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Designing the user experience of musical sonification in public and semi-public spaces

Abstract

Sonification refers to sonic expression of data or information. It is often thought of as an auditory complement, providing additional information about data which can reveal patterns and facilitate interpretation and understanding of the data. Hence, the listening space created by a sonification is always a hybrid where auditory augmentation complements other information modalities and, in some cases, also spatial qualities. In this work, we focus on sonification in public and semi-public spaces, and specifically on musical sonification – the use of musical sounds to create a sonic environment, augmenting or complementing a physical shared space. We draw upon established approaches in interaction design to focus our work on the user experience of musical sonification in public and semi-public spaces. Specifically, we first identify the experiential qualities of sonic atmosphere *and* performativity *as important aspects of sonification in public and semi-public spaces, then use those experiential qualities generatively in the speculative design of a musical sonification sketch. The design sketch comprises a dynamic musical sonification of air quality data, intending to give citizens an awareness and an enhanced individual and interpersonal understanding of air quality in their city.*

Introduction

In this paper we suggest that sound can be used to provide information in public and semi-public spaces and suggest some starting points for the design of musical sonification in order to achieve this aim. The ability of sound to both be part of the peripheral awareness and to be experienced intentionally and attentionally (that is, focally) is something that makes sound different from visual stimuli. The auditory system has a very high resolution in terms of frequency discrimination as well as temporal resolution and perception of loudness levels, and musical sounds are well adapted to convey a multitude of information to listeners, quickly and intuitively (Tsuchiya, 2015), communicating meaning, information, and emotions (see for example discussions in Rönnberg, 2016, and Tsuchiya, 2015) on a general level. This makes sound suitable for creating sonic moods, providing peripheral information, conveying general information about states in dynamic processes, and more.

Sound might also act as a complement to the visual modality, providing additional information without without straining the visual perception. Transforming data into sound is called sonification (Hermann, 2011, and Pinch, 2012). One approach to sonification is parameter mapped sonification, where different sound parameters, such as pitch, loudness, or rhythm in designed and/or composed sounds, are mapped to data (Hermann, 2011). In this paper, we focus specifically on musical sonification, that is, designed and composed parameter mapped sonification based on a music-theoretical and aesthetic approach (see, for example, discus-

sions in Vickers, 2016). Sonification can be seen as part of a hybrid auditory/spatial listening space. A musical theme can be composed and, subsequently, data relating to a physical space can be sonified and used to change the musical score, the tonal qualities, and the melodic movements. Thus, this combination of traditional and algorithmic composition yields a sonification that can contribute to an emerging listening space, serving as a musical theme for a public space with the goal to create a certain impression and experience for listeners as well as a way of conveying information in or about the public space.

Different approaches to sonification for public spaces have been presented (see, for example, Tittel (2009), Rubin and Thorp's work.[1] and further discussions in Supper (2014) and St Pierre (2016)). Sounds in public and semi-public spaces can be experienced both focally and peripherally. An individual has the ability to focus the auditory attention on a particular sound, while filtering other auditory stimuli (Bronkhorst, 2000). The filtered sound sources can still be heard, but the listener's attention is not focused on them (Getzmann, 2015). Consequently, background sonification can be heard through noise, disturbances, and conversations. Sound is experienced peripherally and somewhat unconsciously: it is hard to turn off the ears. A listener can shift attention to a specific sound when needed or to another sound source, such as a departure call or a conversation. A person can immediately detect words of importance coming from unattended sound sources, such as a person's name or the name of a destination in a waiting hall (Wood, 1995). In both these cases, sounds change from peripheral to focal.

Finally, to round off the general introduction of sonification, music and other sounds work on two simultaneous levels of meaning. The syntactic level, as we refer to it, comprises the perceptual and visceral properties of sound with little dependence on the listener's previous knowledge and other interpretive frames. For example, in general terms and more or less irrespective of whom the listener is, a loud sound can be experienced as more activating than a quiet one. Moreover, there is always a level of semantic meaning in sound and music which concerns the relationship between signifiers, musical and non-musical (referential) meaning (Meyer, 2008), and their denotation. Musical meaning is when music elicits emotions by enforcing, or contrasting, or even violating the musical norms known to a listener. For example, a short melody might cause a listener to expect a certain continuation, which is typical of the cultural affiliation or musical style. The meaning might also come from extramusical associations, such as literary references or conventional uses of a particular musical work (Koelsch, 2009). Semantic meaning in this sense is clearly related to the listener's previous knowledge and experience – the more "code competence", the better the chances that extramusical associations are noticed and understood as intended.

