INTEGRATING HUMAN PERCEPTION AND ENVIRONMENTAL DATA FOR HEALING LANDSCAPE ASSESSMENT IN CHANGCHUN CITY

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Abstract. This research study seeks to examine how human perception and environmental data may be incorporated to evaluate and improve healing landscapes within Changchun City, China. The systematic literature review with the case study analysis of the Therapeutic Garden Network (Singapore), Changchun People's Park, and Nanhu Urban Greenbelt consists of combining manual thematic analysis of important environmental indicators, including thermal comfort, vegetation diversity, and soundscape quality, with perceptual areas of analysis, such as restorativeness and sensory engagement. Results indicate that local parks have cultural and spatial significance. However, they are not designed in a systematic way to sense and monitor their performance. The research study, in turn, suggests a model of surveillance to increase sensor-based data and user feedback. It has been suggested that retrofitting parks with sensory environments, enhancing accessibility and establishing interdisciplinary partnerships can help in transforming non-responsive and monomodal green spaces into responsive, inclusive and therapeutic urban environments.
Keywords: *human perception, healing landscapes, thermal comfort, vegetation diversity, soundscape quality, restorativeness*

Introduction

The process of urbanisation and rapid technological change has led to even more artificial conditions, most of which are characterised by a high level of stress, negative interaction with nature, and worsened mental health. Subsequently, this has been met by the increased need to realise the importance of green spaces within the urban environment, which not only promote environmental sustainability but also psychological health (Ancora et al., 2022). Restorative urban spaces, also known as healing landscapes, are becoming increasingly popular in landscape and urban design, as they enable users to overcome stress and exhaustion (Yating et al., 2023). These landscapes can stimulate the human senses and emotions, as well as enhance the quality of the surroundings through vegetation, thermal comfort, natural acoustics, and other biophilic features. The Changchun City, in eastern China, is a strategic environment to understand the healing landscapes because it possesses unique climatic conditions, a fast-rising urban growth and a relatively strong cultural relationship to the green infrastructures and parks. The city has cold winters, hot summers and a rising population, so there is a rising demand for city places where people can get away from both the stressors of the environment and the pressures of modern living (Yan et al., 2023). Nevertheless, current green spaces in Changchun have not successfully exploited the nature of perceptual and environmental information integration to determine their restorative quality.

Classical measurement of urban landscapes can be based on land use statistics, design typologies or ecological performance indicators. As good as these are, they fail to reflect the experiential, sensory experience of the users, which is the key to the concept of healing landscapes. Human senses and a sense of visual attractiveness, sound acoustics, and the sense of touch are essential indicators of whether an environment encourages psychological recovery (Zhang et al., 2019). At the same time, environmental measurements and monitoring of air quality, thermal comfort, and biodiversity, among other indicators, should be implemented to guarantee the sustainability of the healing designs in the long term (Bungău et al., 2024). Combining these two approaches, such as subjective human experience and objective environmental data, is a new way of analysing and approaching therapeutic landscapes. This study attempts to fill such a gap by developing a conceptual and analytic framework of healing landscape evaluation in Changchun. It synthesises anthropocentric perception and environmental performance indicators to advance a holistic model in the process of monitoring and design of healing landscapes. The proposed research will utilise a critical evaluation of the reviewed peer-reviewed sources in the area, along with a comparative analysis of the chosen domestic and international case studies to identify general principles, spatial planning, and quantifiable indicators within a successful healing environment.

The findings obtained in this study will be used in the creation of the evidence-based surveillance model that would reflect the situation in Changchun. Moreover, the results of the study can be used to provide a generalizable approach for other Chinese cities in the North that need to improve urban well-being by using landscape intervention. This study helps to make the urban landscape design practice more responsive with a holistic and inclusive approach to environmental data.

Literature review

City green areas and landscapes have been recognised as therapeutic spaces and are viewed not only as aesthetic or ecological facilities, but also as aid to human health and wellbeing. Three more closely related literatures are particularly relevant to the proposed study: (1) biophilic design and healing landscapes, (2) sensory and perceptual experience of landscapes and (3) environmental-performance monitoring as a part of restorative urban design. This review summarises the literature to define the most important indicators, design arrangements, and knowledge gaps that will contextualise the proposed whole model of healing landscapes in Changchun City.

Biophilic design and healing landscapes

The term biophilic design starts with the idea that humans are biophilic. This means that humans have a natural affection for nature (Amat et al., 2020). Research indicates that natural characteristics in buildings promote psychological renewal, lessen stress, and improve brain power (Asim and Shree, 2019). The biophilic approach in architecture and landscape design prioritises the following patterns: natural light, greenery, water features and ecological connectivity (*Figure 1*). As an example, Grazuleviciute-Vileniske et al. (2022) concluded that biophilic architecture aims to reestablish the contact between humans and nature, not only through greening buildings. Recent work, however, records an increased research interest: Atthakorn (2022) gives a bibliometric overview on the subject of biophilic design, with the increase in

publications, particularly in the research circles of Southeast Asia and China. This trend posits the applicability of the discipline to the fast-urbanising cities such as northeastern China. In the context of the healing-landscape literature, Harries et al. (2023) give a systematic review of healing gardens, which are usually located in healthcare facilities, and one of their advantages is a decrease in stress levels, better availability of nature, and multisensory experiences. At the same time, the landscape of Chinese hospitals and developed an index model of the demand as perceived by the users, which is an indication of a transition to user-oriented design and evaluation. These sources give major principles of design: available greenery, biodiversity, water, safe and shaded walk, sensory variation (sight, sound, touch) and space layout that is user-friendly. The healing landscapes have a normative template through such principles.

