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SOUND STUDIES OF THE ARCHITECTURAL ENVIRONMENT: URBAN SOUNDSCAPE AND SOUND SEMANTICS

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Abstract. The article is dedicated to a new field for Ukraine – the acoustic study of the architectural environment, the semantics of sound, and the impact of sound signals on human behavior in urban spaces. The concept of the soundscape, introduced into scientific discourse in the 1970s by R. Murray Schafer and his followers, is explored. They laid the foundation for and initiated acoustic studies of cities in the context of their auditory pollution. The methodology for studying the urban soundscape developed by them became the basis for contemporary practical work and was tested by students of the National Academy of Fine Arts and Architecture (Kyiv, Ukraine). Their task involved recording changes in the soundscape according to different types of urban spaces and observing human behavior under the influence of sound signals. All research results were visualized on graphic sound maps. The role of sound in perceiving the architectural space of a city is defined in comparison to the significance of sound in cinema. It is noted that, as in cinema, sound in the urban architectural environment has its own functions: illustration; contrast or counterpoint to the visual sequence; communication; synchronization; structuralization. As in films, sounds can emphasize events (e.g., the sound of a theatrical celebration in a city square), maintain tension in transitional spaces (e.g., the sound of a traffic light), warn of danger, obstacles, or threats (e.g., the sound of a siren), act as a dominant element indicating direction (e.g., a clock on a town hall), convey the novelty of a space or its mystery (e.g., unclear, atypical sounds for a given soundscape), and so on. Based on this, it is hypothesized that the architectural environment can be modeled by programming impressions of its perception and influencing people's behavior within it. Sound is one of the most powerful tools for shaping the perception of architectural space, and sound compositions become an essential component of the sound environment of a modern city, requiring further research and the development of principles for urban sound design. The authors note that the study of the semantics of sound in general and sound signals in particular, as well as their influence on human behavior, is not yet complete but holds great promise for further development of such research on the architectural environment of cities, particularly in Ukraine.
Keywords: architectural environment, soundscape, sound design, sound semantics, sound signal

Introduction

Since the mid-15th century, thanks to Johannes Gutenberg's invention, it became possible to mass-produce and distribute images in any quantity across vast territories. This marked the beginning of the formation of visual culture, with visuality becoming dominant in the perception of the surrounding environment. Visual images not only permeated everyday life but also began to displace other ways of perceiving the world—sounds, smells, and tastes.

It is believed that humans perceive 70-80 % of information about the surrounding world through their eyes, which is why most studies on the architectural environment of cities focus on its visual perception. It should be noted that perception largely depends on the cultural frameworks established within a particular society. Today, this is the so-called e-culture – a digital culture shaped by the influence of cinema and new media. The main feature of this culture is its spectacle-oriented nature, which means that the relationship with the environment is primarily based on visuality and cinematic principles. This legitimizes the study of urban environments using methods developed in cinema, as evidenced by prior research by scientists, including Olena Troshkina [6; 7; 18; 25], as well as Luidmyla Shevchenko and Natalia Novoselchuk [17] – the authors of this article.

However, comparisons between the perception of urban architectural spaces and film frames usually focus exclusively on imagery and rarely consider sound, smell, tactility, or other sensory experiences. It is clear that films are not just moving images, where the movement of the camera simulates the viewer's eye movement—they are a complex of elements that ensure the "realness" of the cinematic environment on screen, aligning with the audience's everyday experiences in real settings. The most crucial component here is the film's sound accompaniment. Therefore, our studies of cities should be not only visual but also auditory.

This highlights the urgent need to study the role of sound in urban spaces, not only from the perspective of acoustics and ecology but also in exploring how sound can influence a person's perception of urban environments. This requires defining the principles, techniques, and tools of urban sound design, which can only be achieved after a thorough examination of its semantic foundation.

The aim of this article is to analyze existing auditory methods for studying the architectural environment of the city, to identify the symbolic nature of sound, and to examine the influence of sound-signs on the perception of urban space and, consequently, on human behavior.

Materials and Methods

Over the past two decades, studies dedicated to sensory perception – such as sound, smell, taste, and touch – have emerged in the global scientific field. While not all of them may currently be applicable to the analysis of the architectural environment (at least, as far as is known today), sound studies have been widely practiced internationally since the 1960s. This initially occurred within the framework of acoustic ecology, a field founded by Canadian composer and researcher Raymond Murray Schafer (1933-2021). Schafer aimed to teach people how to listen and sought to restore auditory culture, which had been gradually displaced by visual culture.

