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ID 1728 | WINTER BUZZ AND SUMMER SIESTA IN ZAGREB - PERCEPTUAL DIFFERENCES IN SOUNDSCAPE OF THE SEQUENCE OF URBAN OPEN SPACES

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1 INTRODUCTION

What makes a good public space? There are many answers to this question, but no definite ones. This ongoing research focuses on perceptual differences within sequences of urban open spaces in the historical city centres of Zagreb, in Croatia, and Sheffield, in the United Kingdom, in the hope of providing some new insights. A harmonious historical setting is perhaps one of the most recognisable visual factors,

while soundscape is one of the most elusive. The former can be protected by law as cultural heritage, but the latter changes according to activities and weather conditions, regular or irregular daily or weekly rhythms, or even seasons. Yet both contribute to personal assessments of comfort in public space and in the end, directly to the quality of city life (Carr et al, 1992).

Both the chosen locations were recognised as containing sequences of acoustically specific urban open spaces, with different visual presence of historical elements. Studying their perceptual differences and similarities may lead to a better understanding of the importance that soundscape and the authenticity of a heritage setting have in the management and enhancement of urban open spaces.

The paper focuses on the sequence in Zagreb known as the Green Horseshoe. It consists of seven squares and one park of approximately the same sizes and shapes, with similar traffic regulation, but different ambiences in their central parts, due to different types of foliage, pavilions and activities. No square on its own conveys a particular aural experience, but in a sequence, they are worth investigating, as the fact that they are nearly the same shape and size eliminates the influence of these factors during comparison. The visual and acoustic properties differ from one square to the next, like the rooms within a Baroque enfilade from the salon to the boudoir – from the square housing the opera building to the Botanical Gardens. The complex was built in the late nineteenth and early twentieth centuries. Today, it forms a vital part of Zagreb's city centre, where the historical setting has been well preserved (Knežević, 1996). However, not all the urban open spaces in the sequence are equally important or adequately used in terms of their potential.

The research is primarily concerned with visual and aural perceptions and their congruence. Methodologically, it is based on onsite recordings, listening experiments held in laboratory conditions and software analyses of objective acoustic parameters. Monitoring was conducted in December 2013, February 2014, June 2014 and December 2016 in Zagreb; and in September 2016 and May 2017 in Sheffield. Monitoring enabled comparisons of the effect the different uses of the spaces through the seasons and subsequent changes in the soundscape have on the overall experience. This included temporary winter commercial activities during Zagreb's five-week Advent and Christmas Fair.

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2 SEQUENCES OF URBAN OPEN SPACES 2.1 SOUNDSCAPE ASSESSMENT OF URBAN OPEN SPACES

Soundscape research started in the second half of the 20th century and has grown significantly in the last fifteen years. It is mainly concerned with finding holistic answers to noise mitigation. Noise has a negative effect on health and the overall quality of city life, and it affects people in enclosed and open spaces. The definition of noise is inherently subjective, so both qualitative and quantitative approaches are needed. Noise propagation models do not provide sufficient information for assessing acoustic comfort, which motivates ongoing research into models for soundscape quality prediction which could be implemented into urban planning and design (Aletta and Kang, 2016).

Standardisation of soundscape research is one of the most recent advances. It includes the descriptors for soundscape assessment defined by Axelsson et al (2010), along with the standardized soundscape assessment protocol and adoption of the ISO soundscape standard (Kang and Schulte Fortkamp, 2016).

The concept of soundscape is based on interaction between sounds, listeners and the environment (Truax, 2001). The acoustic features of urban open spaces in a strict sense are an important factor in the perception of urban soundscape (Maag, 2013). Urban morphology has a strong influence on sound propagation (Kang, 2007), while visual features influence both aural and visual perceptions (Marry, 2010).

Since every urban open space is experienced within its context, it is argued that the analysis of the sequences of urban open spaces is vital to assessment. The soundwalk is a soundscape research method that allows assessments of different ambiences within urban open spaces to be captured (Truax, 1999). Four major soundscape assessment methods have been recognised: soundwalks, laboratory experiments,

narrative interviews, and behavioural observations (Aletta et al, 2016). In order to enable comparison of the monitored locations, a hybrid method of soundwalks and laboratory experiment was used, by conducting a listening experiment based on the concept of a spatial sequence.