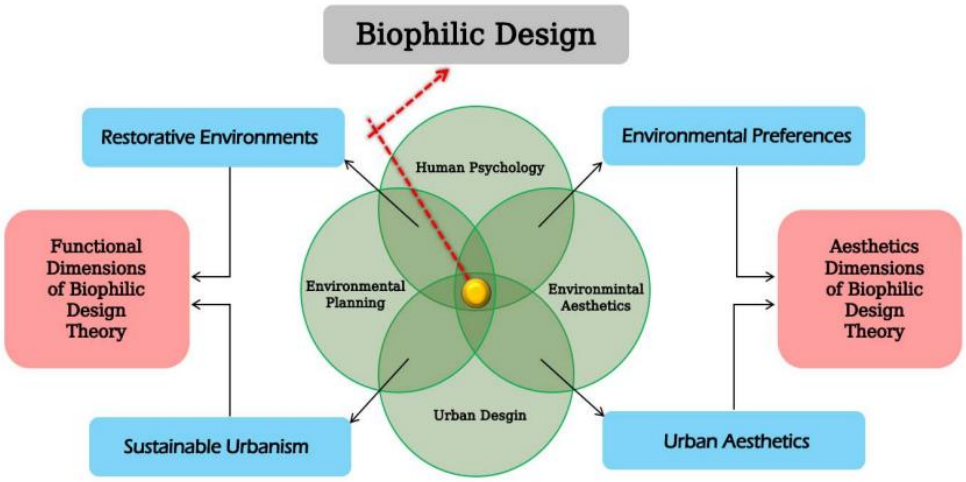

Figure 1. *Scientific areas of biophilic design.*
Source: Bin Sulaiman (2021)

Human perception and sensory experience in landscapes

Although design frameworks offer structural directions, the experience aspect of landscapes, the way people experience and encounter them, is also important in healing landscapes. Environmental psychology boasts of two powerful theories, which include the Stress Recovery Theory (SRT), which postulates that exposure to natural environments triggers positive affective reactions and physiological rest (Egner et al., 2020). The other one is the Attention Restoration Theory (ART), which proposes that nature helps one get over mental exhaustion through soft fascination and a feeling of an absence of being elsewhere. As an illustration, the connection between nature and well-being is explained in terms of these theories. The present studies bring these models to the multisensory and inclusive design. Using the example of Finnigan (2024), who examines the experience of outdoor built landscapes by people with neurodivergent needs (autism, ADHD, dyslexia) in his study, the author finds sensory affordances, such as serene soundscapes, predictable surfaces, and barriers, such as noisy traffic and disorderly visual stimuli (*Figure 2*). This piece of work stresses the significance of making designs that address various experiential requirements rather than the generic users. Simultaneously with the work on sensory-inclusion, Ding et al. (2022) researched the relationship between landscape features and sensory impressions, based on data from social media and the concept of landscape ecology. They discover that some salient features (vegetation and water) are linked to positive sensory labels (calm and

safe), and thus they offer an empirical connection between physical features of the landscape and perceptions of users.

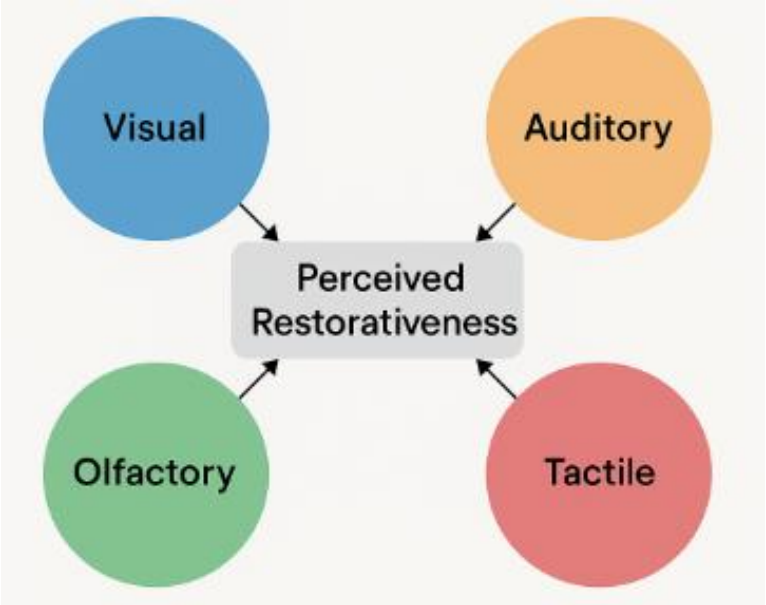

Figure 2. *Sensory engagement framework.*

Other applicable studies include soundscape and thermal perception studies. Although not every research is directed toward healing landscapes, there is a growing conceptualisation of the idea of natural versus traffic and industrial sound landscape and its psychological implications, such as audio and visual consideration of soundscapes in residential locations in cities. Taken together by incorporating the findings of these studies, it is a healing landscape that must (a) cause an increase in positive perceptions (preference, restorativeness, and safety) and (b) decrease negative stimuli (noise, harsh microclimate, and visual monotony). In this way, such perceptual indicators as preference to landscape, perceived multisensory soothingness and restorativeness become important.

