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LEARNING FROM THE APPLICATION OF CRITERIA FOR RECOGNISING POTENTIAL HEALTH RESTORATION SOUNDSCAPES (HeReS) IN URBAN PARKS: TOWARDS SOUNDSCAPE-INFORMED DESIGN

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Abstract

Urban green spaces can support psychological restoration, but relevant soundscape conditions vary within and across parks. This paper revisits the Health Restoration Soundscape Criteria (HeReS-C), integrating naturalness, sound levels, perceived sound sources, soundscape assessment and sensescape coherence. We compare three contrasting cases from the original study and examine their spatial application in Quinta Normal Park, Santiago, using multidimensional and synchronic in situ data from 263 adult visitors. Fulfilment varied markedly across the park, with only limited sectors meeting all five criteria. Traffic, maintenance and recreational activities also indicate temporal sensitivity in sound levels and source balance. Rather than treating HeReS-C as evidence of restoration outcomes, we discuss its use as a diagnostic and planning tool for urban green spaces.

Keywords: *health restoration soundscapes (HeReS), urban green spaces, spatial variability, soundscape-informed design.*

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1. Introduction

Natural environments can facilitate psychological restoration by supporting recovery from stress and mental fatigue, restoring attentional capacity and improving affective states [1]–[5]. In urban contexts, parks and other green or semi-natural spaces, such as urban forests, wetlands and riparian corridors, are especially relevant because they provide everyday opportunities for contact with nature, recreation and respite from environmental demands. Their restorative potential, however, depends not only on visual greenery or spatial form, but also on the acoustic environment as it is perceived and experienced by people in context [2]–[6].

Natural sounds have been associated with faster stress recovery, tranquillity and positive emotional states, while technological sounds—particularly road traffic—may interfere with these processes [2]–[5]. Creating, enhancing or protecting restorative acoustic conditions in urban parks therefore requires approaches that go beyond noise reduction and consider the balance among natural, human and technological sources, as well as the relationship between sound, other sensory modalities and the activities and expectations associated with the setting.

Environmental psychology has developed complementary instruments for distinguishing perceived restorative potential from self-reported restoration outcomes, as reviewed by Suko [7]. The Perceived Restorativeness Scale (PRS) evaluates restorative qualities attributed to environments [8], [9], whereas the Restoration Outcome Scale (ROS) addresses self-reported restoration outcomes associated with environmental experience [10], [11].

The Perceived Restorativeness Soundscape Scale (PRSS) adapts perceived-restorativeness constructs to soundscape experience [12]–[14]. These scales address perceived potential or experienced outcomes; they do not replace an environmental diagnosis of the conditions under which restoration may be supported. The Health Restoration Soundscape Criteria (HeReS-C) were proposed as a practical framework for recognising urban green-space soundscapes with potential to support health restoration [15]. This study revisits their application through three contrasting cases from the original study and a spatial analysis of Quinta Normal Park in Santiago, Chile. Its purpose is to examine what can be learned from patterns of fulfilment, non-fulfilment and possible reconversion, and how these patterns may inform soundscape management and design.

2. The HeReS Framework

HeReS-C integrates five complementary conditions derived from literature review and field research: naturalness, sound levels, perceived sound sources, soundscape assessment and sensescape coherence [15]. The criteria were conceived as practical screening thresholds for potential restorative soundscapes, rather than as direct evidence that restoration has occurred. Their application combines objective and subjective data acquired synchronously and organised within a georeferenced database, preferably using the Zamba methodology for multidimensional soundscape data collection [16].

Table 1. HeReS conditions, data types, descriptors and initial practical thresholds.

Condition	Type	Descriptor	Initial practical threshold
C1 Naturalness	Obj.	Predominance of natural over artificial physical elements.	91–100% of the study surface is covered by natural elements.
C2 Sound levels	Obj.	Compatibility of sound exposure with rest and restoration.	Leq < 50 dBA, except when this level is exceeded due to natural sources.
C3 Perceived sound sources	Subj.	Predominance of natural sounds over traffic and other technological sources.	Average Green Soundscape Index (GSI) ≥ 2; natural sounds should dominate [19].
C4 Soundscape assessment	Subj.	Consistently positive global and affective assessment.	Overall soundscape assessment ≥ 4/5 and classification within the calm or vibrant positive-pleasantness quadrants.
C5 Sensescape coherence	Subj.	Balance among auditory, visual and olfactory quality, and congruence with place and activity expectations.	Difference among sensory quality scores < 25%; ≥ 75% of participants judge the soundscape appropriate for the place.

Note: thresholds were proposed as initial practical criteria and should be interpreted in relation to context, sampling design and temporal variability [15].