R. Murray Schafer introduced the term "soundscape" into scientific discourse – a composition of sounds perceived by individuals in their surrounding environment. A soundscape

is a landscape whose sounds create a "sound picture," through which one can determine the form, state, dynamics, and other properties of natural landscape components and predict their impact on living organisms and their individual development [21].

Together with his students, Schafer studied urban sounds and emphasized the need to revive the practice of listening, which had been diminished by the dominance of visual culture over the past centuries. According to Schafer, modern humans, due to the primacy of visuality, are aurally illiterate. They have developed an auditory immunity that simply blocks out excessive sound information, leaving them defenseless in an auditory sense. This is especially evident in urban environments, where the cacophony of technical sounds, sirens, advertisements, and other noise is so overwhelming that people stop actively listening as a survival mechanism – learning to filter out sounds and subconsciously transferring them into a "safe" zone.

Schafer points out that, unlike a visual image, one can't simply look away, close their eyes, or avoid what they dislike. Sound, however, permeates the environment entirely. Even if it is unpleasant, we cannot ignore it or "close" our ears [21]. A person cannot always choose what to listen to and does not necessarily interpret the meanings of sounds in the same way as others.

In his book "The Soundscape: Our Sonic Environment and the Tuning of the World", Schafer practically demonstrated the evolution of soundscapes associated with the Industrial Revolution. He traced this progression, starting from the sound of the first typewriter (1714) and cast-iron railways (1738) to the hydraulic press (1794) and the screw-cutting lathe (1797) – and this was just in the 18th century! Schafer also highlighted the influence of rural, industrial, and electronic environments on the formation of soundscapes [21].

The scientific works of the composer and researcher R. Murray Schafer became a catalyst for other sound studies, not only within the realm of urban acoustic ecology and the fight against noise pollution but also in anthropology and sociology. In these fields, sound is examined beyond its physical characteristics – such as pitch, duration, tone, timbre, frequency, and volume – taking into account its broader meanings.

It is worth noting that Schafer's research was conducted in the 1960s, while the global emergence of sound studies began only about 20 years ago. In Ukraine, however, scientific works on this topic are still rare and are mostly limited to the fields of acoustics and geography. For example, the article by V. S. Kanskiy and V. V. Kanska focuses on concepts and approaches to the classification of soundscapes within the study of anthropogenic landscapes [2]. Another notable work is by O. Z. Baiteryakov, who applied a geographical approach to the study of urban soundscapes. In his article, he proposed a "structural-logical model of the urban soundscape, which allows for a systematic understanding of the subject of study. The model consists of four main components: the prerequisites for the formation of the soundscape, its functional structure, as well as the typological structure and the peculiarities of human perception of the sound environment" [1].

Architectural acoustics is perhaps the only discipline within the training system of architects that directly deals with sound. Its foundation lies in the diverse abilities of surfaces and materials to reflect or absorb sound. Previously, acoustics was considered particularly significant for entertainment buildings and, in general, for spaces with auditoriums or conference halls. However, today, the understanding of the importance of acoustic characteristics in various spaces has significantly expanded.

In this regard, it is worth mentioning the dissertation research of K.O. Komarov, "Principles of Architectural Organization of Internal Transit Spaces Considering the Features of Non-Visual Perception" [3], where the researcher examines the principles, techniques, and tools that "create tactile, auditory, thermal, and aromatic markers in the internal spaces of buildings, which can be regarded as navigational elements of the spatial environment to improve orientation for the visually impaired" [3, p. 23]. These elements can also be used for sound modeling of both interior and exterior spaces, i.e., for the sound design of the architectural environment. The researcher concludes that impressions of a space and orientation within it can be modeled by altering surfaces and influencing their tactile and auditory characteristics.

Thus, every space has its unique sound. As in the past, when music was composed for specific places such as temples, palaces, salons, and parks, today composers create music tailored to particular locations. Supporting this claim is the popularity of contemporary soundscape composers like Michael Rüsenberg, who released an album featuring recordings of Cologne's bridges and the sounds of Rome, or Brian Eno, the pioneer of the Ambient style (from the English word "environment"), whose music for various spaces – most famously music for Airports [16] – has gained widespread acclaim.