2.2 SEQUENCES OF URBAN OPEN SPACES IN ZAGREB AND SHEFFIELD

Both chosen sequences contain several squares, but are morphologically completely different. Both include a path leading from the square in front of a railway station to a central pedestrian zone. So both act as 'city entrances'. In Zagreb, the eastern and western parts of the horseshoe were planned as representative city axes – the eastern one forms part of the city's central axis, a straight line of almost 6.3 km, included in most 20th century urban plans, while the western one forms part of the axis connecting many buildings belonging to the University of Zagreb along 1.75 km. In 1913, it was planned to locate arts and cultural facilities in the eastern axis and science and education ones in the western axis (Bojanić Obad Šćitaroci and Obad Šćitaroci, 2004). The Sheffield sequence does not have these characteristics. It starts at the railway station at the eastern edge of the city centre and ends in a park in the west. The Zagreb sequence is more like a loop, with the station is positioned at the south eastern joint on the central axis. So the Horseshoe is morphologically similar to the grander sequence of public spaces around the Ringstrasse in Vienna. The squares in the Horseshoe are directly physically connected, square, in shape, and about 1.7 hectares in size. The squares in Sheffield's Gold Route are sometimes adjacent (Millennium Square and Peace Gardens) and at other times physically separated by up to 350 metres (Devonshire Green and Barker's Pool), and they differ in shape and size (from Leopold Square at 0.1 hectares to Devonshire Green at 1.4 hectares). However, it is the scale of the imaginary line connecting the squares that makes them comparable. Both are roughly 1.5 km long (the sequence in Zagreb is approximately 1.65 km and the one in Sheffield approximately 1.45 km), so they can be walked in thirty minutes (Figure 1, Figure 2). This study was motivated by key differences in the authenticity of the historical settings (high in Zagreb, in terms of surrounding buildings and urban and landscape design elements, and low in Sheffield, where only a few historical buildings surround a recently built public space) and soundscape features (the high presence of traffic noise in Zagreb, and low noise in Sheffield, with specially designed sound sources – water fountains). It is expected that that the comparison will determine the influence which different soundscape factors have on the quality of urban open spaces in relation to visual factors concerning cultural heritage issues. This paper, however, only focuses on the soundscape factors analysed in Zagreb, and the first deductions made from the different recordings made in summer 2014 and winter 2016 and the listening experiments conducted in winter 2014 and spring 2017.

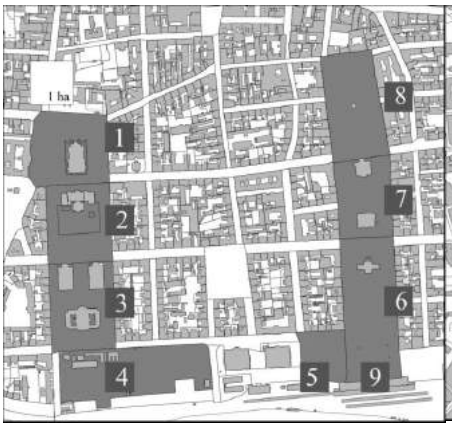

Figure 1 (left) – Map showing the analysed sequence of urban open spaces in Zagreb: 1) Marshall Tito Square, 2) Mažuranić Square, 3) Marko Marulić Square, 4) Botanical Gardens, 5) Ante Starčević Square, 6) King Tomislav Square, 7) Strossmeyer Square, 8) Nikola Šubić Zrinski Square, 9) Railway station.

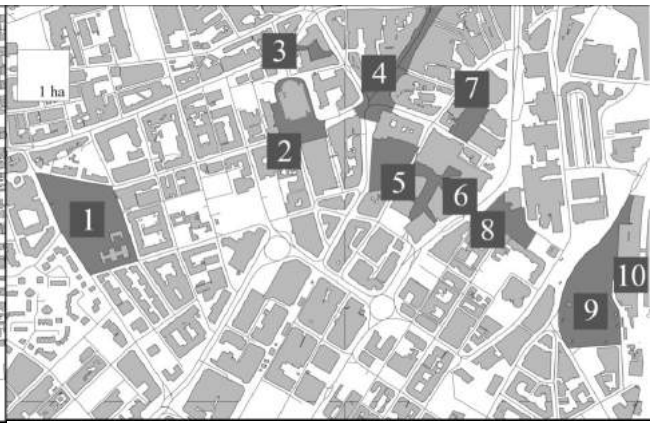

Figure 2 (right) – Map showing the Gold Route in Sheffield: 1) Devonshire Green, 2) Barker's Pool,
3) Leopold Square, 4) Fargate, 5) Peace Gardens, 6) Millenium Square, 7) Tudor Square, 8) Hallam Square, 9) Sheaf Square, 10) Railway station.

