Linking Design Intention and Users' Interpretation through Image Schemas

Asikhia O. K*, Setchi R. **

Edo State Institute of Technology and Management, Usen, Edo State, Nigeria (e-mail: asikhia.ok@esitmusen.edu.ng)
***School of Engineering, Cardiff University, Cardiff, UK (e-mail: setchi@cardiff.ac.uk)*

Abstract: Usability is often defined as the ease of use of a product but this definition does not capture other important characteristics related to the product design as being effective, efficient, engaging, error-free and easy to learn. Usability is not only about measuring how people use a product but more importantly, it is about exploring the relationship between how designers have intended their products to be used and how users interpret these designs. Previous research has shown the feasibility of using image schemas to evaluate intuitive interactions. This paper extends previous research by proposing a method, which uses image schemas to evaluate usability by measuring the gap between design intention and users' interpretations of the design. The design intention is extracted from the user manual while the way users interpret the design features is captured using direct observation, think aloud protocol and a structured questionnaire. The proposed method is illustrated with a case study involving 42 participants. The results show close correlation between usability and the distance between design intent and users' interpretation.

Keywords: Image Schemas, Usability, Performance evaluation, User study, Product Design.

1. INTRODUCTION

It was once estimated that each person in the Western world uses some twenty thousand different objects, most of which are highly specialised and require learning (Norman, 1993). New interfaces with ever-more sophisticated features and functionality appear every day. This trend has a negative impact on users, as unfamiliar interfaces increase the cognitive effort required during interaction with products (Blackler et al., 2010). The correct interpretation of the product features is even more challenging for the users when several technologies are employed in the same device. Over the last decade, this problem has been aggravated due to market demand and high consumer expectations.

The importance of relating intention to interpretation has been recognised as a research problem but the relationship between how designers intend products to be used and how they are subsequently interpreted has been regarded as a communication issue (Crilly et al., 2008).

Traditionally, the use of image schemas has been advocated as an approach for exploring user centred design (Hurtienne, 2011; Maracanas et al., 2012). An image schema is a recurring structure within the human cognitive system that establishes patterns of reasoning with the physical world (Johnson, 1987). The theory originates from cognitive linguistics and is linked to metaphors (Johnson, 2012). Recently, image schemas have been found useful in capturing interactions with products and analysing product features. Examples of products used in usability studies include cameras (Kuhn and Frank, 1991), airplane cockpits (Hurtienne, 2011), mobile phones (Britton et al., 2013) and alarm clocks (Asikhia et al., 2015). The methods used to analyse the interactions include direct observation (Antle et al., 2011; Britton et al., 2013) and 'think aloud' protocol (Maglio and Matlock, 1999; Hurtienne and Langdon, 2010).

This paper extends previous research by proposing a method, which uses image schemas to evaluate usability by measuring the distance between the designer and user mental models, i.e. the gap between design intention and user's interpretation. A user's mental model in this context is the understanding the user develops of how the system operates or is used. On the other hand, the mental model of the designer is his/her expectation of how the product should be used. A good understanding of the gap between design intention and user's interpretation of design features could lead to significant improvements in usability. The main hypothesis in this paper is that both design intention and user interpretation could be expressed through image schemas, and the gap between them can be measured by exploring how the intended image schemas are used.

The remainder of the paper is organised as follows. Section 2 discusses product usability and image schemas. Section 3 introduces the approach developed, which is then illustrated in Section 4 using a case study. The results are discussed in Section 5. Finally, Section 6 concludes the paper.

2. LITERATURE REVIEW

2.1 Usability

Usability is defined as the extent to which a product can be used by a specific user to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use (ISO 9241, 1998). When users are confronted with the use of a tool, they creatively select the interaction

style that fits their own understanding of the system, and their aims and situation. In other words, they develop a mental model of how the product should function. Therefore, product design can be discussed in terms of designer's implementation and representation, and user's mental model (Cooper et al., 2014). The implementation model typifies the designer's idea, while the representation model is the embodiment of that idea in the product. The user's model is their understanding of how the product operates. Users normally do not have access to the designer's intent and often their interpretations are based on previous experiences with similar products.