3. Applications of HeReS-C

3.1 Contrasting cases from the original application

The original study applied HeReS-C across 21 urban green spaces and squares in Argentina, Sweden and Chile [15]. The same three cases examined in detail in that study are revisited here: Stadsparken (City Park), Fountain 1 (FP), in Lund, Sweden; the Little Forest (BO), on the Universidad Nacional de Córdoba campus in Córdoba, Argentina; and Italian Plaza (PI), in Córdoba, Argentina. Together, they illustrate fulfilment of all five conditions, partial fulfilment with potential for reconversion, and non-fulfilment, respectively (Table 2; Figure 1).

Table 2. Fulfilment of HeReS-C in three contrasting cases from the original application [15].

Condition	FP Stadsparken N = 9/20	BO Little Forest N = 17/78	PI Italian Plaza N = 13/31
C1 Naturalness	+	+	-
C2 Sound levels	+	+/-	-
C3 Perceived sound sources	+	-	-
C4 Soundscape assessment	+	+	-
C5 Sensescape coherence	+	+	-
HeReS classification	Yes	Possible	No

Note: N = objective acoustic samples/subjective interactor surveys. Surveys were conducted concurrently with acoustic sampling, so several visitors could be surveyed during one sampling instance [16]. + = fulfilled; +/- = partial or inconsistent fulfilment; - = not fulfilled.

At Stadsparken, all five conditions were fulfilled. Although the fountain increased the mean Leq to 53.8 dBA, its natural water sound masked sporadic technological sources; the GSI reached 2.05 and the soundscape was classified as calm. The Little Forest fulfilled three conditions, while the sound-level condition was met only intermittently and its GSI of 1.85 remained below the threshold. It was therefore classified as a possible HeReS site requiring targeted management or design measures. In contrast, Italian Plaza fulfilled none of the conditions, with limited natural cover, a mean Leq of 69.4 dBA and predominance of technological sounds [15].

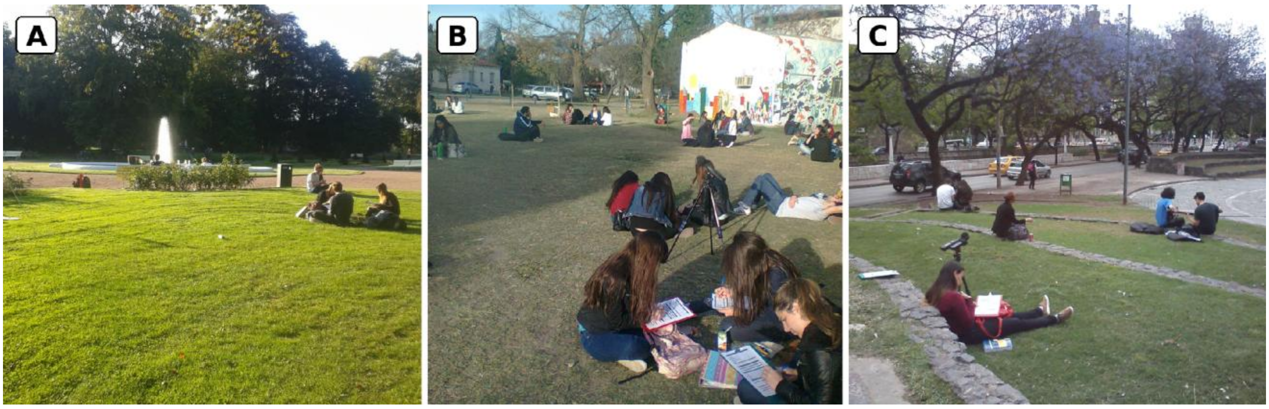

Figure 1. Contrasting HeReS-C applications: (A) Stadsparken, Fountain 1 (FP), Lund, Sweden; (B) the Little Forest (BO), Universidad Nacional de Córdoba campus; and (C) Italian Plaza (PI), Córdoba, Argentina.

3.2 Spatial variability of HeReS-C within urban parks: the case of Quinta Normal Park

Quinta Normal is a large urban park in central Santiago, bordered by major traffic corridors and containing heterogeneous vegetation, water, recreational areas, museums and other buildings. Data were collected between December 2023 and July 2024 [17], [18] at fixed locations using the multidimensional and synchronic Zamba methodology [16]. Questionnaires, acoustic measurements, audio recordings, photographs, videos and georeferenced contextual information were collected simultaneously, following the approach described in the original paper. The study setting and field data collection are illustrated in Figure 2.

Figure 2. Sound-level measurement and participant surveys during field data collection in Quinta Normal Park, Santiago, Chile.