It is also important to mention differences in typology, since the functional-spatial type of urban open space influences planning and design, the way it is used, and how it is finally experienced. Bearing in mind the areas covered in foliage, hence the name Green Horseshoe, the spaces in Zagreb could well be called parks instead of squares, especially when compared to Peace Gardens in Sheffield. The presence and position of adjacent public buildings has perhaps contributed to this typological expression.

3 THE CASE STUDY METHOD

3.1 THE CASE STUDY SITE

This unique sequence of seven squares and one park is variously known as the Green Horseshoe, Park Horseshoe, Lenuci's Horseshoe or Zagreb Horseshoe. Its shape was defined by the late 19th century orthogonal grid of Zagreb extending from the main square and Ilica Street in the north to the railway line in the south. The horseshoe was the result of keeping a linear sequence of blocks for the purpose. They form an almost continuous urban open space intersecting with the street grid. The sequence is discontinued only in the southern part between the Botanical Gardens and Ante Starčević Square.

Each square has one or more public buildings and therefore contributes to the city's social life. They include the Croatian National Theatre, the Academy of Drama, the State Archives, the Importanne shopping centre underneath Ante Starčević Square, the Arts Pavilion, and the Academy of Sciences and Arts. The setting also includes the University of Zagreb's main building, the Academy of Music, the Museum of Arts and Crafts, the Museum of Ethnology, the Ministry of Culture, the main railway station, Hotel Esplanade, Hotel Palace and the Supreme Court.

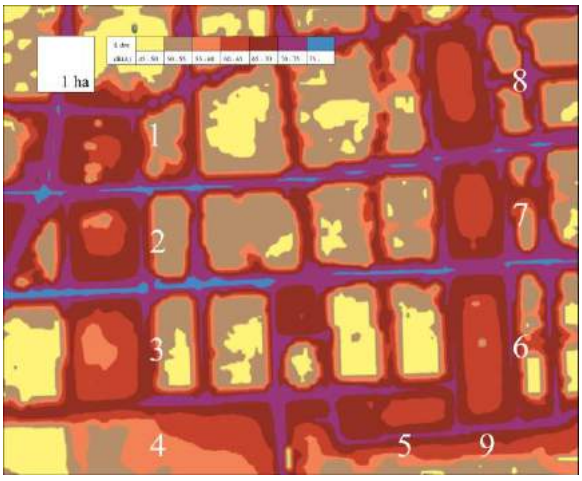

Figure 3 – Noise propagation model for the analysed location in Zagreb – road traffic (Lden). The sound pressure levels measured in situ correspond with the expected values shown in the model. (Retrieved May 30, 2017, from https://geoportal.zagreb.hr/Karta)

Implementing the horseshoe shape in the grid of Zagreb's 19th century centre was not integrally envisaged (Bojanić Obad Šćitaroci and Obad Šćitaroci, 2004). It came about as a result of partial plans and clever ad hoc design solutions by the engineer Milan Lenuci, along with the unfolding of historical circumstances (Knežević, 1996).

Parks in 19th -century town centres reveal a culture of providing a complete sensory experience of public space, and were planned to provide relaxation, peace, and relief from the psychological effects of the hectic city atmosphere (Hauser, 2008). These characteristics could be considered as the design requirements for the Zagreb sequence. The noise map model shown in Figure 3 suggests that the sequence's soundscape has surrendered to the contemporary traffic.

However, the historical authenticity of its urban and landscape design elements and surrounding buildings contribute greatly to its ambient value. The Horseshoe is protected by legislation and urban plans, including its historical mid-19th and early 20th-century strata.

3.2 THE SEQUENCE

Like in a Baroque mansion, where one room follows another, varying in size, shape and acoustical properties along the enfilade, so one square follows another along Zagreb's Horseshoe. From the mansion entrance, the sequence begins with a marble hall, followed by a large dining-room, a salon with silk-

panelled walls suitable for chamber music, then a smaller room, and ends in a satin-lined boudoir suitable for whispered trysts (Rasmusen, 1962).