A design-driven approach to exploring sonification

As we shall see, sounds and music are pervasive in public and semi-public spaces. Our mission here is to focus on this sonic backdrop and unpack it to some extent with the intention of beginning to understand the difference between sonifications that appear to be more and less effective in public and semi-public spaces. We will do this by means of a design-driven approach, where we start by identifying so-called experiential qualities that are arguably central to the experience of sonification in public and semi-public spaces, subsequently using those experiential qualities generatively in designing a sketch for a musical sonification of urban air quality.

The notion of experiential qualities has emerged within interaction design (Löwgren, 2009) as a way to articulate and communicate design knowledge on an intermediate level of abstraction, inspired by the role that criticism plays in more mature design fields (Bardzell et al., 2010). Experiential qualities are particularly characteristic qualities of the users' experience in a specific type of use situations, or a specific genre of interaction design. For example, it is known that if users experience an interactive visualization as pliable, they will tend to explore the data more deeply and reach further insights. In the following, we present exemplars and conceptual analysis to argue that *sonic atmosphere* and *performativity* are two significant experiential qualities of experienced sonification in public and semi-public spaces.

Experiential qualities are tools for articulation in the sense that they support intersubjective understanding of what the users' experience is like or should be like. They are most commonly used to articulate desirable qualities. Returning to the previous example, we can talk about interactive visualizations as being more or less pliable, and the assumption is that more pliable is better in the sense of desired interaction outcomes (deeper exploration, more insights). Moreover, it has been shown in interaction design teaching and practice that they can also be generative in that designers can set experiential quality goals to give direction to design processes. Here, we aim to show how the concepts of sonic atmosphere and performativity help us to better understand the phenomenon of sonification in public and semi-public spaces, as well as how they inspire affordances in new design ideas for such sonification.

Sonic atmosphere

The sonic atmosphere refers to the way in which designed sounds in a given location or space are experienced as an environment. It is therefore part of the presence and is a vital part of how we experience and perceive a location. The presence or ambience of a location is discussed by Thibaud (2002) as the multi-perceptual experience of a space: our work is limited to sonic ambience. Further, our use of sonic atmosphere is influenced by Murray Schafer's (1993) notion of soundscape, even though

we focus on a part, a subset, of soundscape. Each and every location in public and semi-public spaces has a distinct and subtle sound created by the environment. The sound sources that form the basis for the soundscape can include natural sounds like wind, rain, running water, and rustling leaves as well as unnatural sounds such as traffic, machinery sounds, human movement, and speech. The soundscape is also affected by architecture and acoustic characteristics that determine the reverberation of sounds, altering the frequency spectrum and blurring the temporal aspects in the sound.

Another important factor is music, and the choice of musical style and genre used to affect and change the soundscape of a space. As opposed to sounds created by the environment, music is deliberately chosen or designed to create a specific feeling, a particular emotional impression, consistent with the desired expectations and the desirable outcome of the activities in the public space.

Our focus here is on the way in which sound can intentionally contribute to the creation of designed sonic atmospheres, including both musical and non-musical sounds. The reason is that this is the most interesting case to consider when we want to go from analytical to generative, i.e., providing useful knowledge for designers of sonification for public and semi-public spaces. Designed sounds can to some extent be characterized by musical parameters and elements, such as harmony, pitch and melody, timbre, sound level, tempo and rhythm (see, for example, Deliege, 1997; Seashore, 1967; Levitin, 2006). In order to connect the objective musicological properties of musical sound with the listeners' perceptions and experiences, we choose to use Russell's (1980) circumplex model of affect. This model has been used with some success to characterize emotional qualities of experience in other areas of interaction design (e.g., Ståhl, 2014). It proposes that all affective states arise from two systems related to valence (from displeasure to pleasure) and arousal (from deactivation to activation). Each affective state can be understood as a combination of valence and arousal.