Environmental performance monitoring and indicators

Perception alone cannot be the design and evaluation criteria of the healing landscapes, and objective efficacy and sustainability need measurable performance of the environment. In this case, there is literature on urban ecology, microclimate, soundscape, biodiversity and urban greening that is applicable. As an example, Asojo and Hazazi (2025) address biophilic design as a connector that enables sustainable and healthy space ecosystems with reference to such measures as thermal conditions, energy efficiency, vegetation richness, and human health performance outcomes. Cabanek et al. (2020) also suggest a system of biophilic streets applied in the city, which incorporates nature into the street layout, focusing on quantifiable multi-benefits (environmental, social, economic), and requires the monitoring of performance. Regarding neuro-inclusive outdoor conditions, a study conducted by Finnigan (2024) demonstrates that the environmental conditions of the ambient (quality of air, materiality, and acoustics) contribute to the sensory comfort and well-being.

Particularly in the case of healing landscapes, Guo et al. (2023) develop an index model of hospital landscapes in terms of green space ratio, distance, accessibility, sound alleviation, and microclimatic comfort. Future healing environments highlighted by emerging work (Mishra, 2025) include adaptive resilience, infrastructures of micro-healing spaces and monitoring, which implies that emerging healing landscapes need to feature sensing networks and performance feedback loops. Therefore, vegetation diversity (number of species and canopy cover), soundscape quality (degree of noise and natural sound), thermal comfort (shade, temperature, humidity), air quality (PM2.5, CO_2), biodiversity indicators, and appearance are all other environmental indicators that are pertinent to the healing landscape. In addition to that, the dependency of those indicators on perceptual feedback (through surveys, sensors, and behavioural tracking) is increasingly being promoted.

Synthesis: Integrating perception and environmental data in healing landscapes

The pose of crossing the subjective world of human perception and the objective world of environmental performance is the primary boundary of healing-landscape research. Current literatures on the research cover either one of the (one-sided design and biodiversity, and one-sided user perception and psychology), but has not explicitly considered them in a single monitoring framework of restorative spaces in urban environments. As an example, Tabassum and Park (2024) observe that the notion of biophilic architecture has had no standardised human health and environmental performance measurements. In the meantime, Gao et al. (2025) designed a perception scale of campus landscapes, which shows the path of perception of characteristics of mental restoration in the mediation of objective landscape features. This suggests a series of relationships between the physical environment and the consequences on the psychology through perception.

Gaps in the literature and implications for this study

Although the literature on healing landscapes has been increasing lately, there are also some significant gaps to be filled. To begin with, there is a deficiency of integrative models that can integrate the human perceptual reaction and the environmental performance measures in a single model. Most of the available studies dwell either on psychological or ecological measurements, but not on the intersection of the two, in real-life urban environments. Secondly, the geographical scope of the literature on healing landscape is biased to the West or the healthcare context; there is less focus on urbanised public space in the fast urbanisation process of Chinese cities, such as Changchun. *Figure 3* and *Figure 4* show the image of the Therapeutic Garden of Singapore and Changchun People's Park. Moreover, in spite of the fact that both biophilic architecture and sense encouragement are greatly conceptualised, the empirical research that utilises such concepts in the cold climate urban context, in which the seasonal variations play significant roles in perceiving and environmental functioning, is lacking. Inclusive and neurodivergent views of the design of healing spaces are also an underrepresented phenomenon in the literature, even though there is an increasingly recognised interest in the concept of sensory diversity in landscape experiences.

Figure 3. *Therapeutic garden of Singapore.*

Figure 4. *Changchun People's Park.*

Lastly, little is said about long-term monitoring systems, which this study terms a surveillance model that participates in real-time environmental sensing and also incorporates human feedback mechanisms. These gaps outline the necessity of an analytical, context-sensitive and multisensory model in response to the urban scenario of Changchun. The present research aims to fill in these gaps by matching literature with the discoveries of the case study to suggest a conceptual framework that can be applied to local and regional urban healing measures. To conclude, the literature highlights that the concept of healing landscapes does not pertain to the greenery or any beauty qualities when the literature depicts a discursive emphasis on establishing multisensory, restorative, and quantifiable environments. Biophilic design offers the theoretical framework, sensory/perceptual research, the experiential apparatus, and environmental monitoring, the instruments of the latter. The synthesis of these streams

in building a more holistic conceptual base of healing, landscape design and evaluation specific to the urban context of Changchun will be offered by this study.

