What a Blackbird Has Told Me. Latent (Acoustic) Learning in the Times of Covid-19

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The soundscape of the world is changing

Schafer The tuning of the world 3

Abstract

Throughout the first self-isolation period due to COVID-19 outbreak I was recording the sonic environment from my balcony for one minute and one second every evening. During these sessions I realised that a family of blackbirds had built their nest on my rooftop and their chirruping was reaching my ears uninterruptedly. In an era of extensive urban noise pollution overloaded with meaningless saturated acoustic information, the sudden and dramatic drop of long-standing anthropogenic noises allowed for soft sounds which were previously masked, such as the song of chicks, to emerge on the acoustic surface.

This paper suggests that the ubiquitous lockdown did not only change the perceived sonic environment by revealing hidden soundscapes, but also redefined our qualitative hearing; it unveiled a forgotten latent acoustic memory (Hergenhahn & Olson, 2001) which was for a long period of time inactive due to the prevalence of lo-fi soundscapes in urban areas. As if this latent memory had been genetically incorporated in our perception, it has revealed - during the lockdown - the hereditary right of all species to perceive and comprehend their immediate acoustic surroundings. The memory of transparent soundscapes has emerged once again refreshing our memory, unfolding the necessity of acoustic transparency in our environment and sensitizing our ears and brain to vulnerable sounds. Even after decades of living in noisy environments, the latent memory of transparent soundscapes persists and can be revealed by the single song of a blackbird.

How silent urban soundscapes can become

Over the course of the lockdown due to the Covid-19 pandemic we all have experienced minor and major changes in our sonic environment. In many urban areas the noise levels have dropped significantly due to the reduction of anthropogenic noises. Although further research is needed, some early data have already been recorded revealing that noise levels in urban areas were dramatically lower during the lockdown. As revealed by Manzano et al (2021) in an indicative research in Granada, Spain: “During the COVID-19 pandemic the situation completely changed because of the absence of human activity, giving place to a great decrease in noise levels… The considerable drop in SPLs during the lockdown in 2020 evidences natural non-anthropic sounds, mainly birds” (27-28) and “In terms of recorded sound pressure levels, the lack of human activities between the 2019 (pre-lockdown) and 2020 (during-lockdown) measurements campaigns at four typical touristic destinations in Granada accounted for reductions ranging between 13.3 and 30.5 dB(A)” (Idem, 30).

Additional early studies in several European cities indicate a notable decrease in urban noise due, mainly, to the reduction of commuting and traffic noise (Asensio et al, 2020, Acoucité, 2020, Basu et al, 2021, Aletta et al, 2020, Smith et al, 2020, Rumpler et al, 2020, Parker et al, 2020, Spennemann et al, 2020).

In an article published in Science, Derryberry et al (2020) argued that the noise levels during shutdown across the San Francisco Bay Area in the United States were similar to those of the 1950s, and that people became “…newly aware of more conspicuous animal sounds, such as bird songs, particularly in normally noisy areas” (575) and that they could “…hear birds at twice the previous distance, or effectively four times more birds than usual” (576).

Movement restriction resulted in lower levels of anthropogenic and mechanical noises: “…it is possible that restricted human movement reduced use of motorized vehicles, effectively unmasking bird songs otherwise obscured by associated noise pollution” (Ibid). As a result, socially distanced people confined to their homes, balconies and courtyards in previously noisy areas were able to hear the bird songs and other susceptible sounds in their close surroundings. Many realized that the environment can be quitter than it used to be and that they can hear more subtle sounds. Birds and a variety of insects and smaller species reclaimed their acoustic space of favoured frequencies, which was previously masked by overlapping noise.

Blackbirds in my Roof

During the first lockdown in Greece (March-May 2020) I realised that a family of blackbirds had built their nest on my rooftop. I could clearly hear their chirping, the sound of their wings and, later, the calls of the nestlings in the nest.

At the same period, I decided to record the sonic environment from my balcony for one minute and one second every evening[i]. Throughout these recording sessions I realised that I was perceiving a hi-fi version of - what it used to be - a lo-fi sonic environment. However, listening to the chirping of a bird does not imply the perception of its whole sonic activity (small noises of its nest, subtle noises of its movements, wing flapping, communication with the chirps, other birds at a distance). The quietness imposed by the restrictions on movement manifested the fact that our prior-to-lockdown daily acoustic experience included only a part of the whole soundscape. A variety of isolated, fragmented sounds (known as sound signals) were often cut off from their context due to the omnipresent anthropogenic noises.