As is the case with all discussions of experiential qualities, it is important to note that the connections we suggest between musical parameters and experiential outcomes are not objective, strictly causal, or "scientifically true" (see also discussions in Schubert, 2004). Musical parameters, such as those mentioned above, might be perceivable individually, but each also contributes to the experience of the entirety of the sound (see the discussion in Webster, 2005). Changes in musical parameters might very well be experienced differently depending on cultural (Argstatter, 2016; Wong, 2012; Morrison, 2009), musical background (Vuust, 2010) as well as the listening context (Blumstein, 2012). However, the aim of an analysis such as this one is to articulate aspects of an experienced designer's practical knowledge – in this case, an experienced designer of musical sonifications – with the intention to provide potentially actionable knowledge for other designers working in the

same domain. There is no certainty in design, but there is still knowledge value in a palette of musical parameters for the mapping of data in musical sonification. With this caveat, we move on and introduce a range of musical elements and their typical connections with Russell's model of affect (see Figure 1).

Harmony is the combination of tones that form chords where, traditionally, a major chord is more positive (higher valence) than a minor chord (Hunter, 2010). More complex harmonies can be experienced as more activating (higher arousal) compared to simpler harmonies (Iakovides, 2004), and dissonant chords might be experienced as more unpleasant (lower valence) (Pallesen, 2005; Zentner, 1998).

Pitch is the perception of frequency, where both higher and lower pitch can be more activating (higher arousal) than tones in the middle register. Melody is the sequential use of tones, and ascending melodic movements are generally perceived as more positive (higher valence) than descending melodies (Schubert, 2004; Juslin, 2004).

Timbre is the "color" of the sound, and softer, duller timbres might be experienced as more negative (lower valence) than brighter timbres. A more complex timbre can be more activating (higher arousal) with a greater emotional response compared to a simpler timbre (Juslin, 2004).
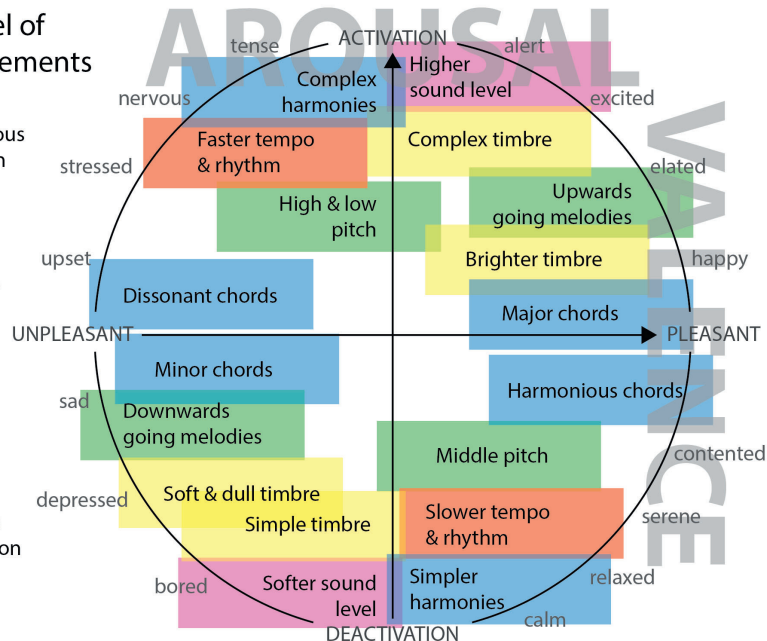

Figure 1. The circumplex model of affect with high arousal and valence in the top right corner, where feelings like alertness, excitement, and happiness might be found, and with low arousal and valence in the lower left corner, where feelings like sadness and boredom reside. The musical elements and their typical effects on valence and arousal are indicated through their placement in the diagram.

Tempo is the pace or speed at which the music is played. A fast-paced rhythm and fast tempo can be more activating (higher arousal) than a slower paced rhythm (Iakovides, 2004; Hunter, 2010; Liu, 2018).

Finally, sound level is the amplitude of the sound, where a higher sound level might yield higher activation (higher arousal) compared to lower sound levels (Iakovides, 2004; Juslin, 2004).

