not form a large part of city studies (Thrift 2004: 57). Affect and emotion remain externalized from the day-to-day practice of design and planning. Often, they are only considered for anticipating and avoiding undesired emotional responses from the audience (Hoch 2006: 138). While the traditional design and planning discourses have been enhanced by theoretical imports, questions of embodiment and sensorial experience remain left out of focus (Mackrodt 2019: 3). This hinders a reduced understanding of how emotion and feelings shape the plans and, respectively how plans shape the emotions and experience of urban dwellers. A scrutiny of literature shows a rich body of work that takes emotions, affectivity and the everyday experience as central dimensions to the experience of a city and its individual places. Rooted in this literature, during spring and summer 2022, the author co-conducted an empirical pilot study of the sensorial qualities of Lausitzer Platz at night in the Kreuzberg borough of Berlin. Participants were asked to walk along with the researchers and then alone while answering a questionnaire implemented in a digital questionnaire. Conducting the study at night had the additional benefit of drawing the attention of the study participants to all their senses. The study focused on several dimensions: light, environmental conditions, smell and sound. For the assessment of the soundscape, the

framework for variables were the requirements outlined in the ISO/TS 12913-2:2018(en), Acoustics — Soundscape — Part 2 report (ISO 2018) and implemented in a 5-point Likert scale, ranging from no to high expression of each variable. Additionally, respondents were asked to locate their perception of the soundscape as a whole on a scale between 'rejecting' and 'inviting'. Given the size of Lausitzer Platz, the square was segmented in five zones in order to locate the data in a discrete zone. On a more qualitative side, participants were asked to answer which sound they could perceive in their vicinity (closeness) and in the distance. This would allow us to obtain data on the types of sound events occurring and to aggregate them. In the following, some diagrams of the study site will be shown as well as the study results for the soundscape assessment, by zone and by gender as well as the aggregate results of nearby and distant sound events.

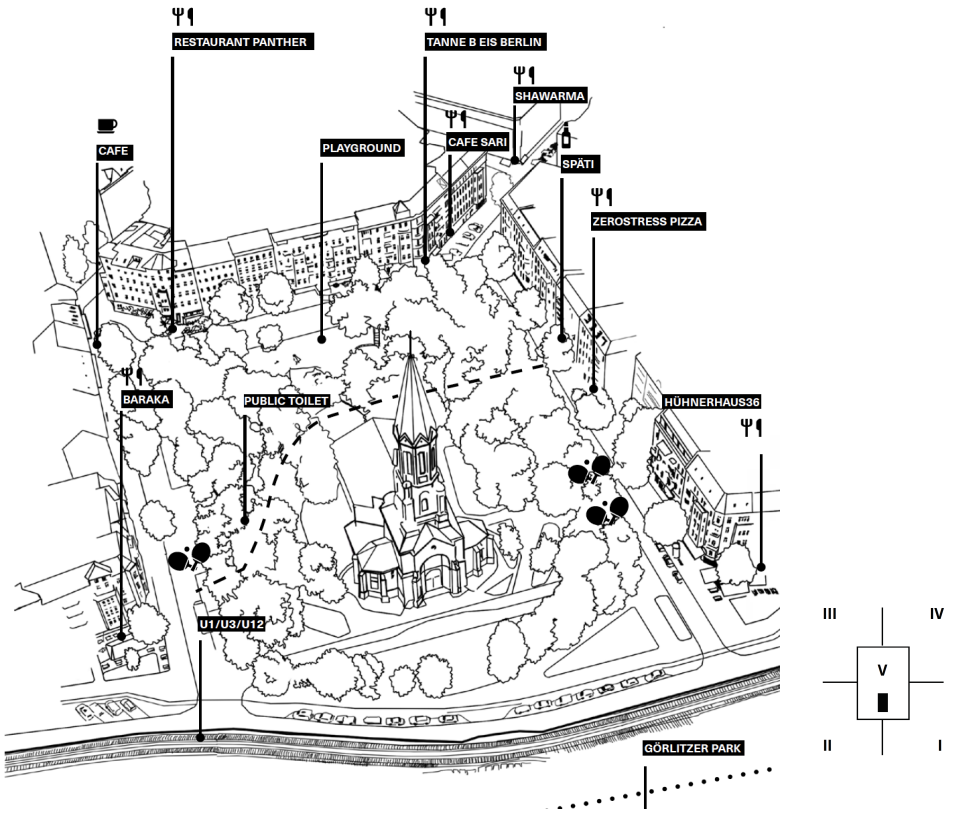
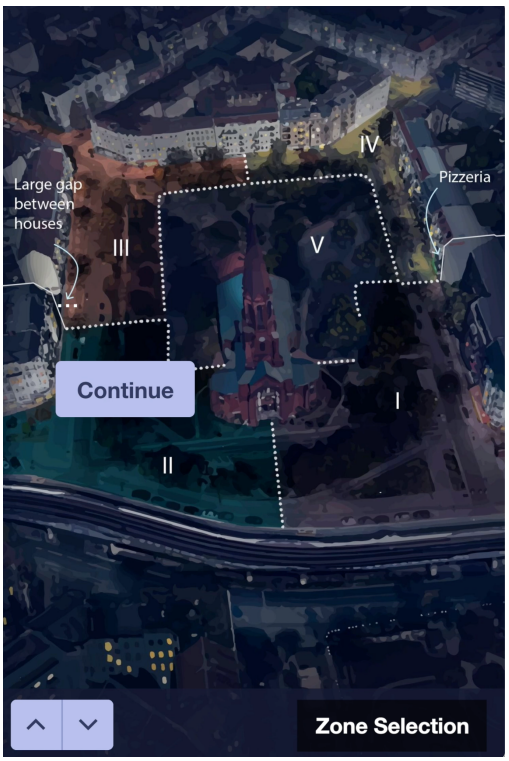
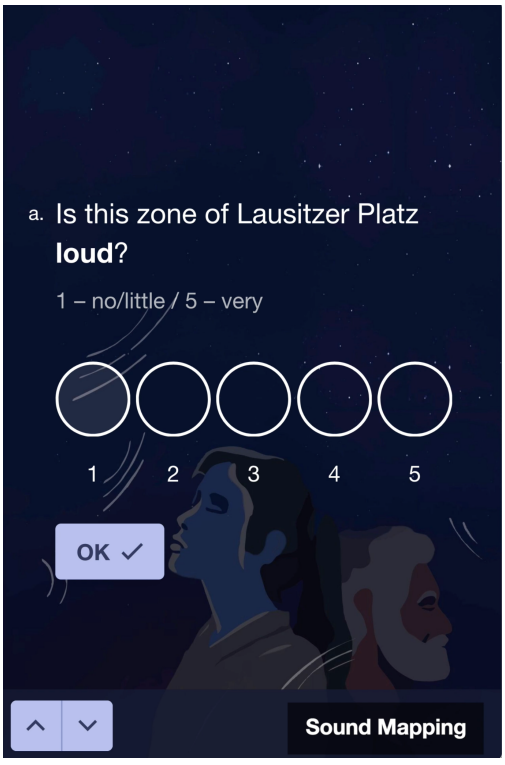