The sample comprised 263 adult visitors who were spontaneously present in the park and surveyed on weekdays and Sundays [18].

C1 was calculated through GIS-based delimitation of natural and artificial surfaces [17]. C2 used georeferenced Leq measurements [17]. C3 was assessed through the perceived balance between natural sounds and traffic noise using the GSI [19]. C4 combined overall soundscape assessment with the pleasantness-eventfulness model [20]–[22]. C5 integrated auditory, visual and olfactory quality with perceived appropriateness of the soundscape for the place [15]. The spatial analysis combined the adult questionnaire sample with 101 georeferenced acoustic sampling positions.

Natural elements covered approximately 93.9% of the delimited park surface, so C1 was fulfilled throughout the study area and was therefore assigned to all 101 evaluated locations [17]. C2 was by far the most restrictive condition: the overall mean Leq exceeded the 50 dBA threshold, and only 12 locations (11.9%) complied. The perceptual conditions showed progressively higher fulfilment: C3 was fulfilled at 55 locations (54.5%), C4 at 65 (64.4%), and C5 at 79 (78.2%). Consequently, the number of conditions fulfilled was not distributed uniformly, as shown in Figure 3; sectors meeting all five conditions were spatially limited, while many locations fulfilled three or four conditions. Across the 101 evaluated locations, 5 fulfilled one HeReS condition, 21 fulfilled two, 39 fulfilled three, 32 fulfilled four, and 4 locations fulfilled all five conditions.

