Effect of graphic simplification and graphic metaphor on the memory and identification of travel map signs running head

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ABSTRACT

With the rapid development of the tourism industry, the design of tourist guide signs has become a crucial concern. This study investigated the effects of 3 graphic simplification techniques and 3 graphic metaphor techniques on graphic memory and identification. The results indicated that simplification and the interaction between simplification and metaphor influence graphic memory; moreover, simplification and metaphor were found to significantly affect identification. These findings suggest that iconic simplification with appearance-resembling metaphors, and metaphor techniques with text simplification result in superior memory. Simplification techniques with appearance-resembling metaphors and metaphor techniques with text simplification also yielded superior identification. This paper thus provides a reference model for map designers who are producing digital and travel maps.

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1. Introduction

A tourist guide is an indispensable tool for travelers that identifies popular tourist attractions and provides relevant information on service facilities. Therefore, well-designed tourist guides are essential. An effective guide does not contain redundant information, but highlights landmarks and other points of interest, thereby helping travelers to locate desired places. The main content of a tourist guide comprises signs and interpretive text. The graphic design of signs on a guide is a critical point of discussion among cartographers, and clear feature identification is a key factor in guide design (MacEachren, 2004). For the aforementioned reasons, the focus of our study on tourist guide graphic design was feature identification designs.

Sign designs can convey subject-related environmental information (Salaheddine and Khalid, 2010), and their features can influence readers' comprehension of tourist attractions. Graphic design is developed not only by designers but also users; as researchers have pointed out, users' psychological cognitions should be considered because the process of understanding a graph is a type of transformation of psychological cognition (Lin et al., 2010; Lohse, 1993). In general, memory presents more challenges than identification during the cognitive process because of the

limitations of short-term memory. Consequently, an effective tourist guide with appropriate graphic design can provide tourists clear instructions and save them time.

Although graphic recognition is determined by personal experience and cultural background, simple and figurative signs tend to elicit similar representative meanings among most people. In addition, the cognitive load of users may be reduced by simple graphic signs. Therefore, graphic producers and designers have adopted several common approaches to improving the design of tourist guide signs, among which include graphic simplification and graphic metaphor.

According to various psychological studies, a simple graphic is more likely to attract attention than is a complex graphic. Simple shapes that attract attention include circles, triangles, and squares; these shapes are typically accompanied by words and graphics that convey a message to readers for interpretation (Ou and Liu, 2012). As Bailey and Charles (2005) indicated, people also make perceptual corrections when attempting to interpret the meaning of shapes. Signs are designed to convey a specific message, and the process of transmitting information determines their success or failure. Consequently, ensuring that signs effectively convey their intended meaning has necessitated debate in the fields of art and design. Dreyfuss (1984) proposed the authoritative guideline for symbols in the information design domain. Rogers (1989) categorized and conceptualized five types of iconic representation: resemblance, exemplar, symbolic, arbitrary, and analogy.

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Elsewhere, Huang et al. (2002) identified and investigated the main factors involved in the design of computer icons; in their study, the concepts of graphic simplicity and graphic metaphor were two critical factors affecting designs. Goonetilleke et al. (2001) also considered simplicity and metaphor to be two effective elements of icon design.

Simplicity is a crucial principle in the art and design field, and refers to depicting an object figuratively without reproducing it. Designers often apply simplification techniques to depict and design objects, or to conceptualize a figure or object incrementally. The Gestalt school and several artistic psychologists believe that the simplification and abstraction of a figure helps to store and retrieve memory (Alan and Annie, 2010; Arnheim, 1971; Gombrich, 1982). For example, Son (2005) adopted crude paths, districts, and landmarks as graphic elements to construct sketch maps. Several other studies have indicated that simplified graphics are more easily recognized than photographs (Mauro and Kubovy, 1992; Ryan and Schwartz, 1956). McDougall and Reppa (2008) found that viewers preferred simplified graphics to complex graphics, and Byrne (1993) stated that, when using icons to find documents, "simplicity is critical."

Kacmar and Carey (1991) indicated that research on icons and graphical symbols has enhanced viewers' comprehension because it has enables common knowledge regarding reproductions to be shared. These scholars conducted an experiment to assess the usability of menu items that comprise text, icons, and a mix of text and icons, and their results suggested that using a mixed format increases the probability that viewers make the fewest incorrect selections. Elsewhere, Crow (2003) applied and analyzed signs according to three types, (i.e., icon, index, and symbol), and Guan and Hsieh (2009) later used the terms icon, text, and symbol to evaluate the design of signs.