Sound signals however are not the only collateral damages of a lo-fi sonic environment. The motivations, the stimuli and the associations that emerge from all sounds and nourish our learning processes are also buried beneath the noise floor. The lockdown unfolded in front of our ears the establishment of our daily global sonic regime.

Basic Terminology

Before proceeding further I shall identify some key terms as described by R. M. Shafer in his book *Our Sonic Environment and the Soundscape. The Tuning of the World*. Shafer identifies *soundscape* with the sonic environment: "Technically, any portion of the sonic environment regarded as a field for study. The term may refer to actual environments, or to abstract constructions such as musical compositions and tape montages, particularly when considered as an environment" (274-275). Soundscapes are dynamic environments. They constantly change according to variations in seasonal weather conditions, human and animal behaviour, social, cultural and economic activities, traffic congestion and any alteration in the behaviour or the state of the biophony, geophony and anthropophony (Brooks et al, 2014 and Truax, 1999).

Depending on their spectral characteristics and density of sonic events, soundscapes can be characterized as hi-fi or lo-fi. Shafer (1977, 272) defines hi-fi sonic environment thus: "Abbreviation for high fidelity, that is, a favorable signal-to-noise ratio…Applied to soundscape studies a hi-fi environment is one in which sounds may be heard clearly without crowding or masking". On the opposite side, lo-fi environments are identified by unfavorable signal-to-noise ratio. "Applied to soundscape studies a lo-fi environment is one in which signals are overcrowded, resulting in masking or lack of clarity" (Ibid).

In sonic environments, *keynote* sounds constitute a relatively constant base line from which other sounds emerge. According to Shafer (Ibid): "…keynote sounds are those which are heard by a particular society continuously or frequently enough to form a background against which other sounds are perceived...Often keynote sounds are not consciously perceived, but they act as conditioning agents in the perception of other sound signals". Keynote sounds "…become listening habits in spite of themselves…they help to outline the character of men living among them" (Idem, 9).

Sound signals are pronounced sounds usually associated with specific connotations. Shafer (Idem, 275) describes a sound signal as "Any sound to which the attention is particularly directed. In soundscape studies sound signals are contrasted by keynote sounds, in much the same way as figure and ground are contrasted in visual perception".

Noise Pollution

Today, a large number of keynote sounds have changed significantly compared to those of past centuries. Urban environments are overpopulated by mechanical and technological sounds to such an extent that "…it is no longer possible to know what, if anything, is to be listened to" (Shafer 1997, 71). A great part of the world's sonic environments move into an all-time lo-fi state with ubiquitous and "imperialistic" properties (Idem, 77).

Technologically and mechanically generated noise is continuously rising while the perception of subtle sounds and signals is generally declining. Whilst producing low noise-emission machinery (including air conditioners and fans, compaction machines, welding and power generators, compressors, etc.) should mitigate this increase in noise levels, the extent of this mitigation seems to be far from reassuring, certainly in Europe (Suter 1991, 11).

Continuous noise and the salami sound

Noise pollution occurs as a consequence of society's urge for increased mobility, productivity and product preservation and storage. Backup and portable generators, industrial and domestic refrigerators, air conditioners and fans, motors and compressors "…create low-information, high-redundancy sounds" (Shafer 1997, 78) adding not only to the opacity of urban sonic spectra - mostly at their lower and middle parts - but also to the general noise levels within the soundscape. Constant engine noise, long-lasting drones with little or no variation in time, continuous noises of equivalent energy intrude into the soundscape as the new 24/7 keynote sounds in urban areas. I shall refer to these keynote sounds as *salami sounds*. The continuous, prolonged and unchanging sound energy is their foundational and "…predominating feature" (Ibid). Such constant and broadband spectra reduce the acoustic horizon of the environment, the perception of distant sounds and, consequently, the overall sense of spatial distribution (Truax 2001, 26).

As an example, an "average backup generator measures between 60 and 70 decibels" whilst a "portable generator has a noise level between 70 and 100 decibels when heard from the industry standard of 7 meters"[ii]. If we consider that most roads in cities accommodate several shops with power generators, air conditioners, refrigerators and fans, and that whenever two broadband noise waveforms of the same intensity are added together they result in an increase of approximately three decibels, we can safely assume that tackling the phenomenon of the salami sound is both demanding and challenging.