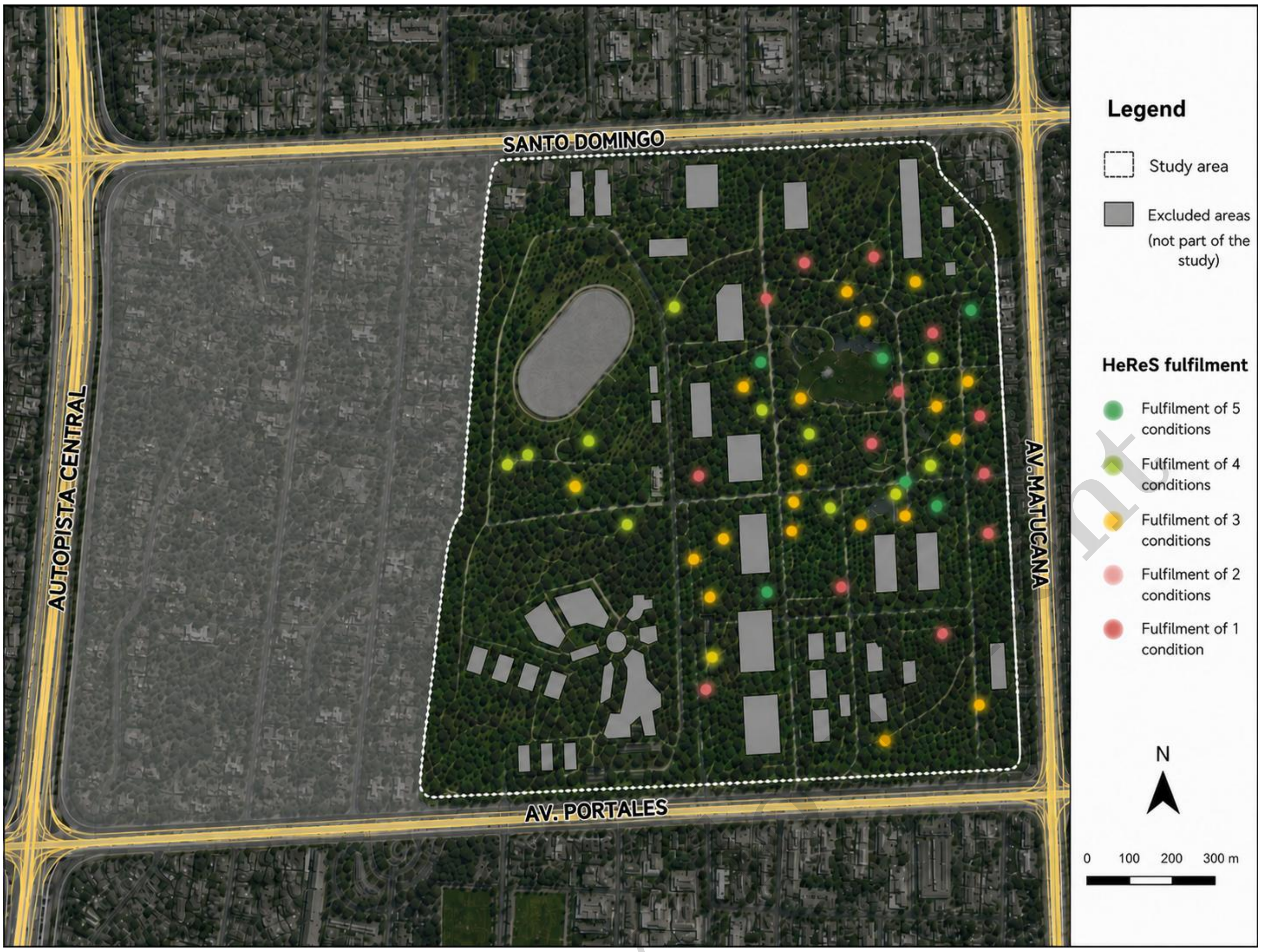

Figure 3. Spatial distribution of HeReS conditions fulfilled in Quinta Normal Park. The dotted line delimits the study area; grey areas were excluded. Colours represent fulfilment of one condition (red) to all five conditions (green).

4. Discussion

4.1 Spatial and temporal variability of HeReS within urban green spaces

The Quinta Normal case demonstrates that potential restorative soundscape conditions should not be treated as a homogeneous attribute of an entire park. A park may satisfy naturalness at the landscape scale while presenting marked internal differences in sound levels, perceived source balance, soundscape quality and multisensory coherence. Spatial overlap is therefore essential: isolated positive indicators do not necessarily produce fulfilment of the complete HeReS configuration. In Quinta Normal, the sound-level criterion constituted the main bottleneck, whereas sensescape coherence was comparatively widespread, indicating that acoustic exposure more frequently constrained complete HeReS-C fulfilment than the broader multisensory appraisal.

The results also reinforce the temporal sensitivity identified in the original HeReS study. Traffic exposure changes through the day and week, but internal park activities can be equally important. Although this paper does not report a formal weekday-Sunday comparison, field observations indicated that Sunday recreation, amplified music, maintenance devices, conversations and occasional events could increase sound levels even when traffic contribution was reduced. Increased social activity may also reduce bird activity or audibility, thereby diminishing natural sounds and potentially lowering the GSI. A site may therefore fulfil the criteria at one moment and fail at another. Representative sampling must encompass ordinary temporal patterns and, where possible, less predictable events that affect the acoustic environment.

4.2 From recognition to preservation and reconversion

HeReS-C can support three related management tasks: identifying and preserving existing sites, remediating environments with partial potential, and informing the creation or redesign of urban green spaces [15], [23]. Preservation requires attention not only to the interior of a green space but also to surrounding traffic, construction, commercial activities and other sources capable of altering its acoustic conditions. Periodic or continuous monitoring may help determine whether favourable conditions persist.

The Little Forest (Argentina) provides a concrete reconversion example. Its naturalness, positive assessment and sensescape coherence were already favourable, while sound levels and source balance remained deficient. Potential actions include restricting nearby parking and vehicle access, regulating technological sources, adding carefully designed water features, and increasing vegetation attracting biodiversity [15]. These interventions should be developed with users through participatory processes, because the site also performs social, educational and cultural functions. Kogan et al. [24] present a complementary participatory workflow for biophilic soundscape design, applied to a sector of Parque O'Higgins in Santiago currently occupied by an amusement park.

For Quinta Normal, the spatial map identifies where preservation may be prioritised and where interventions should address specific deficiencies. Measures near the perimeter may focus on traffic exposure and spatial buffering, whereas interior sectors may require management of maintenance schedules, amplified sound and recurrent activities. The framework therefore moves from asking whether the park is restorative towards a more operational question: which conditions are present, where and when, and which of them can be preserved or modified through design and management?

4.3 Limitations and Suggested Refinements

A central limitation of this study is that HeReS-C identify environmental and experiential potential; they do not directly demonstrate psychological restoration.

Future applications should compare HeReS-C classifications with self-reported restoration and examine the transferability of the thresholds across cultures, park types, activities and seasons. Because the criteria were intentionally practical and exploratory, repeated applications can help refine their descriptors and sampling guidance, while distinguishing conditions that are broadly applicable from those requiring context-specific interpretation.

5. Conclusions

Comparing the original HeReS cases with the spatial application in Quinta Normal shows that the criteria can distinguish among fulfilled, deficient and potentially manageable configurations. The Quinta Normal map reveals substantial internal variation despite high overall naturalness, demonstrating that restorative soundscape potential is spatially and temporally dynamic. HeReS-C are therefore most useful as a diagnostic bridge between soundscape assessment and intervention: they indicate which environmental and perceptual conditions should be preserved, managed or redesigned. For urban green-space planning, this implies examining the spatial distribution of HeReS-C within a park rather than treating restorative potential as a uniform site-level attribute.

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