Based on the terms commonly used within the relevant literature, this study focused on three dimensions of graphic simplification for sign design: *iconic simplification*, *text simplification*, and *symbolic simplification.* The definitions of these three dimensions are presented in Table 1.

The word *metaphor* is rooted in Greek and literally means *to convey* or *to transfer* (Gatsou et al., 2011). Lakoff (1993) indicated that people interpret a picture of an abstract concept and execute abstract thoughts through metaphor. Gatsou et al. (2011) claimed that a metaphor can function as a means of understanding abstract digital concepts, and Neale and Carroll (1997) argued that "metaphors allow the transference or mapping of knowledge from a source domain (familiar area of knowledge) to a target domain (unfamiliar area or situation)." Thus, people use previous experience and knowledge to gain an understanding of unfamiliar concepts. Sopory and Dillard (2002) also suggested that metaphorical statements are more persuasive than literal statements. Consequently, visual metaphors are often employed to deliver advertising and marketing messages (Boozer et al., 1992). Visual metaphors also generate a high degree of cognitive elaboration because they deviate from expectations (Jeong, 2008).

Gentner and Markman (1997) explained the mechanism of metaphors by using the concepts of similarity and analogy: in short, a metaphor is derived from analogy and similarity. Owing to people's cognitive differences across fields, similarity plays a vital role in providing general insights into human thinking (Smith and Medin, 1981).

In this study, we summarized the categories of metaphoric similarity and analogy based on previous studies. First, we referred to Markman and Gentner (2000), who proposed relational similarity, structural consistency, and systematicity as the three benchmark criteria for analogy. Next, we reviewed Gentner and Markman (1997), who distinguished between analogy or relational metaphors, mere-appearance or attribute metaphors, and literal similarity as the three dimensions of metaphoric similarity. We also adopted ideas from Gregan-Paxton and John (1997), who classified knowledge-transfer research into categories of literal similarity comparison, relational comparison, and mere-appearance comparison. Finally, research by Lin and Yang (2010), who proposed three criteria for metaphorical similarity in metaphorical advertisements (namely, appearance-resembling metaphors, symbolic-resembling metaphors, and relational-resembling metaphors), was examined.

Primarily, the present study used the classification applied by Lin and Yang (2010) because their three dimensions of graphic metaphors contain general definitions and are broadly comprehensive. Definitions and examples of appearance-resembling, symbolic-resembling, and relational-resembling metaphors are listed in Table 2.

Cartographic techniques have been examined in numerous studies, some of which have highlighted the benefit of graphic simplification or the use of graphic metaphors in the design of map signs. For example, Atkinson and Shiffrin (1968) developed a model that indicated that the control process in the human memory system may transmit environmental inputs from the sensory memory to the short-term memory through attention. Maps schematize the real world into two-dimension to reduce the possible cognitive artifacts that are created during information processing (Tversky, 2000). A more general sense of cognitive images can help visitors to easily recognize unfamiliar environments (Walmsley and Jenkins, 1992).

Notably, the cognitive image of readers can be affected by their cultural backgrounds, cognition, and the meaning of original graphics. People are exposed to various graphic shapes in daily life, both simple and complex, and they can interpret them and make judgments by using their memory of previous graphics. In the case of complex, visual, cognitive actions, factors that affect the manner in which graphics are interpreted have been explored from multiple perspectives. Hsiao (2008) conducted a study on the complexities of shape with reference to shape memory; the results revealed that remembering simple shapes is easier than remembering complex shapes. Subsequently, Hsiao and Chen (2009) conducted another study on the recognition and memory of shapes. In addition, Huang et al. (2002) demonstrated that the main communicative functions of a computer icon are to be memorable and facilitate correct interpretation. Therefore, memory and recognition were selected and applied as the dependent variables in this study.

Table 1
Simplification types.

Type	Definition
Iconic Simplification	Simplify signs through an image resembling or analogous to the thing it represents, which corresponds to its exterior characteristics.
Text Simplification	Simplify signs through the original word of the object, or the abbreviation of the thing it stands.
Symbolic Simplification	Simplify signs through something that represents the target by association, resemblance, or convention. Normally interpreted by viewer's own experience and learning.