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A taxonomy of representation strategies in iconic communication

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Abstract

Predicting whether the intended audience will be able to recognize the meaning of an icon or pictograph is not an easy task. Many icon recognition studies have been conducted in the past. However, their findings cannot be generalized to other icons that were not included in the study, which, we argue, is their main limitation. In this paper, we propose a comprehensive taxonomy of icons that is intended to enable the generalization of the findings of recognition studies. To accomplish this, we analyzed a sample of more than eight hundred icons according to three axes: lexical category, semantic category, and representation strategy. Three basic representation strategies were identified: visual similarity; semantic association; and arbitrary convention. These representation strategies are in agreement with the strategies identified in previous taxonomies. However, a greater number of subcategories of these strategies were identified. Our results also indicate that the lexical and semantic attributes of a concept influence the choice of representation strategy.
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1. Introduction

"A picture is worth a thousand words", they say. This proverb summarizes both the greatest strength and the greatest weakness in iconic or pictorial communication. By iconic communication, we mean communication through the use of pictures instead of words. Rather than words, the lexical units in iconic communication are pictures. When used to suggest specific meanings, these pictures are referred to as icons, symbols, or pictographs, among other terms. In this paper, we chose to use the term pictograph because this is the most commonly used term in healthcare, our field of study. In the background section, we elaborate on the distinctions among them. The association between a picture and its meaning is a many-to-many relationship. That is, the same picture can suggest many different concepts or ideas and, conversely, a single concept or idea can be conveyed through many different pictorial representations. A pictograph, on the other hand, is intended to represent a specific concept or idea with minimal ambiguity, as in verbal communication. Unlike verbal communication, however, iconic communication seldom relies on pre-established codes or conventions.

Languages allow us to communicate with each other in a relatively effortless way because they rely on many types of conventions (e.g., morphological, syntactic, semantic, phonetic). Although dominant, verbal communication is not the only form of communication that we use on a daily basis. The domain of cartography, for instance, is derived from the fact that, in many contexts, spatial relations are more easily conveyed visually than verbally. The same logic applies to the use of charts and diagrams to communicate quantitative information. Given this dichotomy, one can recognize that iconic communication stands on murky territory. Pictographs do not have the same representational advantages of other graphic formats such as maps or diagrams. At the same time, pictographs do not operate at the same level of codification of verbal communication, save a few exceptions (e.g., traffic signs). Nonetheless, pictographs can be found virtually anywhere: museums, hospitals, shopping malls, airports, and computer desktops. Two rationales support their use in these contexts: legibility and universality.

The legibility rationale means pictographs are more robust to changes in scale, reading speed, and distance than text. That

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is why pictographs are often used in traffic and orientation signs (see Fig. 1). The universality rationale assumes that it is possible to convey certain concepts or ideas without the use of any convention. While the legibility rationale has been empirically demonstrated (Babbitt Kline et al., 1990; Huchingson, 1981), the universality rationale has not. In fact, the universality rationale has been discredited from both a conceptual and empirical perspectives.

The only reliable way to decrease communication ambiguity is through the establishment of a code. Indeed it is possible to convey the concept "dog" to people that do not speak the same language by showing them the picture of a dog. However, this strategy only works for a very narrow class of concepts. Namely, for those concepts related to concrete entities. It will not work reliably for concepts related to conceptual entities (e.g., envy, sloth) or events (e.g., growing up, allergy) and it certainly would not work reliably at the sentence level of discourse. For a more in-depth discussion about the constraints of iconic communication, see King (2000).

From an empirical perspective, one can quote any of the several pictograph recognition studies that have been conducted in the past. In the specific field of healthcare, studies such as the ones conducted by Dowse and Ehlers (2004); Houts. et al. (1998); Kim et al. (2009), and Ngoh and Shepherd (1997) have investigated the recognition levels of specific sets of pictographs. Virtually all of the existing studies show that the recognition of a pictograph's meaning varies considerably across cohorts. Further, studies such as the one conducted by the *Hablamos Juntos* initiative (Cowgill and Bolek, 2003) show that pictograph recognition varies considerably even within a set created by the same design team.

Empirical studies on pictograph recognition also have their methodological shortcomings. They can determine how easily recognizable the meaning of any given picture is in a given population. However, their results cannot be generalized to other pictographs. To make the outcomes of such studies more generalizable, researchers must first be able to identify a manageable set of relevant characteristics that are shared by most, if not all, pictographs. More specifically, researchers need a comprehensive taxonomy of pictographs.

Every pictograph is intrinsically composed of two parts: a graphic representation and a referent (i.e., meaning). Thus, a taxonomy of pictographs must necessarily be able to identify and systematically classify all possible representation/referent relations. That is, it must be able to catalog all possible strategies used to convert a concept or an idea into a picture. Fig. 2 shows some possible representations of the concept "water".

A pictograph taxonomy can be used to extrapolate the findings of pictograph recognition studies to other pictographs that were not part of the original study. Fig. 3 shows a hypothetical case for extrapolation. Let's consider that a pictograph recognition study includes two depictions of the concept "milk". One of them is classified as a pictograph in which the concept (milk) is represented through the familiar shape of its container (milk carton). This pictograph is recognized by 50% of the study's participants. The other is classified as a pictograph in which the concept is represented through the shape of its container and through its source (cow). The recognition rate this time is 70%. Assuming analog representation strategies yield similar recognition rates, one can predict that, for example, a pictograph in which the concept "coffee" is depicted through a coffee cup and saucer would yield a recognition rate of approximately 50%.

Indeed, the predictive power of a pictograph taxonomy that focuses on the types of possible semantic relationships between representation and referent is conditional on the actual weight that these relationships bear on pictograph recognition in naturalistic contexts. Other factors such as readers' familiarity with the original concept, graphic quality, and representation genre surely influence recognition as well. Consequently, a synergistic relation between taxonomic studies and recognition studies must occur. That is, a pictograph taxonomy can enable the generalization of the findings of pictograph recognition studies. Conversely, pictograph recognition studies can be used to fine-tune the taxonomy.

The study we describe in this paper is part of a larger research project in which we propose to develop a computer application that automatically complements patient instructions with pictographs. Studies have shown that patients often do not fully understand or recall the instructions they receive (Heng et al., 2007; Hwang et al., 2005; Spandorfer et al., 1995). Aside from the instruction's

Fig. 2. Examples of verbal and pictorial representations of the concept "water".

Fig. 1. Examples of pictographs used in traffic and orientation signs.