As for the study of sound semantics, aside from a certain number of academic works in the fields of music and linguistics – such as A.M. Kondratov's "Sounds and Signs" (1978) – as well as research into the human vocal system, it is worth highlighting the work of researchers from the renowned semiotic school led by Yuri Lotman, which operated in Tartu, Estonia, during the 1960s-1980s. Many studies by members of this school were dedicated to the semiotics of cinema, and consequently, sound within it, but they did not address the architectural environment [5].

As mentioned earlier, methods for studying the soundscape of a city were developed by R.M. Schafer in collaboration with his students. The study of a soundscape in any given area can be conducted by a researcher-observer who may either remain stationary or move through the space. Their task is to document all the sounds they hear in accordance with the typological features of the locality and identify the following characteristics:

- Moments when elements of the sound background transition into the sound focus, determined by intersections along the listener's route (paths, boundaries, nodes, landmarks with static and dynamic elements of the soundscape—background sounds, ignored and recognized signals, etc.);
- Differentiation of soundscape elements based on their source, origin (natural or mechanical), and types of sounds, both predictable and manageable.

Thanks to the availability of audio recording technology and the ability to measure sound using applications installed on smartphones, soundscape studies have not only advanced since Schafer's time but have also become an accessible and engaging practice for students. For instance, students of the National Academy of Fine Arts and Architecture, during their studies in courses such as "Fundamentals of Urban Planning" and "Urbanism," tested Schafer's methodology over the course of one semester.

The group was divided into subgroups of 2-3 students, with each team assigned a unique route. All routes started from the academy's campus and extended to various locations

in Kyiv, including residential streets, squares, public centers, and major transportation corridors. In addition to the primary task – observing and documenting changes in the soundscape in accordance with the changes in land use – students monitored human behavior under the influence of auditory signals. These signals were identified as sound signs that act as stimuli for certain behaviors.

The results of the observations were compiled into albums, which effectively served as graphic sound maps of the routes. These maps allowed for the acoustic zoning of the studied areas, enabling the identification of acoustically problematic and acoustically appealing spots. Such findings could inspire professionals from various fields, particularly architects and designers, to improve or adjust the architectural environment and its soundscape.

Thus, this experience became one of the first attempts in Ukraine to study the architectural environment of a city through sound, to define the role of sound in its perception, and to reveal its semantic nature and influence on human behavior.

General regulations

When studying the physical properties of sounds (volume, speed, pitch) in the soundscape of urban areas, R. Schafer identified three types: background sounds or "keynotes", primary sounds or "sound signals", and the most distinctive sounds or "soundmarks" [21]. Essentially, this classification aligns with the categorization of sounds by their informativeness: background sounds, dominant sounds, and unique sounds.

It is evident that every area contains all these types of sounds, but their intensity, speed, pitch, and duration vary. This variability forms the basis for identifying territories by their prevailing sounds and creating their sound maps.

As noted by Kansky V.S. and Kanska V.V., the first attempts to represent the sound component of a landscape using cartographic methods were made by Finnish geographer J. Granö in 1929. He developed a qualitative classification of acoustic phenomena and attempted to document them cartographically [2]. The global spread of such studies is primarily linked to two factors: the growing noise pollution in cities, which needs to be addressed through systematic study, and the availability of sound recording equipment, which enabled the creation of sound maps for urban areas.

Sound maps allow for the acoustic zoning of a city's territory, thereby identifying acoustically problematic and acoustically attractive locations. Without a doubt, such psychoacoustic maps of urban spaces should serve as a stimulus for professionals from various fields – primarily architects and designers – to improve or adjust the architectural environment and its soundscape.

Sound maps of cities reveal that each district has its unique soundscape, which influences the sense of territoriality and self-identity of its residents. The practice of creating sound maps has highlighted a pathway for identifying vernacular districts – areas that "are distinguished based on the analysis of their perception by the population (local residents, tourists, residents from other regions)" [4].

Sound studies of urban architectural environments conducted in Europe have confirmed that the boundaries of actual districts sometimes differ significantly from those perceived by people under auditory influence [10; 26]. At the juncture of sound and silence, a sound barrier often emerges – a powerful, symbolic protection of these boundaries that is not always physical but perceptual.