The most obvious example of using music affectively in public and semi-public spaces is, of course, the musical score of a film, and how it is used narratively and emotionally in conjunction with the moving image (see, for example, Gorbman, 1987; Prendergast, 1992). However, it is hard to think of film music as musical sonification since it is such an integral part of the movie, already from its conception. A more pertinent example of music in public spaces is Michael Hayden's installation "Sky's the Limit" at Chicago O'Hare International Airport (see Figure 2). In the mile-long underground tunnel connecting terminals B and C, a light art and sound installation brings colors and brightness to the gloomy walkway, and the sounds have a relaxing and soothing effect, a lower level of arousal, in an otherwise noisy and stressful environment. The sonic elements consist of electronic-sounding synthesizer pads with a quite soft timbre, playing chords in the middle range of tones, creating a deactivation. This is accompanied by slow bell sounds that might almost resemble bird song, creating an airy and lofty impression. The sounds change slowly, creating a sonic environment that is repetitive without being intrusive or disturbing. Interestingly, in this sonic installation there are also elements of semantic information. Among the tones and harmonies creating the ambience, traces of

Figure 2. "Sky's the Limit" is a sonic and light art installation at the Chicago O'Hare International Airport, where it creates a calming and relaxing sonic atmosphere in the mile-long transit between terminals B and C.

Gershwin's "Rhapsody in Blue" can be heard. They might be somewhat transformed in tempo and arrangement, but nevertheless cleverly connect the sonic atmosphere in the public space of the airport to United Airlines' commercial advertisement where Rhapsody in Blue has been used for a long time (Bañagale, 2014). The use of music connects United Airlines to O'Hare Airport via semantic interpretation and understanding of the strands of tones from the Gershwin composition. However, it is something that requires a relatively high level of code competence in the listener.

Another example is the waiting room at the dentist's, where classical piano music is often played in the background. The rather understated, somewhat subtle, music in slow tempo is relaxing to listen to, reducing stress and concerns about the imminent examination, creating lower levels of arousal, but still quite high levels of valence. The music also serves to cover noises from the examination room, that might both be embarrassing for the patient and upsetting for the ones waiting. The choice of music also serves another purpose, with a more semantic meaning. The classical music suggests that this is a fine cultural establishment, with class and finesse, where dentists and dental hygienists know what they are doing, and there is no need for concern. There might also be a hint of a substantial bill after the examination.

Even if only short fragments of already known music, the use of existing music can create recognizable and relatable associations and provide information to a listener, as in the example from O'Hare Airport. The genre, the overall style of the music, sends a message about the situation and about the space where the music is heard. The music might be classical as already discussed, it might also be cool and modern with the intention of creating a trendy atmosphere, or even a bit rebellious and exclusive. Musical elements, such as timbre and the use of specific sounds and instruments, can also contain semantic information. The sound of a church organ, for example, might bring to mind churches and sacred moods and situations, while the sound of a bagpipe could take the listener on a journey to the heather-covered hills in the Scottish Highlands, and the sound of muted trumpet might be associated with night time in the big city. Sound levels can also be used semantically, where a loud sound might represent coolness and rebelliousness, whereas a softer sound level might give a hint of more sophistication and class. Tempo might be used in a similar way, where a faster tempo might appeal to a younger and more fast-paced group of visitors, while a slower tempo suggests that there is time for considerations and informed decisions.

Designing the sonic atmosphere of a public or semi-public space is a powerful way to influence people's perceptions and experiences of the space. The takeaway is that *musical elements can influence the level of valence and arousal in the listener,* as suggested in the examples from O'Hare Airport and the dentist waiting room. For obvious reasons, most examples of designed sonic atmosphere fall on the pleasant side of valence, even if it might differ between examples what is pleasant and how it may be used. Finally, the syntactic and semantic meanings as well as the listeners'

cultural pre-understanding of music and sounds are always intertwined and must be treated as a whole.

Performativity

The experiential quality of performativity pertains to the way in which people are making expressions in social space, performing their personas to others. When considering performativity, interaction design for public and semi-public space is always more or less a matter of setting the stage and providing the props for the users' performance (Bardzell et al., 2010). Sonification is no exception in this regard.

An everyday example would be the customizable ringtones of mobile phones. When we unbox a new phone and go through the settings, the choices of ringtones and other audible alarms are surely influenced more by considerations of the connotations of our choices than by, say, audio-ergonomic principles of effortless perception. You are expressing or yourself to someone else or, more specifically, to everyone who shares the space within earshot around you when your phone rings. The connotations are only meaningful to the extent that others are there to infer them (and by extension – to infer certain things about you or, more precisely, about the public persona you wish to present).