Although there is sufficient scientific evidence that noise exposure can impair public health (Kerns et al. 2018, Münzel et al. 2020, Basner et al. 2014, Passchier-Vermeer et al., 2000) and the environmental quality of life, there is still reluctance among central policy makers to adopt effective action plans for the reduction of noise in public areas. This is clear when one delves into the labyrinth of conflicting European directives and regulations. Albeit the stated aim of EU's Environmental Noise Directive 2002/49/EC (consolidated in 2021) "…to define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise…"[iii], parts of the legislation are vague or poorly defined. For example, "Directive 2002/49/EC carefully avoided the setting of any binding noise limit value or non-binding target value, the exceedance of which would require the elaboration of an action plan. It defined the term 'limit value' but hastened to add that this value was to be determined by Member States: 'the exceeding of which causes competent authorities to consider or enforce mitigation measures' (Article 3(s))"[iv]. The sound power levels requirements of air conditioners and power generators outdoors are established respectively in Regulation (EU) 206/2012 and Directive 2000/14/EC. In Regulation 206/2012 the requirements for maximum sound power levels of air conditioners and comfort fans are set to 65-70 dB(A)[v]. Manufacturers of air conditioners and comfort fans are urged to label the noise levels of their products without however being subject to efficient limitations. Moreover, a review of Regulation 626/2011 concerning the air conditioners and comfort fans, published in 2018, indicates another unspecified issue in EU's legislation regarding adequate noise prevention and mitigation strategies: "The prescription about noise is not that clear: 'The noise level of fans and regulators at all speeds shall be within reasonable limits'"[vi]. The prescription of the "reasonable" limits is left to the reader's imagination[vii].

The salami sound, or *flat line* effect (Shafer 1997, 78) introduces a new soundscape context within which humans, animals and birds are called to adapt their listening strategies. Low information background sounds create homogeneous sonic environments with poor acoustic definition. However, listening is the key issue in sonic perception because "…it is the primary interface between the individual and the environment. It is a path of information exchange, not just the auditory reaction to stimuli" (Truax 2001, xviii). Low-information high-redundancy soundscapes obstruct the interactivity between the individual and the environment because "such environments do not encourage more active types of listening, and their prevalence may prevent listeners from experiencing any alternative" (Idem, 27). The perception of acoustic information by the listener is highly dependent on the soundscape's context, which is "…essential for understanding the meaning of any message" (Idem, 11). Whenever the salami effect is prevalent in the soundscape, the listener's perception slips away on an doubtful and non-contextual experience.

Let us examine the following example from the one-minute-and-one-second recordings during the lockdown. The spectrogram in Figure 1 illustrates the spectral characteristics of the captured sounds. The microphones were placed in a distance of about 60 meters from the sources.