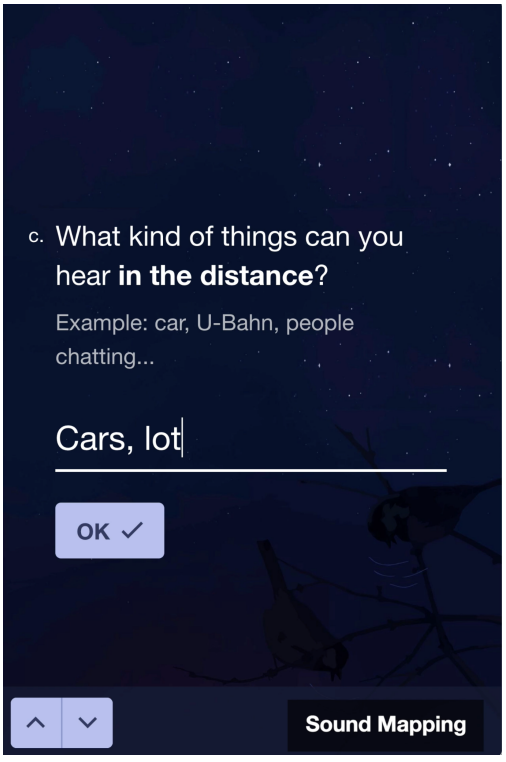

Illustration of Lausitzer Platz and schematic division into five zones. Black square indicates the church in the lower center of the square. Source: own mapping, drawing by Anastasia Kuznetsova




(a)

(b)



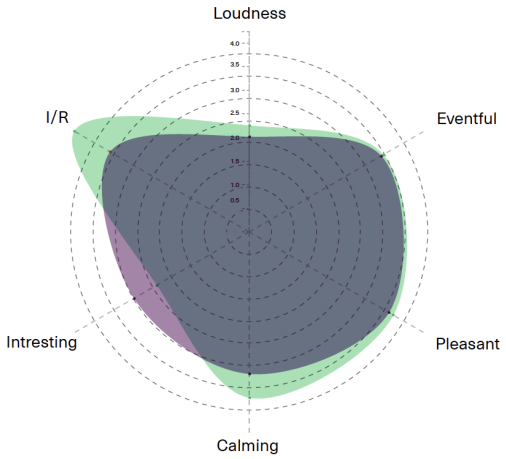




(c)