Performing through sound is somewhat different from performing through visually observable behavior, in the sense that the "audience" cannot close their eyes to the sound or look away from it. Sound in public or semi-public space is inherently intrusive which is probably the reason why the norms of public sonic performances are remarkably malleable. To draw further on the example of mobile phones, there was a time not long ago when speaking on the phone in public came across as a violation of the social norms for public sonic behavior. Complaints were made in private and public, mobile phone etiquette was being professed, and critical design projects were launched in efforts to collectively deal with the norm transgression. However, the controversy subsided rapidly thanks to the need for the phone speaker to actually hold the phone to the ear. This visually observable performance provided enough complementary cues for bystanders to disambiguate the situation and rule out the unpleasant alternative of a deranged fellow citizen speaking out loud or, even worse, trying to engage strangers in loud conversation.

Until hands-free became common, that is. The absence of the hand at the ear caused a new wave of discomfort about speaking out loud in public. But again, things settled rather quickly, and norms adjusted to the point where it is now quite acceptable and unremarkable to meet people in the streets who are carrying out loud and hand-waving phone conversations through nigh-invisible earbuds.

Performative sound in public or semi-public space can, as already stated, be focal as well as peripheral: it is not uncommon for it to move between the two states

through the course of the unfolding of events, or for one person's focal sound perception to be another person's peripheral sonic ambience. Electric cars, for example, can technically be made to move almost completely silently at low speeds. However, the whole system that we have painstakingly evolved for structuring the urban interrelations between pedestrians and cars relies heavily on peripheral as well as focal sound. When sitting at a table in a sidewalk café, facing away from the street, the totality of the sounds from cars passing behind you forms part of the sonic periphery that enables you to sense the pulse of the traffic and sometimes even tell the time without paying conscious attention. As you get up and start crossing the street without looking properly to your left, the incoming car sound that suddenly turns focal for you can be the difference between stepping back in time and spending weeks in intensive care. Imagine these everyday situations in a city where an increasing number of sound-emitting vehicles are being replaced with silent electric cars, and it is plain to see the performative properties of car sounds in very concrete action. Based on this observation, an argument in favor of designing electric cars with an intentional sound emission profile seems straightforward.

There is an obvious difference between mobile phone ringtones and electric car "engine sounds" in that one is designed to provide explicit means of musical or sonic expression to its user, whereas the other is typically hardwired into the car and not customizable by the driver (similar to how dentists design their waiting-room ambience by choosing a soundtrack that customers are not able to influence and change). However, it can be argued that this difference can be explained based mainly on holistic design reasons: being a highly visible and visually distinct entity spanning a broad scope of established cultural connotations, the car needs a designed engine sound that is coherent with its overall product expression. The same would hold true for the soundtrack as part of a holistically designed dentist brand. The phone, on the other hand, is typically not visible from afar – and all phones look more or less alike anyway. From the "user's" point of view, the performance in one case is to choose a custom ringtone, in the other to choose a dentist whose brand resonates with personal values and social aspirations.

For our purposes, the generative insight is the same in both cases: *when designing sound-emitting possibilities for use and interactive engagement in public or semi-public spaces, you are always to a certain degree designing props for people's social performances.* The design results would generally benefit from bearing this in mind.

Design sketch

We argue that there are many potentially valuable sonifications of public and semi-public spaces waiting to be designed and deployed. Here, we propose one idea in order to show how the experiential qualities of sonic atmosphere and performativ-
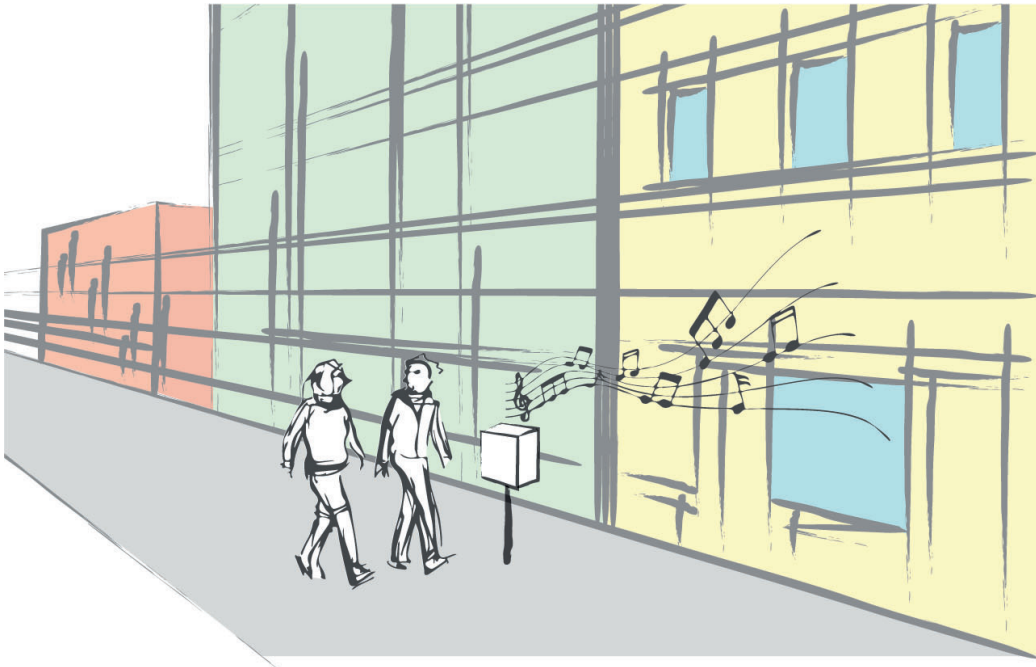
Figure 3. A sketch of our proposed design.