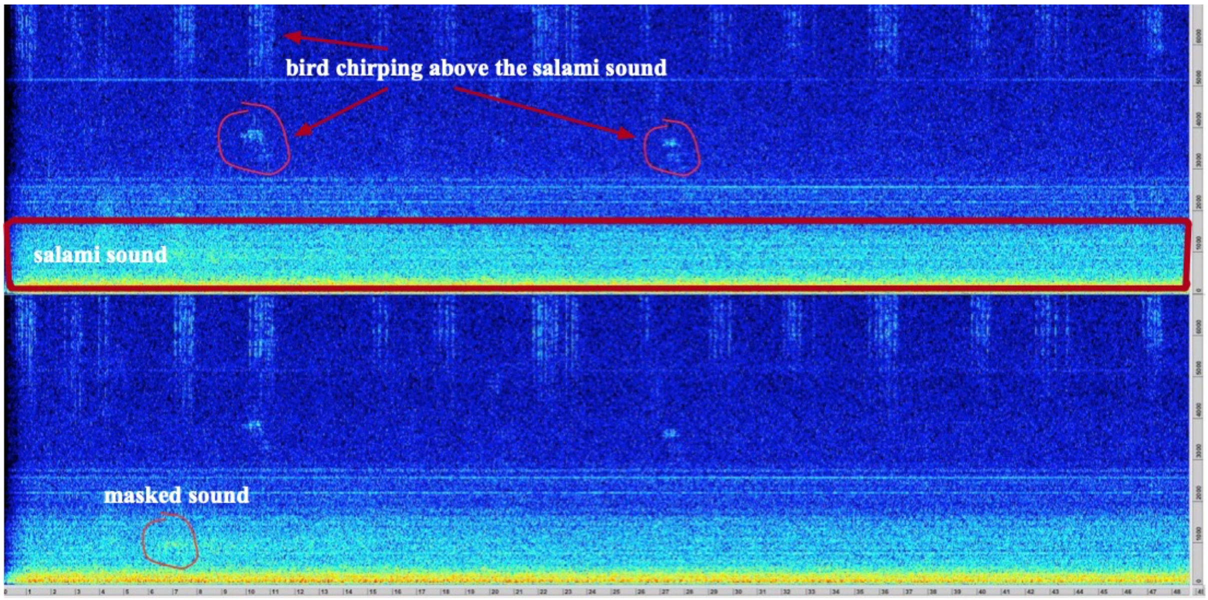

Figure 1

The salami sound, which was emitted by a nearby power generator of a corner shop, occupies the low and middle areas of the spectrum (part of it constitutes the recording noise). Its spectral energy is continuously distributed over a fairly large range of frequencies (up to 1700 Hz). On the upper parts of the spectrum we can observe chirping birds far above the salami sound. The chirping is perceived clearly by the listener. At about 850 Hz within the salami sound resides an almost imperceptible sound, which is, possibly, the chirping of another bird. This sound is completely masked by the noise of the power generator, which obscures the auditory image and "…lessens the clarity or definition of the acoustic information…" (Idem, 96). As a consequence, the acoustic definition is blurred and the listener is no longer able to hear all the sounds clearly and to perceive their distinctive and varied acoustic features. The constant noise interferes both with the communication of the birds and the perception of the listener. This fact leads to the following question: what is the relationship between man and the sounds of the environment and what happens when those sounds are obstructed, masked, or interrupted?

Latent Learning and Cognitive Maps

Latent learning (from Greek λήθη (lēthē) and Latin latentem (concealed, secret, unknown) is the subconscious observation of the environment with no particular motivation to obtain any information from it (Tavris and Wade 2000). Early experiments with rats (Tolman et al. 1930, 1946, Tolman 1948, 1949) demonstrated that latent learning is a form of learning that stores environmental information on a daily basis. This information emerges and effects later behaviour when the right incentives are presented. Hergenhahn et al. (2001, 298) define latent learning as "…learning that is not translated into performance. In other words, it is possible for learning to remain dormant for a considerable length of time before it is manifested in behavior".

Although reinforcement, associations and motivation with the stimuli are usually absent or irrelevant, latent learning provides us constantly with invaluable knowledge of our surrounding environment. Humans and animals are able to exploit this knowledge at a later date when adequate motivation appears. As scientists suggest (Nelson 1978, Medina 2001, MacLeod 1988), even after a memory is apparently forgotten, its latent residue can still be present because "…a latent (residual) memory persists and can be revealed by facilitated acquisition in a subsequent learning task" (Philips et al. 2006, 224). This type of memory is known as latent memory.

Latent memory and latent learning are common characteristics of learning and memory across animals and humans (Ibid). They explain, to some extent, the way we perceive and store information from the environment for later use. In his 1948 paper "Cognitive Maps in Rats and Men", Tolman introduced the concept of cognitive maps as a "…tentative map, indicating routes and paths and environmental relationships, which finally determines what responses, if any, the animal will finally release" (192). Although cognitive maps are usually related to the representation of a space in the brain, a cognitive map can refer to "…any visual representation of a person's (or a group's) mental model for a given space, process or concept" (Gibbons 2019). In general, cognitive maps are mapping/memory systems responsible for context-dependent memories in the brain. Cognitive maps contain information about the spatial environment. For example, if we want to exit from a cinema we remember where the exit door is in relation to our position. The knowledge of the position of the door was acquired prior to our exit without the presence of any motivation. Epstein et al. (2017, 1508) describe the operational process of cognitive maps thus: “For a cognitive map to be useful, the organism must have a mechanism for connecting map coordinates to fixed aspects of the environment that can be identified by perceptual systems”. Cognitive maps provide us with a framework for identifying our position in relation to other objects or stimuli in our surroundings.

Auditory cognitive maps. A hypothesis.