Materials and Methods

Research design

The paper adopts a qualitative, conceptual and analytical research approach, which entails coming up with anthropocentric perceptions and environmental indicators to assess the nature of the healing landscapes. There are two elements of the research design: the systematic peer-reviewed literature review and analysis of the case study of some urban landscapes. All these approaches are connected to one another via a manual thematic analysis that attempts to define key indicators, patterns, and strategies that are applicable to healing and restorative environments. The methodology is based not on experimental or primary data collection but on secondary data to develop a framework that is flexible to the urban environment of Changchun City.

Systematic literature review

The systematic literature review was done to determine the academic viewpoints, tendencies, and confirmed signs concerning the healing landscapes, especially those methods incorporating both environmental performance and human perceptual reactions, besides providing that. Three themes formed the review process, which were: (1) principles of biophilic and healing landscape design; (2) sensory and psychological perception of urban green space and (3) methods of environmental monitoring in the landscape architecture. The themes were chosen in agreement with the dual focus of this research: environmental data and the anthropocentric perception. Peer-reviewed journal articles published in the period 2015 to 2025 and found in two academic databases, including Google Scholar and ScienceDirect, were retrieved. Research queries contained combinations of terms which included: healing landscapes, urban restorative design, biophilic design, sensory perception, thermal comfort, natural soundscapes, landscape performance indicators and post-occupancy landscape evaluation. Specificity was enhanced through the application of Boolean logic and the use of manual filtering in a bid to get coverage in the various subfields.

The inclusion criteria identified articles that had to be peer-reviewed, English and thematically gateway to either one of the two topics, human-centred landscape experience or environmental performance measures. Opinion articles, undergraduate dissertations, and sources that were not clear in their methodology were excluded. To identify shared findings in every article, a manual thematic analysis was used. A preliminary familiarisation was followed by the application of open coding to point out the recurring terms, such as the vegetation diversity, soundscape quality, thermal comfort, restorative effect, and user feedback. These were separated into three overarching themes, such as environmental indicators, perceptual dimensions and healing design strategies. The indicators that are important were determined, by comparison and refinement, including: natural acoustic buffers, coverage by tree canopy and shaded areas, all of which affect quantifiable environmental quality and the restorative perceived value.

Literature review indicated that there is an increased endorsement with regard to the usefulness of sensor-based monitoring in combination with subjective user rating in

landscape design. Nevertheless, not many studies suggest a model of surveillance that would create a balance between the two. This is the gap that makes the objective of the current research acceptable and justifies its proposal of such a model to Changchun City, based on the global and local contextual relevance of best practices

Case study selection and rationale

The selection of three case studies was intentional in order to guarantee the representation of geographic and contextual orientation to the healing landscape design. The Therapeutic Garden Network in Singapore is an internationally recognised model that incorporates biophilic strategies that are organised as well as post-occupancy evaluations. Changchun People Park provides a historical local setting of the locality based on the cultural and recreational utilisation, whereas Nanhu Urban Greenbelt reflects updated ecological planning in Changchun. The purpose of selecting these cases is the availability of the design proposal, the representation of accessible secondary data, which allows for analysing with a comparative approach the spatial strategies, the environmental performance, and sensorial involvement in the context of healing landscapes, both locally and on a global scale.

Case study data collection and organisation

The information in the three chosen case studies was gathered through secondary literature, such as research papers, government planning literature, landscape architecture publications and online image archives and Google Earth online. The information has been sorted and categorised into five major items, namely spatial arrangement (layout and circulation), design purpose (healing or ecological targets), environmental aspects (vegetation, shade, water), sensorial features (soundscape, visual and tactile aspects), and monitoring or evaluation systems (post-occupancy research, feedback systems). This systematic criterion allowed carrying out a systematic comparative analysis and determining the presence of common design strategies and performance indicators in different healing landscape environments.

Thematic analysis

Thematic analysis of 15 peer-reviewed journal articles was performed manually to extract common ideas, signs, and measures related to healing landscapes. After the framework of Braun and Clarke, familiarisation and open coding started, and the main terms were revealed, which were restorative experience, thermal comfort, natural soundscapes, and biodiversity. These codes were categorised under three umbrella themes: (1) Environmental Indicators, which involved vegetation diversity, air quality and microclimatic regulation, (2) Perceptual Dimensions, which included landscape preference, attention restoration and emotional response and (3) Design Strategies, which included shaded zones, water features, and multisensory spatial layouts. The review showed that integration of user perception and ecological performance was given a high level of emphasis, but deficiencies are presented in one integrated monitoring model. These subjects influenced the structure of analysis by case study comparison and were used to propose one model about healing landscape assessment, guiding in the case of Changchun.

Methodological integration and limitation

The thematic triangulation was levelled to bring together the results of both the systematic literature review and the case study analysis. Thermal comfort, natural soundscapes, and restorative perception are the themes of peer-reviewed articles that were cross-linked with spatial strategies that were observed in case studies. The comparison methodology made it possible to validate the key indicators that were measurable and of experience at the same time. Thematically, overlap, including restorativeness through biodiversity and sensory-inclusive design, had a priority in the elaboration of a conceptual model. This synthesis approach proved to be very coherent in that both the insights of the theory and the applications made to the Changchun urban healing landscape were practical. The main weakness of this approach is that it makes use of secondary data, which limits the potential of obtaining real-time user experience or environmental data to be measured. This empirical confirmation is constrained by a lack of access to primary action in the fields with respect to surveying and sensor environment applications. Also, there was the potential of interpretive bias since some local documents were accessed during the process of translation. The case studies chosen also do not reflect the complete palette of healing landscapes in China. Even with such limitations, the methodology offers a good conceptual base to support more information-based studies in the future.