ity can be used generatively in sonification design. The suggested ideas are purely speculative/illustrative, yet hopefully indicative of the benefits of working consciously with experiential qualities to guide a creative design process.

Assume that we are in a city where the air quality is measured, analyzed, and sonified. Small boxes containing speakers are placed at strategic locations in the city, such as outside the library, at bus stops, in the squares, and around shopping malls (see Figure 3). The sonification used is what we call musical sonification, contributing to a hybrid listening space conveying information, meaning, and – in a small way – calls to action.

There are a number of possible measurements of the air quality that could be made and sonified: ground level ozone, carbon monoxide, sulphur dioxide, nitrogen dioxide, and aerosols to mention a few. They could be sonified individually in regard to different musical elements, but still as parts of a concerted musical sonification. Therefore, changes in one variable would be discernible and understandable when listening to the sonification, however, all variables would contribute to the emerging sonic atmosphere that describes the overall air quality.

Our proposed sonification of overall air quality data is illustrated in Figure 4. The overall value is calculated based on the individual measurements and used in discrete steps to sonify good air quality (Level 1), intermediate air quality (Level 2), and poor air quality (Level 3). Between these discrete levels, the sonification com-

Figure 4. A sketch of the sonification composition, showing the melody and chords for Level 1; melody, chords, and base for Level 2; melody, treble tone, chords, and base for Level 3.

position differs in terms of melody, chords used, and pitch, while sound level and tempo are continuous parameters.

In *Level 1*, the melodic movement is mainly upwards-going, aiming to create a positive impression with higher valence and arousal. The chords used are mainly major harmonious chords, and both melody and chords are in the middle pitch which is typically experienced as more relaxed and content than higher or lower pitch. The sound level is reasonably low, creating a low activation. The tempo and rhythmic patterns are fairly slow, creating a low arousal level, but high valence. In *Level 2*, the melodic movement changes to become more downwards-going, generating a less positive impression. The chords are changed to become slightly more melancholic and complex, and an additional base tone is added to create a more activating expe-

rience. The sound level and tempo are increased, which changes the general impression to higher arousal and lower valence. In *Level 3,* the melodic movement has an increased impression of being downwards-going and more negative. It is less calm and slowly marching onwards, creating a higher activation. The chords have an even more melancholic expression, compared to Level 1 and Level 2, and an additional base tone as well as a treble tone are added for more activation. Also, a rhythmic base line is added in order to emphasize the feeling of faster rhythm. The sound level and tempo are continuously increased, to create higher activation and decrease valence.

Turning to the individual air quality parameters, ground level ozone at good levels is sonified by a sine wave, but with deteriorating air quality, the sine wave is mixed with a sawtooth wave. This creates a sound that starts as rather simple and pure without much harmonics, but as the air quality decreases, the sound contains more and more harmonics, creating a more complex timbre with a higher arousal level. Carbon monoxide level is mapped to the sound level of the base tones. As the air quality decreases, the lower frequencies in the sonification become louder and more apparent, aiming towards a higher activation and a more unpleasant impression. In a similar way, sulphur dioxide is mapped to the sound level of the higher frequencies and the higher pitched tones. Nitrogen dioxide is mapped to dissonance if each individual tone is built by two (or more) oscillators, and the frequency distance between these is increased with decreased air quality. This would give harmonious tones and chords with higher valence and lower arousal when nitrogen dioxide levels are within good levels, but with decreased valence and increased arousal when the air quality decreases. Aerosol levels are mapped to variations of the melodic movements, such as more and faster rhythmic non-resting tones, with higher levels of variations when aerosol levels deteriorate.