The west wing of the sequence begins a similar gradation from the north with Marshall Tito Square, designed to impress with the dominant central building of the Croatian National Theatre and surrounding flower-beds. During the day, teenagers and students gather and roller-skate, while it becomes the theatre forecourt in the evening. To the south lies Mažuranić Square, mostly covered in chestnut canopies providing shade for children's playgrounds. It is followed by Marko Marulić Square.

Between the western and eastern arms lie the Botanical Gardens, next to the railway line which marked the border of the 19th -century city and stills forms a clear morphological break between the block grid and the unfinished pattern planned and built in the 20th century south of the railway line.

The eastern arm begins in the south as the entrance to the city from the railway station, with vistas opening onto King Tomislav Square and its deep aerial perspective to the north and Ante Starčević Square to the west. Strossmeyer Square follows behind the Arts Pavilion building, hidden behind the former Chemical Laboratory, with bushes and trees designed in the 1938 by the landscape architect Ciril Jeglič. The eastern arm ends with the oldest square in this sequence, Nikola Šubić Zrinski Square, mostly built between 1870 and 1893, surrounded by public buildings, shops and restaurants, and largely covered by plane-trees which flank its two symmetrical orthogonal axes and frame its centre (Bojanić Obad Šćitaroci and Obad Šćitaroci, 2004).

3.3 COMMERCIAL ACTIVITIES IN DECEMBER 2016

Commercial activities in Zagreb's city centre during festive periods have been organized regularly by the Zagreb Tourist Board since 2002, and include many souvenir and food stalls. Since 2011, they have also appeared on some parts of the Horseshoe (Pauček Šljivak, 2016). Through advertising abroad, they have become a significant tourist attraction (Koretić, 2017). The entire eastern arm of the Horseshoe was covered in souvenir and food stalls, stages equipped with amplification systems on Nikola Šubić Zrinski Square and Strossmeyer Square, and a temporary ice-skating rink on King Tomislav Square.

3.4 MONITORING AND FIELD RECORDING

Monitoring of the locations was conducted in December 2013, February 2014, June 2014 and December 2016. It included recording visual and aural data at selected measurement points in the early afternoon on working days. Field recordings were used as representative samples for listening experiments and software analyses.

At each measurement point, as shown in Figure 4, aural data were recorded using an omnidirectional microphone and a first-order Ambisonics microphone. Ten-minute periods were recorded to obtain a representative sample, including various combinations in the exchange of dynamics according to traffic and the use of the space.

Visual data collection was performed by taking panoramic photos from the exact position of the microphones. In 2016, spherical panoramas were also taken to enable future experiments based on the partial virtual reality principle.

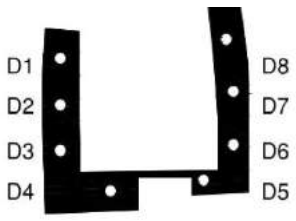

Figure 4 – Position of measurement points: D1 - Marshall Tito Square, D2 Mažuranić Square, 3) Marko Marulić Square, 4) Botanical Gardens, 5) Ante Starčević Square, 6) King Tomislav Square, 7) Strossmeyer Square, 8) Nikola Šubić Zrinski Square (Oberman, 2015)

3.5 TWO LISTENING EXPERIMENTS

Two listening experiments were conducted; the first in December 2014 (35 participants, average age 27) and the second in March 2017 (19 participants, average age 30). Both were conducted in the ambisonics-equipped auralisation laboratory at the Faculty of Electrical Engineering and Computing at the University of Zagreb. In order to isolate the influence soundscape has on overall perception and perception of visual features, identical panoramic photographs were used during both experiments. The first experiment was based on recordings made in June 2014, and the second on those made in December 2016.

In both listening experiments, the participants completed a questionnaire for each square based on the Swedish Soundscape-Quality Protocol, to provide information regarding the presence of certain types of sound sources (traffic noise, other noise, human sounds and natural sounds), soundscape perception descriptors, the quality of visual features and the correspondence between the aural and visual experiences. The results are shown in Figure 5.

