Chapter 11
Analyses of People’s Perceptions on Sidewalk Environments Combining Factor Analysis and Rough Sets Approach

Weijie Wang
Southeast University, China

Wei Wang
Southeast University, China

Moon Namgung
Wonkwang University, South Korea

ABSTRACT
This study investigates the relationship between people’s perceptions of sidewalk environments and their component elements. Participants are asked to judge the selected twenty sidewalk photographs with the rating scales through a psychological survey. Two perception factors including harmoniousness and openness are specified through semantic differential technique by using factor analysis. In the meantime the physical components of sidewalk environments are surveyed in the field survey. Then the rough sets approach is applied to link people’s perception factors and physical components of sidewalk environment. The application of the rough sets approach outputs the most important attributes to people’s perceptions, minimal attribute sets without redundancy, and a series of decision rules that represent the relationships between perceptions and physical components of sidewalk environments. The analytical approach helps to better understand people’s perceptions to sidewalk environments in a small city and then establish a useful and constructive ground of discussion for walking environment design and management.

DOI: 10.4018/978-1-61692-797-4.ch011
1. INTRODUCTION

Recently, considerable interests in improved walking environments have been generated as a result of the desire to encourage no-motorized transportation modes to reduce pollution emissions and to improve public health by increased levels of walking (Evans-Cowley, 2006; Frank and Engelke, 2001; Handy et al., 2002). A large body of research has confirmed that favorable walking environment is a necessary condition for promoting walking and neighborhood interaction (Lindsey and Nguyen, 2004; Clifton et al., 2007; Moudon and Lee, 2003; Williams et al., 2005).

There also have numerous studies on how humans react to walkways or neighborhood environments. However, they suffer from certain limitations. First, most of these studies do not encompass a broad range of physical components. For example, Schroeder and Cannon (1987), and Williams (2002) examined the contribution of trees to the visual quality of residential streets. Todorova et al. (2004) explored residents’ preferences for the combination of trees and flowers on the street. Nasar and Hong (1999) reported the visual preferences in urban signscapes on the streets. Moreover, these studies usually focus on preference alone, whereas preference constitutes only one response among many psychological mechanisms, ignoring other possible psychological responses of the subject.

Therefore, in this study, we focus on not one single physical component and preference but several physical components or their combinations of sidewalk components and people’s perceptions. There can be no doubt that the form of the environment plays an important role in the shaping of people’s perceptions. It is on this relation between physical components and perceptions that our interest concerns. Consequently, we try to link people’s perceptions and physical components of sidewalk environments and look for the representation of linkages.

However, human perception is often subjective and qualitative with uncertainty (Buhyoff and Wellman, 1980; Nassauer, 1980; Shibata and Kato, 1998). Hence, the conventional statistical methods are not suitable due to the unrealistic, rigorous theoretical assumptions, as well as the small number of observations (Baaijens and Nijkamp, 1999; Düntsch and Gediga, 1998). With the development of artificial intelligence techniques, Fuzzy set theory, neural network and other methods have been applied widely to deal with vagueness, uncertainty existing in real world (Sriram, 2006). There are some practical applications of these techniques that can be used for references in this study context. Bailey et al. (2001) employed fuzzy set theory to generate a preference knowledge base to investigate and quantify public preference for specific highway design strategies. Ergin et al. (2004) presented a fuzzy logic model to evaluate coastal scenery. Li and Will (2005) proposed a fuzzy logic model to assess the qualitative and subjective views of building scenes. Mougiakakou et al. (2005) applied neural network technology for the classification of landscape images. Naderi and Raman (2005), Raman and Naderi (2006) used decision tree learning to design pedestrian landscapes.

More recently, rough sets theory, as one member of artificial intelligence techniques has attracted attention of researchers all over the world and been applied in many different fields (Lin and Crcone, 1997; Pawlak, 1991, 1997; Polkowski et al., 2000; Wu et al., 2004). The rough sets theory uses only internal knowledge and does not rely on prior model assumptions as probabilistic models or fuzzy models do. It has been found that rough sets theory can accept both quantitative and qualitative data, identify important attributes and minimal sets of attributes through elimination of redundancy, and discover hidden facts in data and express them in natural language (Pawlak, 1997; Walczak and Masart, 1999). Due to these advantages, some practical applications of rough sets theory in the study context have been carried out. Hirokane et