For example, auditory studies of areas near the National Academy of Fine Arts and Architecture (NAFAA) in Kyiv, conducted by its students, revealed a notable sound barrier at the intersection of Voznesensky Uzviz, Hlybochytska Street, and Nesterivskyi Lane. This barrier symbolically marks the transition from one soundscape (the relatively quiet NAFAA territory) to another (a bustling street with significant vehicular, pedestrian, and bicycle traffic).

The territory of NAFAA is perceived by residents, employees, and students to extend beyond the academy building to the points of these intersections. Consequently, in their minds, this area is much larger than its actual physical boundaries.

Sound maps correlate closely with mental maps, introduced by Kevin Lynch in the 1960s [15]. Urban sound studies allow researchers to highlight transitions in the soundscape – from background to focus – based on intersections along a listener's route (corresponding to Lynch's concepts of paths, edges, nodes, and landmarks) with static and dynamic elements of the soundscape (background, integrated, and recognizable signals).

For instance, the actual boundary of the Solomianskyi district, ending near the high-speed tram tracks and the Povitroflotskyi overpass, does not align with the vernacular boundary of the same district, which is perceived as extending to Ivan Ohienko Street, reaching the railway station. This perception

Map of Unique Sounds

1	Sounds of a foreign language
2	Bell ringing
5	Operation of a coffee machine
7	Construction work
13	Live music
14	Live music, metro sounds
16	Sounds of skateboards, scooters, music from the theater
20	Sounds of public transport (trolleybuses)
22	Sounds of a cooling system, trolleybuses
23	Sounds of children, dogs
24	Sounds of live music, dogs, children
25	Sounds of playing chess
26	Sounds of live music
29	Music

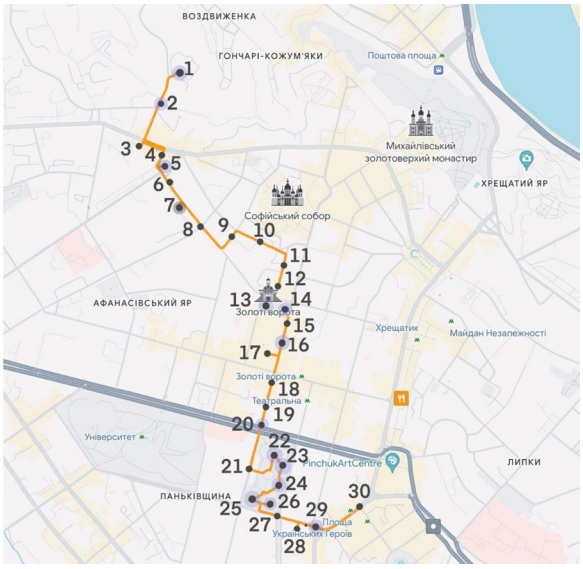
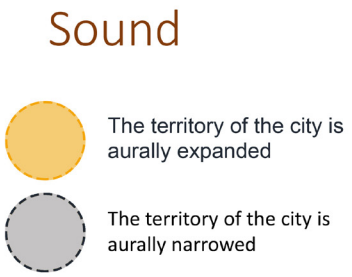


Fig.1. Study of unique sounds on the streets of Kyiv [created bu authors]



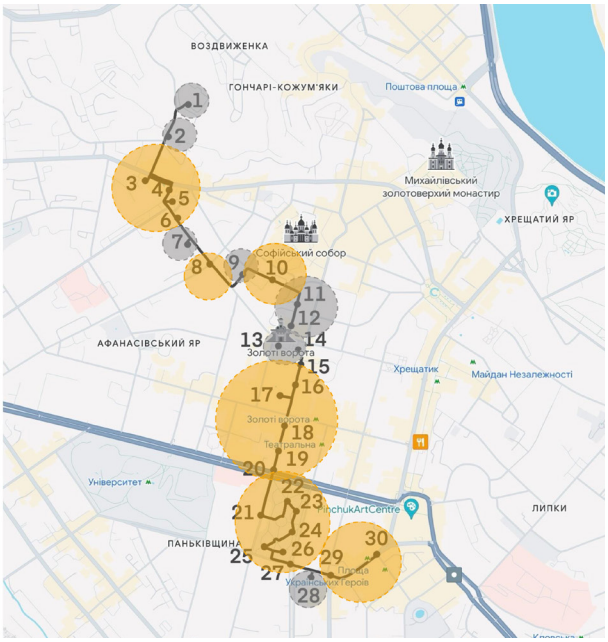


Fig. 2. The influence of sound on the perception of the territory [created by authors]

of a district's territory is shaped by multiple factors, with changes in the soundscape being just one among them – others include the side barriers of the overpass, the railway tracks below, the lack of adjacent spaces to diverge from the main route, and the absence of a visual dominant feature.