The paper is completely grounded in the secondary sources, such as peer-reviewed journal articles, planning documents, and publicly available datasets. There were no human subjects and hence no ethics needed to be followed. Academic integrity in the sources has been ensured by citing the sources appropriately. They were careful not to violate any acts of intellectual property, and no confidential or unpublished information was involved. In the case of local Chinese case studies, only the information that is approved by the government or made publicly available was taken to avoid being culturally or politically sensitive. The research is based on the common ethical standards of qualitative research. This research relies on a strong qualitative paradigm that includes a systematic review of the literature and a comparative case analysis of the data, which is supported by manual thematic analysis. It allows a stratified comprehension of how the markers of the environment and the perception of human capability can be matched with healing landscapes. The methodology helps to develop an adjustable monitoring model that can be applicable in Changchun and other cities by determining recurring indicators and design patterns.

Results and Discussion

Environmental indicators

The literature review and case studies both emphasise the role of certain environmental factors that impact physiological comfort and ecological performance. These are diversity in vegetation, thermal comfort, air quality and natural soundscapes. Within the Therapeutic Garden Network (Singapore), plants used in the gardens were found in a wide variety and could serve partly to add aesthetic variety but also to provide shading, cooling, and sensation (Montefrio et al., 2021). Likewise, native tree species, which help in regulating temperatures and biodiversity, were also incorporated in both Changchun People's Park and Nanhu Urban Green Belt. The issue of thermal comfort became one of the most important things in the cold-winter, hot-summer condition of Changchun. Pergolas, canopy trees and water features used in the Singaporean example moderate the microclimate (Meili et al., 2021). The parks of

Changchun, in contrast, reflected little in the way of organised interventions to keep the heat and wind in or out, but naturally shaded areas may be found (Bao et al., 2022). The local cases did not assess air quality tangibly, which is a fact that should be stressed by the literature, as it can have a psychological and physiological effect, particularly in dense cities. Natural soundscapes were discovered to be a neglected but important aspect of landscape quality. Design features that used layered vegetation and water trickling systems were used in Singapore to minimise ambient noise and to improve sound comfort. The gap observed in Changchun, as being the lack of acoustic buffers along the roadside or open lawn areas, indicates possibilities of better planning of the soundscape.

Perceptual and psychological dimensions

Thematic analysis brought out a number of user-related themes applicable to the perception and emotional experience in healing landscapes. These are perceived security, restorativeness, landscape liking and attention restoration. The theoretical foundation of these outcomes is well supported by the Attention Restoration Theory (ART) and Stress Reduction Theory (SRT), which finds strong support in the literature. Perceptual dimensions were dominant in the Therapeutic Garden Network (*Figure 5*). Pedways were also created in circular ways so as to facilitate easy navigation, and signs followed colour indications, and there were sensory gardens where people could access plants, textures, and smells (Elbasyoni and Gammaz, 2023). Post-occupancy evaluations showed that elderly and vulnerable users were highly satisfied with the user satisfaction and exhibited less stress. Perceptual qualities were incidental, rather than designed, in the local cases. The park People Changchun has a long-time familiarity and cultural memory, as far as it is historically planned, which is a positive factor in the perception of safety and comfort (Yan et al., 2023). Nonetheless, the restorativeness is lowered in certain areas due to such features as poor signage, lack of diversity in seating facilities, and lack of visual diversity. Nanhu Greenbelt was more successful, with other types of spatial experience, though not with consistent multisensory experience (Mao et al., 2022). The users probably get partial satisfaction, especially in the spring and summer seasons, but this is not year-round optimised. The literature also puts emphasis on the multisensory stimulation in the formation of user perception. Floral smell, wind, bird singing, and light and shadow interaction are some of the elements that play a significant part in emotion control and cognitive relaxation (Zheng et al., 2024). This was more manifest in the Singaporean scenario and barely manifested in the sites of Changchun, meaning that there is a need to have sensory programming in local urban design.