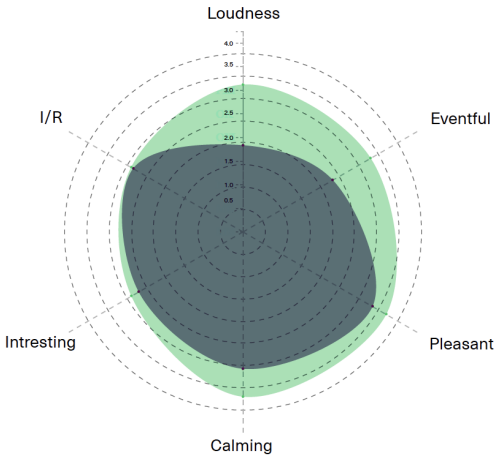
↗ Screenshots from the digital questionnaire used in the pilot study:
(a) Zone Orientation Map, (b) quantitative variable and (c) qualitative variable.
(Source: Dilger & Kuznetsova 2022)

**Sound**

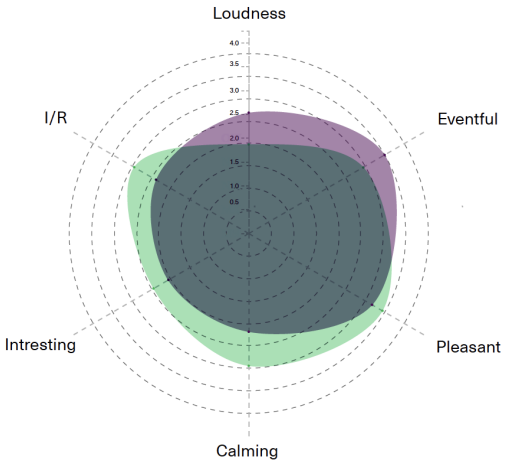
**Zone III**



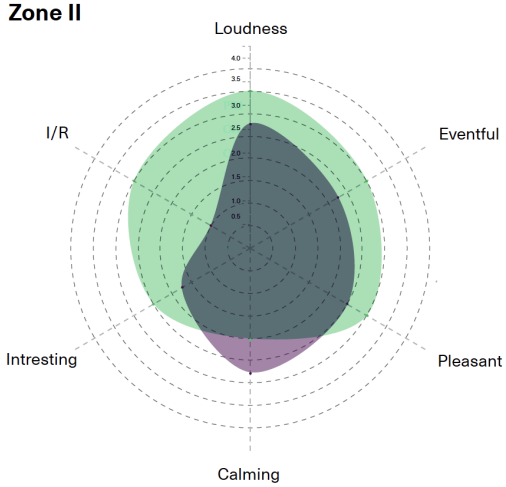

**Zone IV**



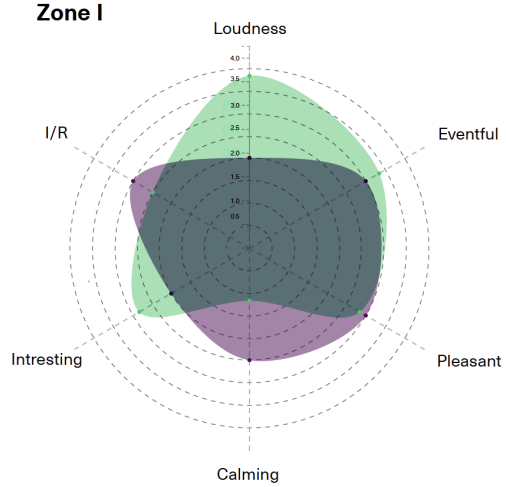

**Zone V**




**Zone II**




**Zone I**




(Source: Dilger & Kuznetsova 2022)