Sound can act as a spatial landmark, guiding movement, indicating distance to/from a sound source, and serving as a temporal landmark – for example, the sound of the first tram or train often serves as a precise time signal for nearby residents.

Unlike sound landmarks, background sounds are often unheard or unacknowledged. People have even learned to ignore background noise, regardless of its intensity.

Generally, the intensity of a territory's soundscape depends on two factors: the intensity of the background noise and the frequency of sudden focal elements, as well as the stability of the listener's attention and rhythm. The dynamics and intensity determine the stability of the soundscape. For example, the sound background of Beresteiskyi Avenue in Kyiv remains consistently intense regardless of time, weather, or season (Fig.1).

A number of researchers studying sound within specific areas emphasize the existence of acoustic communities, where sound serves as a medium of relationships between the listener and the surrounding environment. Sound is not merely heard or perceived as noise; it must be distinguished from other sounds and its meaning understood. Scholars often cite examples of distinctive sounds in rural areas – church bells, the evening return of cows from the fields, or the sound of an axe as a neighbor chops wood in their yard. These sounds are uncharacteristic of urban environments. However, the sound of a rarely passing minibus, recognized only by local residents before it even becomes visible, exemplifies this phenomenon. This ability to perceive, distinguish, and understand the sounds specific to a particular area is a hallmark of belonging to an acoustic community [9; 10].

The phenomenon where residents become accustomed to an intense background noise and cease to hear it (e.g., the residents of Beresteiskyi Avenue in Kyiv ignoring its consistently intense soundscape), in contrast to individuals visiting the area for the first time, can also be viewed as a form of membership in an acoustic community.

Sound Studies often explore urban spaces through the lens of their identity and memory. It is believed that sounds intertwine with memories, and recordings of soundscapes can substitute for memory. The collection of associations and symbols that shape a district's identity in the minds of its residents – those who relate to it as their place of residence, work, or leisure – is complemented by a distinctive soundscape. In such communities, locals can not only hear but also distinguish the sounds unique to the area and, most importantly, grasp their meaning [9; 10].

Sound influences both the mastery of space and its appropriation and personalization. Analysis of sound maps demonstrates that sound allows for the personalization of an environment, indicating its ownership or even expanding or reducing its perceived boundaries. For instance, music playing in a café can be heard not only within the venue but also on its outdoor terrace, audibly marking the presence of the establishment and symbolically extending its territory to the reach of the music. However, excessively loud sound within the venue may compel patrons to lean closer during conversations, disrupting their private interpersonal distance. Thus, sound can enforce a shift between different social distances, a concept explored by renowned anthropologist Edward Hall within the framework of proxemics [11] (Fig.2).

Personalization of space can also occur through the suppression or exclusion of inappropriate signals. For example, people may completely ignore street noises by wearing headphones, using other sounds as a filter for the soundscape of their surroundings. Similarly, a car can act as a protective capsule, with its own auditory environment defined by the sound of the car radio.

Sound not only manifests territoriality but also emphasizes the function of urban environments and facilitates the identification of people with space. It delineates contrasts such as external versus internal, familiar versus unfamiliar, center versus periphery, and festive versus mundane.

Territoriality itself corresponds to different types of spaces – primary (full control), secondary (partial control), and public (minimal or no control) – which people perceive, manage, and adapt their behavior accordingly. Sound can also express

territorial aggression when boundaries are breached or unauthorized intrusions occur.

Sound, noise, and silence can be viewed as categories of social inequality. The American sound designer and scholar B. Labelle discusses how different social groups perceive urban sounds differently, emphasizing the need to consider the "acoustic politics of space." In this context, the territorial and sonic boundaries of urban areas do not align but are crucial for understanding an individual's sense of auditory privacy [10]. The researcher highlights the significance of sound in delineating metropolitan spaces into public and private zones, where the latter is often interpreted as a domain of silence. Silence is not merely the absence of sound but also a privilege in urban settings, carrying social significance.