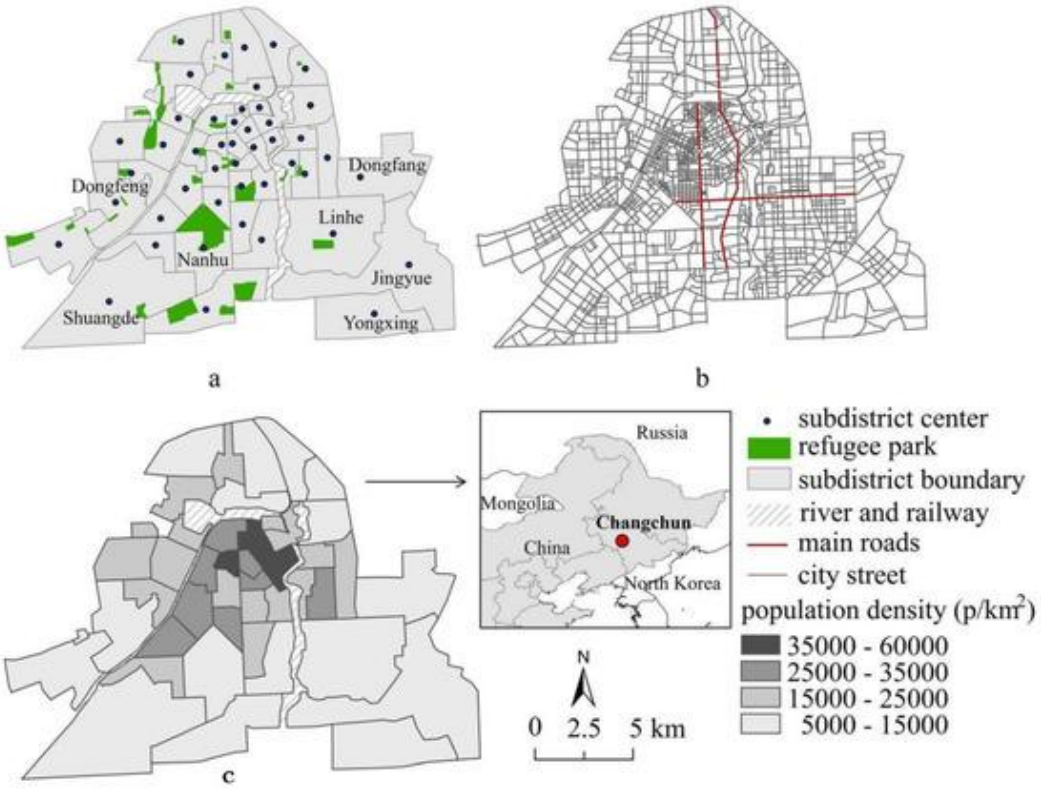

Figure 5. *User pathways and perception zones diagram of Changchun People's Park. Source: Li et al. (2020)*

Design and spatial strategies

The data-related design approaches to be used were both temporal and spatial zoning, circulation rationale, sensorial overlay, and familiar usage. The spatial structure in Singapore was modular, where therapy stations were spotted between walking trails and resting areas (Gobster et al., 2023). As it was shown in the case, circulation patterns affect emotional rhythm, looping paths alleviate cognitive fatigue, and unexpected visual changes provoke the sense of curiosity. Changchun People Park was designed in an old-fashioned axial structure with big open fields and pond boundaries. Although it enabled cultural meetings, the spatial arrangement was not ideal for healing purposes. Sitting was either unmarked or congested. Contrary to this, Nanhu Urban Greenbelt had curvy routes, combined plants, and seats beneath groups of trees to promote an engulfing spatial experience (Mo et al., 2024). Nevertheless, the two locations lacked uniform signage, interactivity, and weather-sensitive shelters. The use of what was known as pause points was another remarkable design strategy used as areas where the users could sit, watch or interact with nature. This is done through the use of pergolas, water edges and sensory walls by the Garden of Singapore. In Changchun, such opportunities existed in theory so far as they have not yet been practised. There was an inconsistency in addressing accessibility and inclusion as well. Although the gardens of Singapore provided users with free access, tactile surfaces, and neurodiverse-friendly layouts, the parks of Changchun were characterised by unbalanced routes, the absence of ramps, and the inability to serve neurodiverse or older consumers. This identifies a big inequity gap in religious landscape provision.

Comparative matrix and synthesis

A matrix was created to compare findings on all three case studies. Mutual advantages were vast areas of green, walking paths, and socialising areas. Singapore was the only place to have organised sensory design and surveillance, but the area of Changchun was based more on the open spaces and informal utilisation patterns. The local cases had recurring issues of environmental sensing deficits, no consistency in thermal, a lack of signage, and multisensory integration. However, their high cultural identity and social familiarity provided their therapeutic benefit, which was intangible. This contrast implies that moving forward, design in Changchun has to be a combination of contextual authenticity and evidence-based spatial and sensorial design. The findings confirm that the strongest healing effect of the landscape is achieved when the environmental performance characteristics, such as thermal comfort, biodiversity, and air quality, are combined with perceptual and psychological aspects, such as restorativeness, preference, and sensory clarity. This relationship is enhanced by spatial strategies that direct motion, provide micro-restorative experiences, and allow participation by the users. The findings are used to define the next phase of the research, which is a conceptual model of a healing landscape in Changchun. The model will be based on identified indicators that will undergo both literature and practice validation, which will guarantee a comprehensive, user-sensitive assessment and design optimisation model.

