



# Open space and their attributes, uses and restorative qualities in an earthquake emergency scenario: The case of Concepción, Chile



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## ABSTRACT

Understanding landscape attributes, uses and their restorative potential is crucial in recovery and management interventions in disaster-prone environments. However, little is known about the role of key landscape features and how they work as an agent of recovery in the event of an earthquake. This study examined the relationship between landscape attributes and landscape use, and the relationship between restorative and landscape dimensions in Concepción, Chile, an earthquake prone city. Landscapes refer here to open spaces, both public and private, in cities or nearby, used for earthquake recovery. Through a Multiple Sorting Technique (based on Kelly's Personal Construct Theory), one hundred and thirteen respondents were asked to evaluate and sort 60 landscape photographs representing open spaces used by the community for earthquake recovery. Participants explored the different uses of the open space in two scenarios: emergency (in case of an earthquake) and non-emergency (use in daily life). Multivariate analyses revealed that in a non-emergency scenario, open spaces with nature-related features and with urban facilities were the best-loaded attributes. In contrast, in an emergency scenario, the presence/absence of water and the level of urbanization were the most important attributes determining open space use. The results also showed that in the emergency scenario, restorative qualities do not seem to play a significant role and were not associated with any kind of environmental use. The paper highlights the relevance of greenery, water, and built features in post-disaster planning and community recovery.

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## 1. Introduction

There has been a long history of natural disasters in Chile making the country one of the most seismically active countries in the world. In Chile, earthquakes are a natural disturbance that occur often due to the location of the country between the Nazca and South American plates. A significant proportion of the Chilean population is thus at risk. The city of Concepción in Chile is used as a case study since it has a significant history of earthquakes with the most severe happening in 2010 (8.8 Mw earthquake). Researchers have studied this earthquake-prone environment in relation to their physical and ecological features (Cisternas et al., 2005; Jaramillo et al., 2012) and for proposing earthquake-safe buildings (e.g. INN, 1997). Nonetheless, this improvement is a great challenge for recovery interventions and it is related to the communities' use of

the landscape in the event of an earthquake emergency. The term landscape in this study refers to the range of both public and private open spaces found in cities or nearby, ranging from streetscapes and plazas to greenspaces, including public parks, wetlands, rural settings and stream corridors. There is still little research available on the quality, access and use of open spaces. Less is known in relation to the specific role of landscape attributes in people's activities and to provide restorative experiences particularly during the aftermath of an earthquake. What landscape attributes are relevant for earthquake recovery interventions?

Nassauer (2012) suggests that landscapes (i.e., open space systems and composition of the urban fabric) function as a 'medium' and as a method for transformation, meaning that open spaces can be used as tools to address urban issues that involve the community and the urban environment. Hence, the system of open spaces serves as a link between the physical and social aspects of a community's life. The presence or absence of specific landscape attributes (e.g. presence/absence of water) influence the use of open spaces. For example, people's perceptions and use of the

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urban landscape have been explored, particularly in relation to non-emergency scenarios, such as in recreational and utilitarian pursuits. Environmental attributes, such as distance, attractiveness, and size (Giles-Corti et al., 2005), lack of nuisance, presence of facilities, trees and plants, and things to watch in the park (Alves et al., 2008; Aspinall et al., 2010) make a difference in terms of preference and use of open spaces. Restorative benefits of parks and other open spaces have also been documented (e.g., Hartig, 2007; Hartig et al., 2014). However, scant information is available on landscape attributes for emergency scenarios where unstable and unpredictable events pose greater challenges for a community's physical and social resources. The benefits of open spaces are thus poorly understood due to the lack of consideration of their role in emergency situations. Nevertheless, if we understand the landscape as a medium and as a method (Nassauer, 2012), we may manipulate landscape attributes to emphasize their positive qualities with a view to promoting adaptive responses to earthquakes.

In the event of an earthquake, knowing about such attributes helps in undertaking expedient measures which are linked to the way the community uses open spaces for coping. Hence, this study compares two scenarios in earthquake-prone Concepción, Chile: a non-emergency (open spaces employed in the daily life of the community) versus emergency scenario (the incident of an earthquake), by using Kelly's Personal Constructs Theory as a conceptual framework.

### 1.1. A personal construct approach to study landscape attributes

The Personal Construct Theory (PCT) (Kelly, 1991) asserts that people attribute unique meanings to landscapes surrounding them. These meanings are defined as 'personal constructs' that help to identify landscape dimensions which are used to interpret past, present, and future events on people's lives. Kelly argued that people's interactions with the environment are construed like a scientist's work, by making hypotheses, testing them, and revising them on the basis of collected evidence.

