ELSEVIER

# Towards supporting evocation processes in creative design: A cognitive approach

Nathalie Bonnardel[a],*, Evelyne Marmèche[b]

[a]University of Provence, Research Centre in Psychology of Cognition,
Language and Emotion (PsyCLE), France
[b]Laboratory of Cognitive Psychology (LPC), University of Provence & CNRS, France

Available online 23 May 2005

## Abstract

In order to contribute to a better understanding of creativity in non-routine design activities, we conducted an experimental study that focused on a cognitive mechanism involved in creative design, that of the re-use of aspects derived from previous sources of inspiration. Our objective was to determine to what extent designers consider potential sources as useful for solving a specific design problem. Since the relevance of sources of inspiration may be appreciated differently according to the level of expertise in design, the experiment was performed with two groups of participants: experienced designers and inexperienced designers. The results show differences in the number and nature of the aspects selected by each group of designers as well as in the judgments of usefulness they expressed about the different types of suggested sources of inspiration. On this basis, we discuss how these findings may influence the design of a computational system supporting creative design tasks and we consider how to facilitate the progression from novices to experienced designers.
© 2005 Elsevier Ltd. All rights reserved.

Keywords: Creativity; Design; Problem solving; Expertise; Analogy; Evocation process; Support systems

*Corresponding author. University of Provence, Department of Cognitive and Experimental Psychology, 29 avenue R. Schuman, 13621 Aix-en-Provence, France. Tel.: +33 4 42 95 37 40; fax: +33 4 42 20 59 05.

E-mail addresses: Nathalie.Bonnardel@up.univ-mrs.fr (N. Bonnardel), evelyne@up.univ-mrs.fr (E. Marmèche).

## 1. Creativity and design problem solving

Creativity can be characterized as a complex activity, consisting of a special form of problem solving (Newell et al., 1962; Guilford, 1964; Mumford et al., 1994; Matlin, 2001). A main characteristic of creative tasks, such as design tasks, is that the initial state is ill defined (Reitman, 1964; Eastman, 1969; Simon, 1973): designers have, initially, only an incomplete and imprecise mental representation of the design to be performed. The designers' mental representation evolves as the problem solving progresses. Therefore, each designer constructs his or her own representation of the design problem and deals with a problem that has become specific to him or her (Falzon et al., 1990; Simon, 1995). In practice, different designers, supposedly solving the same design problem, reach different solutions (Bisseret et al., 1988). This is especially due to the fact that they adopt various points of view and develop opportunistic reasoning (Hayes-Roth and Hayes-Roth, 1979; Guindon, 1990; Visser, 1990; Bonnardel et al., 2003). In this framework, we can attempt to better understand how creativity occurs in design activities.

Far from the earliest definitions of creativity, which suggested that to create is "to bring into being, to form out of nothing…" (Websters dictionary, 1880), a deep analysis of creative situations attest that new ideas are in fact inspired by old situations pertaining or not to the same semantic domain as the current creative context (see, for instance, Friedel and Israel, 1986; Bonnardel, 2000). Thus, creativity has been characterized by "the sudden interlocking of two previously unrelated skills, or matrices of thought" (Koestler, 1975, p. 121). More precisely, creativity is the result of a relationship between working memory and long-term memory, based on a process of "selective emphasis" (Koestler, 1975).

Creativity has also been described as consisting of the activation and recombination in a new way of previous knowledge elements in order to generate new properties based on the previous ones (Ward et al., 1997; Wilkenfeld and Ward, 2001). According to Ward's structured imagination framework, people who are engaged in generative cognitive activities have to extend the boundaries of a semantic domain by mentally crafting novel instances of the concept. However, experimental results show that people have a strong tendency to rely on exemplars (Jansson and Smith, 1991), even when they have been instructed to be as creative as possible. In fact, the more the participants move away from the first evoked sources, the more they are creative and original (Ward et al., 2002). It appears, therefore, that the most successful uses of analogies may depend on the capacity to move beyond initially retrieved information to better or more refined exemplars, interpretations and source analogues.

Analogy-making may thus be considered as a central process leading to the emergence of new ideas (see, for instance, Boden, 1990; Kolodner, 1993). Two kinds of analogies can be distinguished: intra-domain and inter-domain analogies. Intra-domain analogies refer to the same semantic domain as the object to be designed. The evoked sources of inspiration share many semantic features with the target object. Thus, the evoked objects as well as the target one pertain to the same category. For instance, if the target object is a cyber-café seat, links can be