In our everyday life various acoustic stimuli knock on the door of our perception carrying information about the spatial sonic environment. As with objects in a landscape, the acoustic stimuli of a soundscape enrich our latent learning process by creating what I might call *auditory cognitive maps*. I shall compare the process of latent learning and the auditory cognitive maps to Truax’s idea of *background listening*. According to Truax (2001, 24), background listening is a common experience during which “…the sound usually remains in the background of our attention. It occurs when we are not listening for a particular sound, and when its occurrence has no special or immediate significance to us. However, we are still aware of the sound, in the sense that if asked whether we had heard it, we could probably respond affirmatively”. We can assume that background listening is an action with no motivation or reinforcement, an activity that just happens or a part of our daily latent learning process.

However, a great number of subtle sounds, such as the wing flapping of birds, the buzz of insects or the distant song of a bird are either completely masked or obstructed by the salami sound effect. As a result, background listening is partially or completely blocked by the presence of constant noise. Latent learning becomes thus the first involuntary victim under the dominance of noise.

My hypothesis is that the obstruction of the latent learning processes by the salami sound effect interferes with our ability to create auditory cognitive maps of the environment. As a consequence, the capacity to develop an accurate sense of location, direction and distance within our environment, as well as the motivation to enjoy and explore the full range of a soundscape are also diminished.

Constant noise is a condition which favors narrow-strip auditory cognitive maps where the representation of sonic events in spatial-temporal context is blurred and deficient in clarity and in coherence[viii]. Furthermore, constant noise distracts our sense of exploration and curiosity since it impedes the latent learning processes by blocking out the acoustic stimuli. As a result, it interferes with our long term skills of holistic soundscape evaluation and global environmental understanding.

Due to the decrease of anthropogenic sounds (motorised sounds, sounds of technology) during the COVID-19 lockdowns, many of the previously masked sounds emerged once again from obscurity. Traffic noise and mechanical sounds shrank away so that more bird songs and insect sounds could be heard. Soundscape analyses from urban areas in Europe showed that “…eventfulness, acoustic complexity, and acoustic richness increased significantly over the time period, while the amount of technological sounds decreased” and that “…an increased presence of birdsong emerge as a novel characteristic element of the local urban soundscape” (Lenzi et al. 2021). Moreover, long forgotten motivations and associations related to acoustic stimuli emerged once again during the quiet periods of the lockdown.

However, even during the most silent hours of the shutdown, power generators, compressors and air conditioners operated in the open air on a 24/7 basis only to remind us that electrical energy and cooling and refrigeration comforts should be available at any time and at any cost.

During the latent learning processes, one hears a variety of sounds with no purpose or any specific goal in mind. For example, one hears the bird songs without any incentives unless one is an ornithologist. However, there might be a neutral satisfaction in this activity; a sense of exploration and curiosity through which auditory cognitive maps are developed as representatives of the sonic environment.

While hearing and recording the evening soundscapes from my balcony in the midst of the first lockdown period in 2020, it became obvious to me that the salami sound emitted by the power generator of the corner shop obstructed a great part of the soundscape. Sounds in the low and middle parts of the spectrum were completely or partially masked. Consequently, my understanding of the environment was impaired and biased because of the constant noise and the salami sound effect.

Noise pollution and the regular exposure to elevated sound levels and constant noise can have deleterious effects on human-environmental interactions. Alongside with the crisis in climate and the environmental destruction, constant noise and the salami sound effect present us with a new kind of extinction: the extinction of perception of what there is but cannot be perceived.

What the blackbird has told me. Or, how I am related to the blackbird.

Living with constant noise is a process of adaptation. The concealment of acoustic information establishes a new status quo between man and the sonic environment. Adaptive people are continually revising their own auditory cognitive maps to match the loss of information that they encounter in their everyday listening experience. Such deprived acoustic environment could conceivably change their view of the world and the way they interacted with it and fell about it (Epting and Paris 2006). Constant noise and the salami sound effect reevaluate the relationship between societies and the sonic environment.

Although noises of the technosphere were often invasively present, the silent periods of the lockdowns changed the perceived sonic environment, redefined our qualitative hearing and unveiled a forgotten latent acoustic memory which was for a long time inactive due to the prevalence of lo-fi soundscapes in urban areas: the memory of transparent soundscapes within which the operating process of latent learning remains unhindered.