When the landscape is studied through the lenses of PCT, it is seen as a dynamic rather than static endeavour, thus allowing researchers to delineate on-going evaluations and use of the landscape. Since earthquake-related emergency scenarios can elicit stress and they demand effective coping strategies, the PCT was seen as an appropriate approach to study landscape attributes and their use in Concepción, since it requires one to consider people's physical and social context. By focusing on personal construct-based knowledge, this study aims to provide useful information for researchers, designers, and other professionals involved in recovery and emergency programmes in Concepción, where earthquakes are predicted to happen in the future, and theoretical insight into the role of open spaces in earthquake-prone environments.

### 1.2. The role of open spaces in earthquake-prone environments

Open spaces have been regarded as an important contributor to earthquake recovery. Open spaces assume the role of a 'second city' in the case of an earthquake. A second city refers to the dormant network of open spaces that is activated after disaster and provides spaces for refuge, community gathering, and temporary shelter (Allan et al., 2013).

In the second city, landscape attributes (e.g. presence of vegetation, water, openness), which may have been used in a positive and health-promoting manner in a non-emergency scenario (e.g. walking, observing nature), may assume a different meaning in emergency situations (e.g. evacuation, refuge). In this case, the perception, meaning and use of open spaces and their components may be re-assessed to fit the needs and recovery efforts of the target community. The lack of identifiable and meaningful landscape

features may make people more vulnerable and less able to cope with risky situations.

Few studies have focused on this emerging research area and those which have are context specific and cannot be generalized to other sites. In the context of Chile and the United States, researchers have shown the utility of wetlands (Villagra-Islas and Dobbie, 2014) and the role of urban morphology (Allan et al., 2013; Villagra et al., 2014) in fostering community recovery in the aftermath of a disaster. Also, research studies in Japan have focused on the utilitarian role of open spaces in cities. For instance, certain streets, parks, plazas, parking lots and vacant land may facilitate evacuation and provide refuge and survival advantages after a catastrophe by providing water and food to the community (Ishikawa, 2002; Ishimoto, 2000). These studies have informed us about the urban conditions with respect to site size, urban density, distance to the city centre, and spatial diversity of open spaces that contribute to earthquake recovery. Even so, the role of open spaces for earthquake recovery is relatively an unstudied aspect of post-disaster recovery, and further research is needed to explore the specific features of landscapes that facilitate recovery and restorative experiences after disaster.

### 1.3. Restorative experiences in earthquake-prone environments

It is well known that certain landscape attributes can be restorative to people subjected to a high level of stress and mental fatigue (Hartig et al., 1997; Korpela and Hartig, 1996; Ulrich et al., 1991). Access to restorative environments may be crucial also in cities prone to natural disasters, such as earthquakes. The restorative experience is defined as "the process of recovering physiological, psychological and social resources (or capabilities) that have become diminished in the effort to meet the demands of everyday life" (Hartig, 2007, p. 164). Catastrophic events can change one's relationship to the landscape with important implications for health and well-being (Ruiz and Hernández, 2014).

Researchers on the Attention Restoration Theory (ART) (Kaplan and Kaplan, 1989) and the Stress Recovery Theory (Ulrich, 1984; Ulrich et al., 1991) agree that natural over built environments provide tangible benefits to restore physical and mental well-being. Open spaces that allow effortless concentration provide restorative experiences and are also rated high in terms of preference (Hauru et al., 2012; Van den Berg et al., 2007; White et al., 2010). The ART (Kaplan and Kaplan, 1989) suggests that four restorative dimensions characterize restorative environments: Being Away, Fascination, Compatibility and Coherence, which have been used to develop the Perceived Restorative Scale (PRS) (Hartig et al., 1997; Korpela and Hartig, 1996). 'Being away' reflects the need to escape from everyday life or daily mental activities that require major concentration; 'Fascination' is found in environments that attract and hold our attention without effort, usually associated with aesthetic pleasure found in areas with natural features; 'Compatibility' can be considered as a sense of oneness with the environment that provides the capabilities to meet our desires and needs; and 'Coherence' relates to the understanding of the place as a whole.

Studies have shown that restorative environments have specific landscape attributes, such as the presence of water and vegetation (Ulrich et al., 1991). For example, grass, bushes, and trees were found to predict restoration in small urban parks (Nordh et al., 2009) whereas built scenes containing water have been associated with higher preferences and perceived restorativeness than those without water (White et al., 2010). Moreover, health effects of visiting and accessing green spaces have been a recurring result associated with therapeutic environments and healthy lifestyles (Velarde et al., 2007; Ward Thompson, 2011).

Restorative experiences can be obstructed by various aspects such as traffic noise, artificial light and the presence of large buildings (Korpela and Hartig, 1996; Korpela et al., 2001). Unattended,

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