The joint effect of these musical sonification suggestions is an auditory experience whose valence follows the air quality. On days with better air quality, the sonification is intended to be experienced as more pleasant (higher valence) and with low levels of activation (lower arousal). On clear mornings before the traffic starts to flow into the city, the chords used in the sonification are simple, harmonious major chords in the middle pitch register, building up the musical sonification with a slow tempo at a fairly low sound level. As the morning traffic increases in quantity and the industry starts another day of production, the air quality slowly decreases. When the air quality deteriorates, the sonification changes as well. The pleasant harmonious chords are changing to minor and more dissonant chords, melodies change from positive, mainly upwards-going to more negative, downwards-going melodic movements. The simple and relaxing timbre becomes more complex and activating as the sonification lowers the experienced valence and increases the level of arousal. As the tempo and the sound level increase with the decrease in air quality, the sonification changes from being peripheral to becoming more focal.

It is clear that this sonification sketch illustrates a generative understanding of the experiential quality of sonic atmosphere, working with valence as well as arousal. What may be less obvious is that it also contains strong performative elements. On a basic level, you might say that the city performs its awareness of air quality and its desire to mobilize the citizens to improve it. However, there is also another level of performativity as suggested by the decision to make visible, sound-emitting boxes part of the air quality sonification. Drawing on previous research in social interaction design (Durrant, 2015), the boxes are intended to become anchor points for citizen performances directed at other citizens in the immediate vicinity. Or, to put it more plainly, the box can be used as a shared spatial and visual reference when making a remark to a passer-by about the particularly high particle levels this morning: making eye contact and pointing to the box becomes what is known as a "ticket to talk." This performative focalization of what is essentially a peripheral approach to sonification becomes even more pronounced if the box also offers opportunities for interaction, such as providing further visual information or opportunities for spontaneous feedback.

Concluding remarks

What we hope to show in our design sketch is that musical elements in sonification can inspire the design of a sonic atmosphere intended to affect people both in terms of valence and arousal. Design ideas for sonification in public and semi-public spaces might be based on syntactic (as in the use of different musical parameters) as well as semantic ideas (such as musical style and associations). The meaning and experience of these are intertwined and form parts of a whole. These design ideas can also allow for performativity, and the sonification can be used to express the public persona of an individual or an establishment. The sonification of a public or semi-public space can create an intended sonic atmosphere, creating the right "feeling" which also provides peripheral and focal auditory information. The sonification can enlighten a citizen by raising awareness and simplify the understanding of data or visual information, but the sonification can also be proactive and stimulating in terms of facilitating impromptu social performance or even providing an incentive to take action.

The idea of sonifying urban air quality is by no means new (see Andrea Polli's (2014) work Airlight Taipei, Brian Foo's sonification of Beijing air quality data,[2] Cha Blasco's sonification of worldwide air quality,[3] or Michael Blandino's (2018) work among others). In a project with similar ideas as the ones presented here, St Pierre and Droumeva (2016) present a project which links particle levels to frequency content and stereo channels, with the stated goal of contributing to public engagement. The main difference between their work and ours is that they concentrate on focal,

center-of-attention listening situations, whereas our work aims to span the dimension from peripheral to focal attention, based on our explicit recognition of the experiential quality of sonic atmosphere. Moreover, our design idea of providing a "ticket to talk" that stems from considering the experiential quality of performativity, is arguably a more direct contribution to the question of how to facilitate public engagement.

With this work we want to contribute to more and better public listening spaces. Experiential qualities have been shown to support design learning as well as design practice in the general field of interaction design, and we have reason to believe that they could do the same in sonification design. The design sketch presented here suggests the general nature of such generative processes by illustrating what might come out of designing a sonification of a public space with particular attention to sonic atmosphere and performativity.

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Notes

1   Herald/Harbinger (https://vimeo.com/250393598)
2   Air Play (https://datadrivendj.com/tracks/smog/)
3   Data sonification (https://vimeo.com/314758208)