Integration of environmental and perceptual indicators

A combination of environmental and perception signs turns out to be a critical feature of both landscape design and evaluation. As indicated in the findings, the user perception towards restorativeness, safety, and preference are closely correlated with the physical qualities, including vegetation diversity, thermal comfort, and soundscape (*Figure 6*). It comes with Attention Restoration Theory (Kaplan and Kaplan) and Stress Reduction Theory (Ulrich), which state that exposure to nature enhances cognitive functioning and diminishes physiological stress (Marois et al., 2021). This study, however, adds to those theories in that measuring perceptual results needs to be emphasised and that the results of perceptions have to be based on and anchored on environmental data. Thermal comfort is, as an example, not only a design issue but also physiological in cities such as Changchun, where summers are hot and winters are cold. The lack of shaded structures or vegetation to absorb heat and winds is a further loss of perceived comfort, which negatively affects the potential of a given space to easily help (Terrani et al., 2024). On the same note, soundscape design based on natural buffers such as trees and water features not only beautifies but also affects the auditory and emotional control of users. Combined, this literature and case studies confirm that the healing landscapes are optimised when their environmental properties are designed to promote the well-being of multisensory perception.

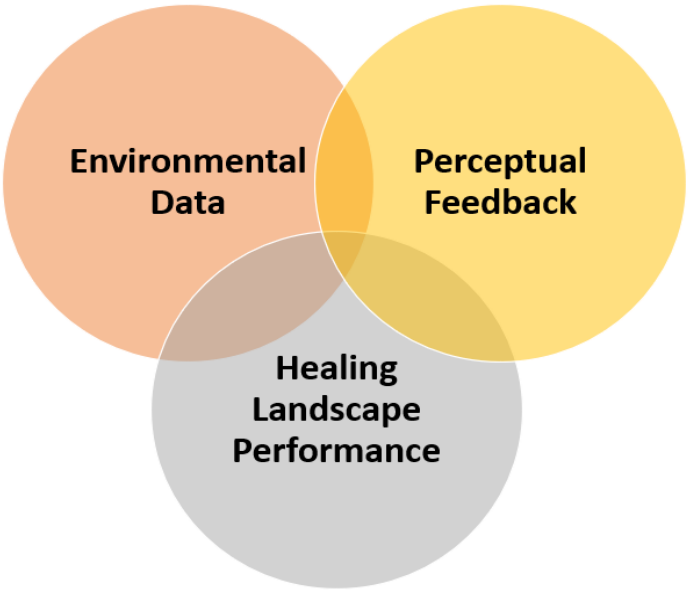

Figure 6. *Healing landscape integration model.*

Contextual relevance to Changchun

There are special problems and possibilities of applying healing landscapes to Changchun, which are connected with the specifics of its climatic, cultural, and spatial conditions. Compared to temperate climates where the strategies of the heating designs are usually designed, Changchun has high temperatures and seasonal changes, which influence vegetation circles, the usability of the outdoor areas, and the expectations of the users (Wang et al., 2025). The local parks examined in this paper, which are Changchun People and Parks and Nanhu Urban Greenbelt, exemplify cultural resonance and social familiarity, which are useful non-material assets. However, they do not have multisensory planning of environments, climate-based design, or performance metrics, as would be in international best-practice models, such as the Singapore Therapeutic Garden Network. This contrast brings out an important lesson that healing landscapes should be culturally adapted and climate resilient. To Changchun, this implies that beyond the aesthetic or generic greening to feature more aspects such as the windbreaks, shade areas, year-round access, and species that are not only suitable to the northeastern China environment but also remarkable (Yu and Piao, 2025). It is also the provision of activities that are rooted in the culture, such as tai chi, family walks, and group dances, which already predetermine the fact that people will be emotionally attached to parks and design will correspond to the lived experience.

Gaps and opportunities in current practice

The practice gap analysis indicates a number of gaps in practices. To begin with, landscape performance, either with the use of digital sensors (temperature, air quality, and noise) and user response, is mostly overlooked in the Changchun cases. This lack hinders the post-occupancy evaluation and does not make continuous improvement possible. Second, though spatial organisation exists, it is not typically connected with the logic of healing. For example, the placement of seating is random, there is little and old-fashioned signage, and sensory aspects (smell, sound, and response) are unevenly distributed. These missing elements restrict the remedial role of the landscape.

Nonetheless, these gaps are also an indication of opportunities. Reusing the existing spaces with low-cost solutions such as acoustic vegetation, sensory trail areas, QR code-based feedback apps, and canopy beautification has a high potential to be retrofitted (Shu et al., 2020). The situation with the experience of Singapore proves the fact that even simple injections, when installed correctly, can have a significant positive impact on the sense experience and the user satisfaction. It is also possible to develop cross-sector cooperation, engaging ecologists, designers, health workers, and municipal planners in the joint development of healing areas that can be responsive towards the needs of Changchun. The other opportunity is accessibility and inclusivity. The existing local parks lack full accessibility to people with mobility challenges, neurodiversity, and visual and hearing disabilities. Changchun is able to increase the scope of its green infrastructure by including fundamental principles of universal design, including tactile paving, ramped access, visual elements, and quiet areas to improve social equity.