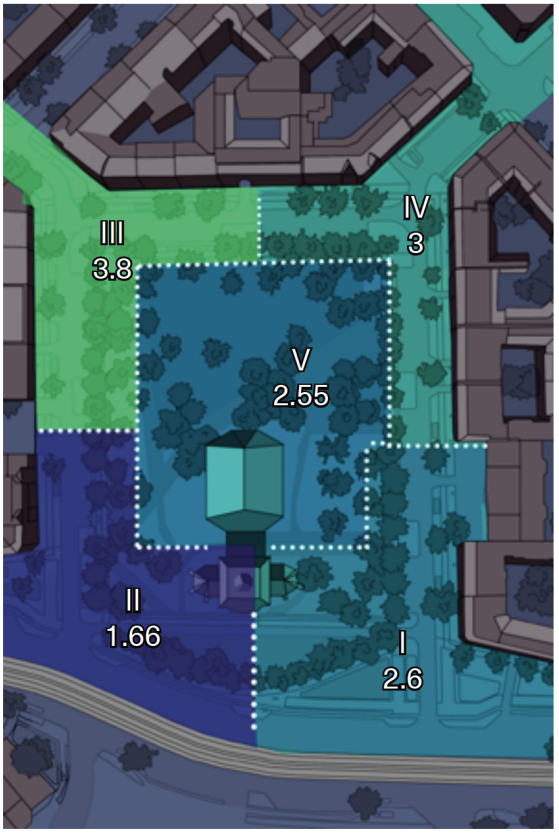

Mapping of **nearby** sounds by zone →


←Mapping of **distant** sounds by zone

(Source: Dilger & Kuznetsova 2022)

The examination of the answers show, across all zones, a dominance of human presence and of traffic noises. The most varied zone, where subtle differences and confluences were identified was zone V, ranging from natural sounds (wind, trees, etc.) to subtle human sounds (footsteps, cobblestone) with human and traffic sounds forming a rather comfortable sound backdrop. Lausitzer Platz's soundscape is somewhat 'contradictory' due to its dual character of city square and park at the same time. With an overall high volume

level at the beginning of the (summer) nights and reducing after restaurants and shops close, it does not offer the traditional “calming” soundscape of a park, nor is it only reducible to the sounds expectable from a traditional city square. While it has been closed off from car traffic, the sounds from Skalitzer Straße, cars and U-Bahn dominate the soundscape in I and II and, to some extent, even in zone V. Zones III and IV are less so, but the backdrop of traffic is still there, albeit the main contributing factor here are bikes. Notably, many participants perceived the sound of walking and footsteps. Comparing the qualitative data on sound events with the quantitative assessment of sound qualities, the findings suggest that the affective experiences of “intimacy” and “safety” are mediated to a certain extent,by the intensity and quality of the soundscape of each zone. In terms of rejection or invitingness, the zones with the highest amount of intimacy but with a considerable amount of sound events such as “people chatting” yielded the highest values, suggesting that these are the most inviting areas.




↗ Index of inviting/rejecting soundscape by zones (all participants), where a value of 0 would indicate a completely rejecting soundscap and 5 a completely inviting soundscape. (Source: Dilger & Kuznetsova 2022)

**Discussion**

Even if the results from the pilot study shown above should be considered highly preliminary and needing methodological revision and refinement, they suggest that measuring and assessing soundscapes from the two approaches outlined – approximation through (partially non-sound related) data as well as a mixed-method mapping of sound perception by walking through a place – can be a fruitful basis for conducting sound mappings. Data mappings can help to identify important material and environmental factors that influence, for instance, how sound disperses or is also filtered. Such maps could take the role of 'analysis maps', a basis that guides subsequent micro-scale analysis of a place and decision-making in the research process. In this context, it would be necessary to include as well the insights from acoustic and physic experts. A benefit from this approach is that, depending on data availability, it is possible to get an overview over the influencing factors on a city or borough scale. This can be highly relevant when the soundscape research area is large and an appropriate scope needs to be defined.

Regarding the micro-scale sound maps, they allow not only to obtain important insight into user perception but also to aggregate sound event data. The findings in this pilot study are far from being exhaustive and standardized. Despite this limitation, the data allowed a fruitful exploratory analysis. Droumeva reminds us that the format of each soundmap is dependent on designed constraints as well as the audiences interacting with it (2018: 3). Another important limitation of these kinds of soundmaps is that they "[...] qualify as mash-ups by way of combining sound onto topographical information." (ibid) and thus do not offer a methodological development regarding the representation of sound itself. While the data is not 'pinned' onto a specific location, it remains fixed on an area and a timeframe defined by research design and participant recruitment.

Despite these limitations, both these approaches offer some potential benefits for the course goals, as they think of soundscapes in their social and affective dimensions, thus complementing the findings that can be obtained through quantitative data, like those obtained by professional sound measurements. Sound mappings offer the possibility of conveying information that exceeds the acoustical realm and offer insight into other spatial and temporal aspects of a specific place (Radicchi 2013: 270; Thulin 2018). This makes it worth developing a careful methodology for assessing the soundscapes of the university campus of the TU and UdK Berlin. This campus is located in a lively area in the inner city and is used by diverse actor groups. While university members are naturally the biggest user group, other social groups as well as non-human actors are present and need to be

accounted for. An approach as outlined in this essay may be a good starting point for discovering the many layers of a soundscape and put these in relation to other social dimensions and ultimately, inform intervention design and their evaluation.

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