Sound serves as a marker of status and power. R. Murray Schafer noted that a person wielding a jackhammer is more imperialistic and endowed with power than someone with a shovel, and the quieter the neighborhood where one resides – especially in central areas – the higher their social status [21, p.79].

Thus, with the onset of the Industrial Revolution, sound emerged as a territorial marker, particularly evident in contrasting spaces, such as urban versus rural or public versus private. Here, noise and silence are perceived as signs of everyday life, festivity, or privacy.

It is evident that urban sound possesses its own semantic significance and therefore warrants dedicated study, especially considering that psychologists are aware of synesthetic effects – the hidden connection between auditory imagery and non-auditory elements. Consequently, the symbolic nature of sound becomes a subject of inquiry within the semantics of the urban architectural environment. Of particular interest to the authors is the semantics of sound in the context of exploring the cinematic qualities of the urban environment, shaped by the influence of new media.

The soundscapes of films include keynote sounds, sound signals, and sound marks, corresponding to noise, signal-sound, and sign-sound in the semantics of the architectural environment.

It is worth noting that everything that sounds in the city is always contextual. The perception of the environment depends not only on the texture and arrangement of surfaces (facades, roadways, trees, small architectural forms, etc.) that reflect sound, the season, time of day, weather, and so forth, but also on the culturally conditioned expectations of perception – what is expected or customary to hear and what is not. For instance, the Sunday church bell or the sounds of a herd of cows returning home from pasture.

Sound signals (the chime of a town hall clock, church bells, fire truck or ambulance sirens, alarm sounds, mobile phone ringtones, advertising jingles, etc.) are all culturally significant auditory symbols, whose meanings are so familiar that they often go unnoticed. These sound signals are frequently perceived as noise and, alongside actual noise – such as traffic, rustling leaves, or construction sounds – they "go unheard." According to R. Murray Schafer, such sounds necessitate the practice of listening, as all people must cultivate the habit of active auditory perception [21].

By extrapolating research on cinematic sound to the urban architectural environment – which can be designed using cinematic scripting methods, as explored in the scientific works of O. Troshkina [17; 18; 25] – we can trace the similarities in the semantic meanings of sound. For example, the in-depth study of the role of music in films allowed Ukrainian researcher Polina Kharchenko to identify the following functions of music: illustration, contrast or counterpoint to the visual sequence, communication, synchronization, and structuring of on-screen action [12].

P. Kharchenko writes about musical illustration of on-screen action, where "...movement in the frame is accompanied by corresponding changes in tempo, rhythm, melody, harmony, timbre, and so on" [13], [14]. Auditory illustration of cinematic action can be compared to urban noise and soundscapes when the visual and auditory elements align, forming a cohesive whole. For instance, the noise of a busy highway accompanied by a significant flow of vehicles, or the sound of water trickling from a fountain in a city square or a cascading waterfall in a park.

Counterpoint – the simultaneous combination of multiple melodic lines within a musical composition – can be likened to the leitmotifs of an urban environment's narrative: its pathways and the adjacent spaces linked to them. In this case, the visual and auditory layers of urban spaces do not always coincide due to the presence of overlapping environments with varying sounds. For example, the noise of traffic audible in a city park, blending with birdsong and the rustling of leaves, or the sounds of a festive theatrical performance in a city square carrying over into a quiet residential neighborhood. In such instances, sound often precedes the visual element until one arrives at the square to witness the event in person. Thus, sound in the environment functions as a message-sign, allowing individuals to anticipate upcoming events. It also serves as a unifying and connecting element – linking people to spaces and bridging different spaces themselves. This exemplifies the communicative function of sound.

The fusion of soundscapes with the visual environment either enhances the interaction between all components of the human-sound-environment system – synthesizing and unifying them into a cohesive composition of urban space – or, conversely, grants autonomy to each element. In the latter case, the visual and auditory layers may not align. Sound may precede the visual, creating anticipation for events likely unfolding ahead, encouraging individuals to move forward to discover what lies ahead. Alternatively, by lagging behind the main narrative of the urban composition, sound can compel individuals to deviate from their planned route, explore adjacent spaces, or even turn back.