Previous research (Norman, 1988; Giard, 1989; Mono, 1997; Muller, 2001; Crilly et al., 2004, 2008) has studied the relationship between designer's intention and user's interpretation. In this context, the design intent refers to how a product is to be experienced, while the user interpretation is based on how the product is actually perceived. Designers develop their products with the intent of eliciting certain interpretations. As users, the interpretation of the intent can be experienced in different ways, ranging from the experience of meaning (usability) and that of emotion (Hekkert, 2006; Desmet and Hekkert, 2007). In particular, the experience of meaning is linked to cognition; where image schemas play an important role in the process of association, interpretation, and retrieval of features from memory (Hurtienne and Blessing, 2007; Maracanas et al, 2012; Britton et al., 2013). Furthermore, in terms of the experience of emotion, image schemas have the potential to support human understanding about an experience, and thus are likely to shape the words used to describe these experiences (Kuhn, 2007, Hurtienne et al., 2008).

2.2 Image Schemas

An image schema is a dynamic pattern of organism- An image schema is a dynamic pattern of organism-environment interaction that gives understanding to an experience emanating from human bodily interaction with the physical world (Johnson, 1987; 2012). For example, the verticality schema provides a basis for the up-down orientation based on different experiences such as perceiving a tree, felt sense of standing upright, the activity of climbing stairs, forming a mental image of a flagpole, measuring children's height and experiencing of water rising in a bathtub (Johnson, 1987). These experiences represent the abstract structure of the verticality schema. Over time, an association relating these recurring experiences with the observed relationship is established in the user's subconscious. These associations are called 'metaphoric extensions' of the recurring experience. For example, the experience of water rising in a bathtub means that the more water is poured into the bathtub, the higher the level of water in it. Therefore, the *up-down* schema is used to provide an understanding, where more is up in the domain of quantity (Johnson, 1987). Such experiences acquired by the user over a long period of time can form interesting patterns that can subsequently be recruited for interaction with minimum cognitive effort, and in a quicker time frame (Lakoff and Johnson, 1980; Hurtienne and

Blessing, 2007). Other frequently used schemas include *near-far*, *big-small*, and *front-back*.

Forty-two image schemas, divided into eight groups, with over 250 metaphoric extensions have been tested and validated in linguistic studies (Lakoff and Johnson, 1980; Johnson 1987; Hampe, 2005; Hurtienne, 2011). These metaphoric extensions are correlations of sensorimotor experiences in the world. An image schema is meaningless without its metaphoric extension. Metaphoric extensions help to map the features from the source to the target domain via the invariance hypothesis, which states that metaphor only maps components of meaning of the source language that remain consistent in the target domain (Lakoff, 1990). This means that the aspect of the metaphoric extension that is mapped, and the aspect that is disregarded in the target domain, are determined by the hypothesis.

Several image schemas have been studied extensively in cognitive linguistics using verbal and nonverbal stimuli. Examples include *up-down* (Stanfield and Zwaan, 2001; Zwaan and Yaxley, 2003), *big-small* (Glover et al., 2004), near-far (Zwaan et al., 2004; Kaschak et al., 2006), *rotation* (Zwaan and Taylor, 2006), and *left-right* (Zwaan and Yaxley, 2003). These studies show that image schemas can be activated in audio, visual, and motor modalities, and that the responses of the participants are quicker if the image schemas activated are consistent with the stimuli presented, and slower if they are inconsistent.

Traditionally, the use of image schemas and their metaphoric extensions has been advocated in user centred design (Hurtienne and Blessing, 2008; Hurtienne and Langdon 2010). Image schemas occupy sensorimotor level in the continuum of knowledge acquired before interaction (Hurtienne and Blessing, 2007). Therefore, a product feature designed with the knowledge of image schemas is more likely to require less cognitive effort to understand its operation. Several studies have focused on the use of image schemas in usability studies. These studies show that image schemas can be used in analysing the steps involved in interactions with products (Hurtienne et al., 2008), product descriptions (Maglio and Matlock, 1999; Hurtienne and Israel, 2007), direct observations (Britton et al., 2013) and utterances (Hurtienne and Langdon, 2010). The image schemas identified and extracted in these studies have been used to improve the usability and redesign the products.

The findings in the previous studies have a number of implications in product design. First, designers can take advantage of the multi-modal attributes (visual, audio, and motor) of image schemas to present interface features in different forms. Second, the invariance hypothesis provides the structure of the metaphoric mappings. According to Hurtienne (2011), the invariance hypothesis can help interface designers to focus on the relevant feature in user interface metaphors. In other words, the hypothesis provides an explanation of the relevant image schemas identified in the context of the task. Third, these studies indicate that image schemas could be used as an approach for evaluating product usability.