4 CASE STUDY ANALYSIS

It was expected that the warm, sunny weather in June 2014 would result in a lively, vibrant soundscape, due to the many tourists who have been visiting Zagreb in the summer since Croatia joined the European Union in 2013 (Pauček Šljivak, 2016). It also turned out that the commercial events organized by the Zagreb Tourist Board during December and January transformed otherwise unused open places (due to cold weather) into busy ones.

The results of the experiment conducted in 2014 indicated several issues regarding the great discrepancy between visual and aural features, due to:

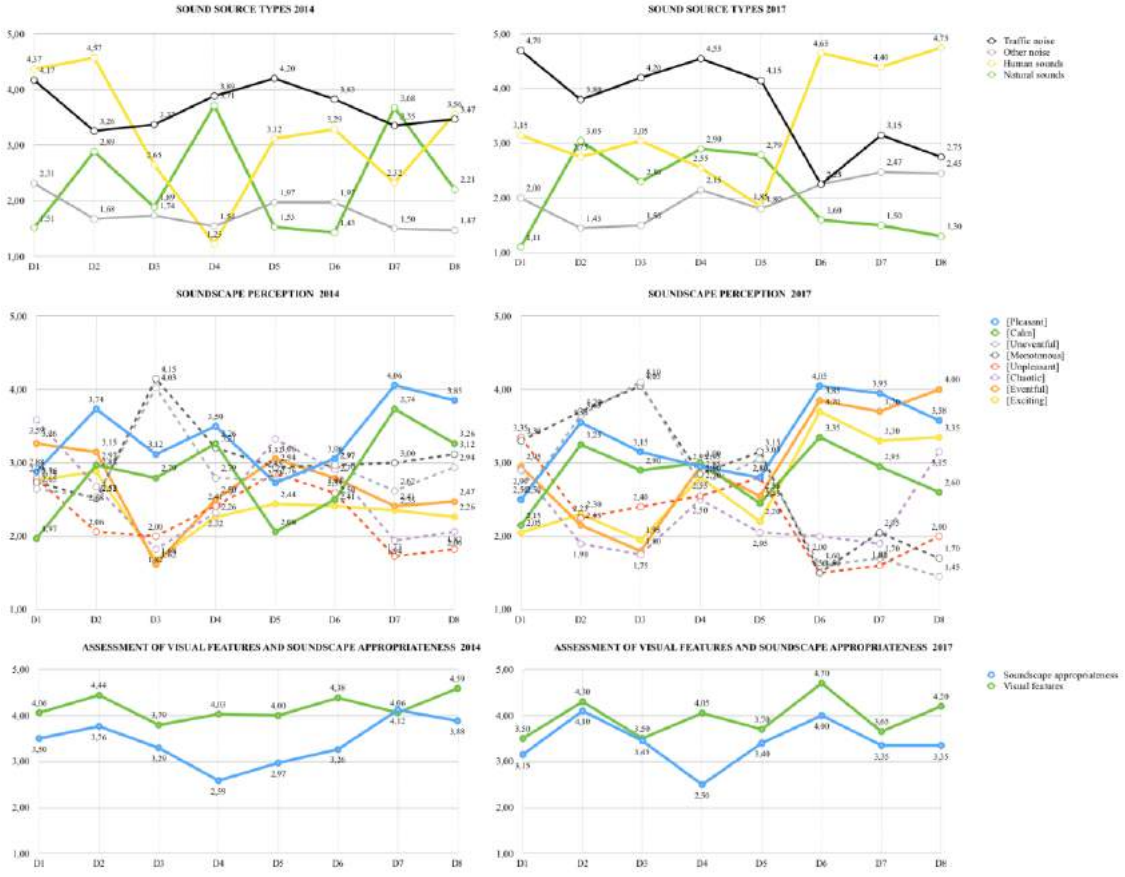

Figure 5 – Soundscape assessment results for (from top to bottom): dominance of sound source types in June 2014 and December 2016, soundscape perception values for June 2014 and December 2016, correspondence between visual features and soundscape appropriateness in June 2014 and December 2016 (Oberman, 2015)

- lack of human and natural sounds, and the much more noticeable presence of traffic noise at King Tomislav Square and Marko Marulić Square.
- the overpowering, unexpectedly high level of traffic noise in Ante Starčević Square and the Botanical Gardens, due to the adjacent railway which is not perceptible visually.