Toward a surveillance model for healing landscapes

The results favour the construction of a surveillance model that requires integration of the indicators of the environment and the perceptions into a single assessment model. This model must comprise both qualitative and quantitative aspects, sensor-based environmental measurements, such as temperature, level of noise, humidity, and air quality and perception-based measurements, such as surveys on preferences, observational audit, and restorativeness scale (*Figure 7*). Variables that should be taken as the baseline variables include indicators found in this study, canopy cover, biodiversity index, confinement, seat comfort, pathway arrangement, decorative sounds, shade density, and subjective safety. It is also suggested to implement a staged approach. Phase 1 may be used to retrofit existing parks with environmental sensors and signage to create awareness. Phase 2 may be used to introduce regular feedback loops in terms of mobile surveys and QR-code-linked feedback points. Phase 3 can be applied to optimise design guidelines according to the received information. This would allow Changchun to no longer dole out the status quo with static ambient park designs but rather create dynamic, data-driven, healing environments that change with user demands and the environment. In addition, the introduction of such a model into the urban planning policy may assist in the prioritisation of budgetary allocations, the determination of those areas that are performing poorly, and be used to direct the development of future parks. The final aspect is to change the paradigm of the amount of green space to the quality of healing, where all of the parks are not contributing to the city ecology, but also to the health of people. Overall, this discussion affirms that the landscape of healing should be engineered to function in the location that interacts with quantifiable ecological operation and the abstract experience of the subjects. The results indicate that Changchun has a huge potential in embracing and developing such principles, should it adopt a performance-based planning approach and do so under the inclusive and multi-sensory-based design options. The surveillance model presented here can be described as a conceptual frame and an arsenal to lead that change.

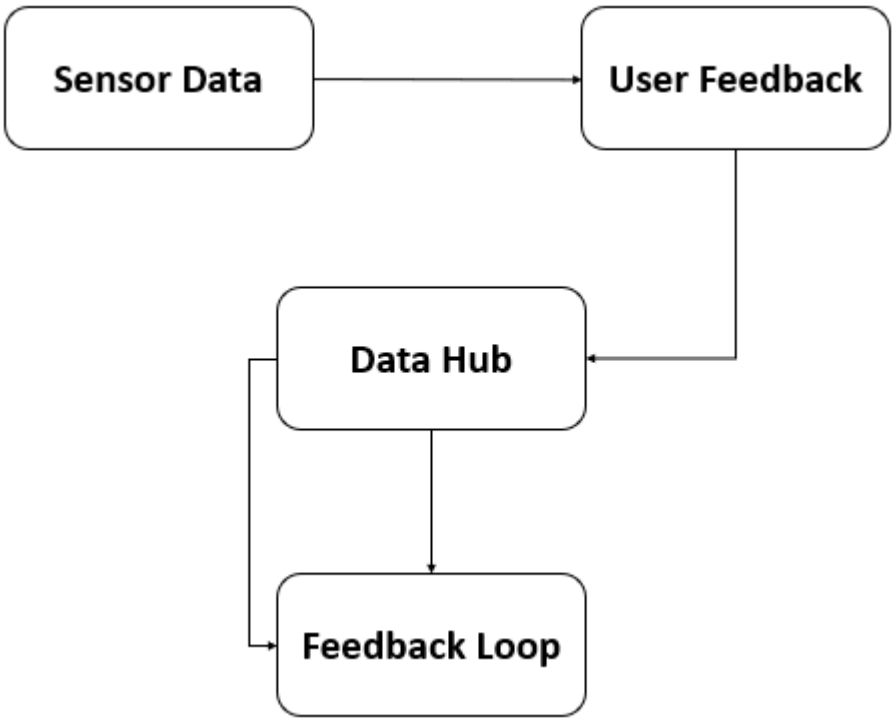

Figure 7. *Proposed surveillance model framework.*

Conclusion

This study aimed to understand the way an intervention to improve the healing landscape at Changchun City can be improved in terms of design, evaluation and tracking by incorporating both human perceptual factors and environmental performance metrics. The paper has merged both systematic literature review and case studies of both international and local cases and used manual thematic analysis to elicit recurrent themes, best practices, and gaps. The results confirm that healing landscapes work best when they regulate objective ecological functionality or biodiversity, thermal comfort and air quality, with the subjective human reactions best described as restorative, preferential and sensory involvement. Major insights were realised through the literature and comparative case study framework. A structured and sensor-informed model that clearly stated multi-sensory experience, inclusive accessibility and user feedback was promoted by the Therapeutic Garden Network in Singapore. By contrast, the Changchun case studies demonstrated useful cultural resonance and spatial openness but failed to provide formalised sensory design, mechanisms of monitoring and inclusive design. Such a gap is an element that demonstrates a significant opportunity for Changchun to go beyond simple greening interventions to evidence-based, perception-attuned landscape interventions that are capable of responding to environmental data, as well as user concerns.

To make Changchun healing landscapes, it is advised that the local government introduce an interdisciplinary surveillance framework integrating environmental performance measurements, that is, air quality, thermal comfort, and vegetation diversity, which could be mixed up with user-focused perceptual data, such as restorativeness and sensory satisfaction. The current parks are to be retrofitted with low-cost sensory interventions of shaded seating, buffers of natural sounds, and seasonal

planting. Real-time user feedback systems, including QR code surveys, may be used to support the process of iterative improvements. The crucial emphasis should be made on inclusive design so that neurodiverse, aged, and mobility-impaired people can become access-friendly. Lastly, there needs to be collaboration between urban planners, landscape architects, ecologists, and public health officials to incorporate healing principles in the planning policy to make the green spaces more sustainable, but also restorative and socially responsive.

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Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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