This autonomy of urban visuality and audibility often highlights sound's contrastiveness – its unfamiliarity within a given soundscape. Any abrupt or unexpected sound stands out in an environment with a consistent auditory background. Moreover, as the researcher, composer, and musician David Toop notes, silence is "... not a neutral void. It is the negative of sound, which we anticipate or imagine, and it is the result of contrast" [23, p. 83]. The alternation of sound and silence – a technique used to heighten dramatic tension in cinema – can thus also be applied to architectural environment design.

Contrast and counterpoint, as in cinema, represent a conflict between the visual and auditory layers. According to David Toop, this conflict amplifies dramaturgy [24].

The synchronizing function of sound manifests in its ability to shape the emotional perception of space and, as P. Kharchenko notes, to create "...additional prerequisites for unfolding the narrative and stimulating further events on screen" [14]. The same applies to the architectural environment, where a sound sign not only evokes emotions but also influences the creation of creation of a suitable background for the main storyline of the urban composition and its other leitmotifs. It unifies all elements of urban architectural scenography – visual images of the territory, enhanced by sound and the

movement of people and objects – with a single emotional tone.

Previously, we discussed how sound can personalize the environment, indicate its identity, expand or contract its perceived boundaries, and contribute to the formation of vernacular neighborhoods. This reveals the structuring function of sound in urban space.

Sound has a beginning, continuation, and end, which cannot be rearranged, as sound develops sequentially, typically in a linear manner. "Sound, unlike vision, inherently implies movement", writes David Toop [23, p. 107]. Thus, sound can also be seen as a driving force behind the narrative of urban composition, encouraging people to move in the direction intended by the author, gradually unfolding – like frame by frame in a film – the scenario of urban space perception. This movement is not only predominantly linear but also rhythmic, as even changes in day and night, weekdays and weekends, or seasons affect the transformation of the urban soundscape.

Sound can act as a stimulus for action, and consequently, for specific behavior within an environment. Research on consumer behavior regulated by background music highlights its impact, such as influencing perceptions of food appeal and subsequently increasing sales [8; 19; 20].

Charles Spence, a professor at the University of Oxford, has dedicated his studies to exploring how music, color, and even the weight of tableware can enhance the taste of food and beverages. In his book "Gastrophysics: The New Science of Eating", Spence argues that people tend to associate specific sounds with specific tastes. For instance, sourness is linked to high-pitched tones, bitterness corresponds to deeper tones, and salty flavors are associated with certain pulsating sounds. Overall, background music can make food taste better. Slow music extends the duration of taste sensations, while lively music causes them to fade more quickly. Using modern technology, Spence conducted experiments showing that music can even replace spices. The more participants enjoyed the music, the tastier they found the food, whereas overly low-pitched sounds made food taste bitter [22].

Thus, consumer psychologists and marketers have demonstrated that environmental cues, including background music, can influence numerous subconscious consumer behaviors, effectively driving higher food and beverage sales. Modeling food choices is now a reality in the competitive struggle for consumers.

It is evident that the background sound of a specific environment encourages habitual actions, whereas unfamiliar sounds in an architectural space can provoke abrupt reactions and behavioral changes. It is also worth noting that sounds originating from anywhere other than directly in front of a person are often perceived as a threat. It is crucial for individuals to see the source of a sound and/or understand its meaning.

Similarly to visual elements, auditory signs semantically shape behavioral patterns, which remain insufficiently studied. David Toop highlights the existence of certain sounds that should be interpreted as public auditory signs capable of both uniting and dividing people, as well as spreading panic [23, p. 146]. Experiencing the reality of nighttime drone attacks on a city, one can assert that the sounds of nearby bomb explosions unite people in a shared state of panic.

Thus, in an urban architectural environment, as in film, sounds can emphasize events (e.g., the sound of a theatrical celebration on a city square), sustain tension in threshold spaces (e.g., the sound of a traffic light), or warn of danger, obstacles, and threats (e.g., the sound of a siren). Sounds can also serve as dominant markers, indicating direction (e.g., the chime of a town hall clock), or convey the novelty or mystery of a space (e.g., unfamiliar, non-characteristic sounds for a given soundscape). Moreover, the same sound in different contexts can symbolize entirely different, sometimes opposing situations. For instance, in peaceful times, the sound of a working generator was perceived as irritating – akin to the noise of a jackhammer that one either had to endure or escape from due to its intolerability. Today, however, this sound in Ukraine is perceived as a sound-signal of rescue, refuge, and safety – ultimately as a sign-symbol of life itself.