The results of the 2014 experiment also indicated the following positive assessments of this sequence:

- excellent congrence between visual and aural features at Strossmeyer Square
- excellent results of the assessment of visual features at Nikola Šubić Zrinski Square.

These made the temporary festive activities even more interesting, since they significantly changed three of the ambiences by adding amplified popular music, stages and stands, attracting large crowds. As Ante Starčević Square, the Botanical Gardens and the western arm of the Horseshoe were not part of these planned events, the assessment relating to them did not change significantly in the 2017 experiment. However, the change in soundscape caused the following differences in perception assessment:

- much better assessment of visual features and audiovisual congruence at King Tomislav Square

- Worse audiovisual congruence and assessment of visual features at Strossmeyer Square

The following are further discussed to illustrate the differences analysed: Strossmeyer Square, King Tomislav Square and Marko Marulić Square.

4.1 STROSSMEYER SQUARE

This square was assessed as the most audiovisually congruent in the first experiment. The central part is shielded from traffic noise to the north and south by the two buildings of the Croatian Academy of Sciences and Arts, while dense trees and bushes surround it visually to the east and west. The summer recording captured prominent human and natural sounds, and the soundscape was considered calm and pleasant. The addition of loud commercial activities and amplified music in the winter recordings shifted the assessment towards less congruent.

4.2 KING TOMISLAV SQUARE

The grand vistas from the railway station over the whole city to the north, in a deep perspective with the overlapping planes (from front to back) of the monument, pavilion, trees in neighbouring Strossmeyer Square, the cathedral spires and Mt. Medvednica in the distance, are well-known features of this square. They were deliberately accentuated, since the central part is approximately 1.5 m lower than the surrounding streets, pavements and buildings. This makes the pavilion on the north of the square seem taller and the perspective deeper. However, it also means that the ears of people walking in the square are at road level. The design of this urban open space is dominantly visual.

The square was assessed ambiguously and in complete discrepancy with its representative visual features during the first experiment, because traffic noise was the prevailing soundscape feature. This and the lack of human activities, meant it was assessed as less audiovisually congruent. The addition of features such as a temporary ice-skating rink and amplified music shifted the assessment towards more congruent and improved the assessment of visual features.

4.3 MARKO MARULIĆ SQUARE

The 2014 summer recordings of this square were sonically similar to King Tomislav Square, as were the assessments. Both King Tomislav Square and Marko Marulić Square are flanked on the east and west sides by residential buildings. Visually and spatially, however, they differ. Marko Marulić Square is less

imposing, despite the former National Library building, and its vistas are more enclosed. No commercial activities have been conducted there by the Zagreb Tourist Board. Although it proved to be characterised by the lowest sound pressure levels within the sequence, assessments were similar during both experiments: mostly monotonous and uneventful, audiovisually incongruent, and amongst the less pleasant places in the sequence.

Figure 6 – King Tomislav Square in June 2014 (above) (Oberman, 2015) and December 2016 (below)

Figure 7 –Marko Marulić Square in June 2014 (above) (Oberman, 2015) and in December 2016 (below)

The square changed its character when the National Library building became the State Archives in 1990s. Although the land use and academic character of the square have remained unchanged since 1910, the perception of it has changed drastically as the public space has become underused.

5 CONCLUDING REMARKS

This research report was motivated by impressions of the Advent in Zagreb Christmas Fair, which in December 2016 attracted more visitors than in previous years, and animated public spaces in Zagreb for five weeks in an unprecedented way.

At the local, site-specific level, the analyses showed that not all parts of the sequence were equally congruent, as some squares were underused by the public. The events organised in the eastern arm tended to exaggerate the contrast. Although there was no significant difference in average sound pressure levels, there was a high presence of traffic sounds throughout, and a significant difference in the frequency of sonic events of other sounds, such as people and music, was noticed. The temporary transformations have not changed how all the locations are experienced for the better. In the squares that were positively assessed before the introduction of commercial activities, the change was not great. But in the squares with poorly and/or ambiguously assessed soundscapes, temporary features such as the ice-skating rink and adjacent pop-up restaurants led to more positive assessments.

The effect of adding temporary commercial urban activities to public spaces characterized by low audiovisual congruence provided several insights which may be valuable for soundscape design. Added sounds changed the dominant perception descriptors, and also influenced assessments of visual features and congruence. Finally, it was not the weather conditions, but planned activities and advertising that contributed to more intense use.

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