Once again, people were able to explore "…the sound in an environment in its complexity, ambivalence, meaning, and context" (Brooks et al. 2014, 30). The memory of transparent soundscapes has emerged refreshing our latent memory, unfolding the necessity of acoustic transparency and sensitising our ears and brain to vulnerable sounds. The subtle sounds of the blackbird family, the song of distant birds, the sound of wind and leaves and all the subtle sounds that suffer under the regime of constant noise emerged afresh into transparent soundscapes. Silence and immobility during lockdown allowed us to reaffirm our relation with the sonic environment through "the function of memory and knowledge (mnemo-cognitive), which concerns the ability to investigate the significance of mnemonic phenomena and constant learning" and through "the physiology of memory (mnemo-physiology), which concerns the acquisition, stabilisation and recall of memories, as well as the identification and correlation of the essential components of memory" (Triarchou 2015, 127, author's translation).

How do I reply to the blackbird. Conclusion

Both the sonic environment and our capacity to interact with it are greatly affected by our economic and social practices and by our impassioned devotion to machines and the process of producing, of consuming and of preserving. Noise emission (an offspring of this devotion) is "the ignored pollutant" (King and Murphy, 2016) for it represents a socially affordable price for the well-being of our societies. As Shafer (1997, 237) puts it: "When a society fumbles with sound, when it does not comprehend the principles of decorum and balance in soundmaking, when it does not understand that there is a time to produce and a time to shut up, the soundscape slips from hi-fi to lo-fi condition and ultimately consumes itself in cacophony". However, the Covid-19 pandemic and the restrictions in movement revealed that human interaction with nature is also an essential element for the human and social well-being. For such interaction to exist, latent learning operations should continue to run smoothly and unaffected by the intrusion of constant noise and the salami sound effect. Indeed, as a WHO working group declared back in 1971: "Noise must be recognized as a major threat to human well-being" (Suess, 1973).

Acoustic sustainability, or "…our ability as a culture to live within a positively functioning soundscape that has long-term viability" (Truax 1999, 3) is of vital importance in maintaining the human-environment interaction through latent learning processes. The hypothesis that latent learning is affected by the constant noise and the salami sound effect needs further development and validation by an interdisciplinary approach that involves ecologists and psychologists, architects and sound designers, businessmen and policy makers and the general public. According to Suter (1991, 36), "This approach could very well provide the key to understanding a great deal more about the general impact of noise on society…". It is also important to define areas of future research that will build a platform for better understanding the interconnections between constant noise, latent learning and latent memory.

At the moment, little research has been done on the subject and proofs of the direct cause-and-effect relationships between the constant noise and latent learning are insufficient if not absent. Meanwhile, palliative measures such as the EU's Environmental Noise Directive and the Member States' legislation can only scratch the surface of the problem. Although the official European and national policies on noise mitigation remain at best only partially successful, there are several action plans that can be adopted by individuals and communities, including the reconsideration of social daily practices in order to re-establish the hereditary right of all species to listen to and to interact with their sonic environment, "…to create 'space' for the sounds that are potentially present to emerge and be heard" (Truax 1999, 5) and to allow latent learning to create auditory cognitive maps that relate us with these sounds. These actions however require a complete redefinition of the notion of environmental normality. As Slavoj Zizek concluded his article at rt.com in 2020: "Instead of dreaming about a 'return to (old) normality' we should engage in a difficult and painful process of constructing a new normality. This construction is not a medical or economic problem, it is a profoundly political one: we are compelled to invent a new form of our entire social life". And that includes noise as well.

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[i] These recordings can be accessed at https://www.theodoroslotis.com/quarantine-soundscapes
[ii] This information is published by the AlltimePower Company: https://www.alltimepower.com/learn-more/how-loud-generator/#:~:text=With%20that%20in%20mind%2C%20the,dishwasher%20and%20a%20vacuum%20cleaner. (accessed on).
[iii] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02002L0049-20210729&from=EN p. 2
[iv] https://ec.europa.eu/environment/legal/law/5/e_learning/module_3_6.htm and https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02002L0049-20210729&from=EN p. 4.
[v] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02012R0206-20170109&from=EN p. 12. Sound power level means the A-weighted sound power level - dB(A) - indoors and/or outdoors measured at standard rating conditions for cooling or heating. A-Weighting is the most common weighting that is used in noise measurement. However, A-weighted sound level discriminates against low frequencies by cutting off the lower parts of the spectrum.
[vi] https://www.applia-europe.eu/images/Library/Review_Study_on_Airco_05-2018.pdf p. 46.
[vii] For a summary on the EU's environmental noise legislation see also King and Murphy 2016.
[viii] For a detailed analysis on cognitive maps and the representation of items and events in spatial-temporal context see O'Keefe and Nadel 1978 and Eichenbaum 2015.