The cinematic nature of the city's architectural environment, shaped by the influence of new media and computer interfaces, fully legitimizes its sound design, as it remains within the framework of audiovisuality inherent to contemporary cinematography. Sound fountains, sound sculptures, sound installations, and sound gardens transform the character of public spaces, influencing residents' perceptions and behaviors. Sound art can exert a powerful impact, leading to its widespread presence in urban settings, much like street art, graffiti, street music, and advertising.

Conclusions

Sound is one of the tools for understanding the city. Although auditory research by architects-urbanists and urban planners is still insufficiently widespread, it demonstrates that urban spaces can be structured, defined, and identified not only through various forms of visuality (material-architectural objects, plan configurations, skyline silhouettes, etc.) but also through sound.

Global sound studies in urban audio ecology, as well as the methods and techniques for sound adjustment, are applicable for examining architectural environments, their semantic meanings, imagery, and the behavior of people – an important component of architectural science. Sound is one of the most powerful tools for influencing the perception of architectural space, while sound artworks have become an essential element of the soundscape in modern cities, necessitating further research and the development of principles for urban sound design.

Thus, the semantics of the architectural environment in contemporary cities is shaped under the influence of digital culture, with its integral components – cinematography and new media – creating new signs and reproducing them within the spaces surrounding individuals. The urban cinematic text affects a person's emotional perception of a place and their behavior within it, provided they know how to interpret and understand it correctly. In turn, an architect must understand the rules of contemporary grammar, morphology, and syntax of architectural language to anticipate and deliberately program impressions. This is why research into the semantics of architecture using cinematic methods should become one of the approaches to studying the architectural environment of cities, with auditory studies taking their rightful place in this process.

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Kopsavilkums

Raksts ir veltīts jaunam pētniecības virzienam Ukrainā – arhitektoniskās vides akustiskajai izpētei, skaņas semantikai un skaņas signālu ietekmei uz cilvēka uzvedību pilsēttelpā. Tiek analizēta skaņas ainavas koncepcija, ko 20. gadsimta 70. gados zinātniskajā apritē ieviesa R. Marejs Šēfers *(R. Murray Schafer)* un viņa sekotāji. Viņi aizsāka pilsētu akustiskos pētījumus, pievēršot uzmanību to skaņu piesārņojuma problemātikai un ieliekot pamatus mūsdienu akustiskās vides analīzei. Rakstā tiek definēta skaņas nozīme pilsētas arhitektoniskās telpas uztverē, to salīdzinot ar skaņas funkcijām kino mākslā. Tiek norādīts, ka – līdzīgi kā kino – arī arhitektoniskajā vidē skaņai ir vairākas funkcijas: ilustratīva; kontrastējoša vai pretstatīta vizuālajai ainai; komunikatīva; sinhronizējoša; strukturējoša. Tāpat kā filmā, skaņas pilsētvidē var uzsvērt notikumus (piemēram, svētku trokšņi pilsētas laukumā), uzturēt spriedzi pārejas zonās (piemēram, luksofora skaņa), brīdināt par briesmām, šķēršļiem vai draudiem (piemēram, sirēnas skaņa), norādīt virzienu (piemēram, rātsnama pulksteņa zvanīšana), kā arī radīt telpas jaunuma vai noslēpumainības iespaidu (piemēram, neparasti, konkrētajai skaņu ainavai nerakstūrīgi trokšņi). Pamatojoties uz šiem novērojumiem, tiek izvirzīta hipotēze, ka arhitektonisko vidi iespējams modelēt, programmējot tās uztveres iespaidus un ietekmējot cilvēku uzvedību tajā. Skaņa ir viens no spēcīgākajiem līdzekļiem arhitektoniskās telpas uztveres veidošanā, un skaņas kompozīcijas kļūst par nozīmīgu mūsdienu pilsētu skaņu vides sastāvdaļu, kas prasa turpmākus pētījumus un skaņas dizaina principu izstrādi pilsētvides plānošanā.