

Fundamental studies in Design-by-Analogy: A focus on domain-knowledge experts and applications to transactional design problems



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Design-by-Analogy (DbA) is recognized for its potential for fostering innovation. Previous work provides insights into how analogies assist in solving problems in engineering design and architecture. However, services currently add more than 65% of global economic value. Designers now face design problems not only in physical systems but transactional as well. This study expands our understanding of design practitioners' cognitive processes by exploring the development of innovative solutions for transactional problems using a DbA approach, via a semantic-word-based ideation method, on a relatively large expert sample size (n = 73) of transactional domain experts. The study shows correlations for semantic solution transfer, quantity of ideation, fixation, novelty and quality when developing solutions for transactional problems by means of DbA methods.

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Analogy is the process of association between situations from one domain (source) to another (target) made possible through the establishment of relations or representations (Gentner, 1983). Designs are analogous if they share at least one function or behavior, but not necessarily similar structures (Qian & Gero, 1996; Visser, 1996). Analogy association processes promote new inferences and problem understanding. Analogical association and retrieval in human cognition depend on how a problem is represented, where previous research shows that multiple representations facilitate analogical reasoning through the retrieval of effective and novel analogies

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stored in designers' long-term memory (Anderson, 1983; Blanchette & Dunbar, 2000; Brown, 1989; Linsey, Murphy, Wood, Markman, & Kurtoglu, 2006; Linsey, Wood, & Markman, 2008b; McKoy, Vargas-Hernández, Summers, & Shah, 2001; Roediger, Marsh, & Lee, 2002; Vattam, Helms, & Goel, 2008).

Numerous examples of innovative systems and products based on analogies may be found in practice and in the literature, like bio-inspired products such as flippers (aquatic bird legs) or Velcro (Arctium plants). Design-by-Analogy (DbA) is an area that seeks to assist designers in identifying and developing examples, related cases and scenarios, and connected experiences (i.e., analogies) to solve design problems (Goldschmidt, 2001; Leclercq & Heylighen, 2002; Linsey, Clauss, Wood, Laux, & Markman, 2007; Linsey, Laux, Clauss, Wood, & Markman, 2007). DbA is a potentially powerful tool in idea generation (ideation), in a number of knowledge domains such as engineering design. The research reported in DbA underscore the intensity of research into creativity at the interface of cognitive science, social psychology, and knowledge domains such as engineering design (Christensen & Schunn, 2007; Schunn, Paulus, Cagan, & Wood, 2006; Tseng, Moss, Cagan, & Kotovsky, 2008b). A careful consideration of the literature indicates the need for more in-depth studies of ideation methods, the theoretical basis of these methods, and the variables or factors involved in executing these methods, especially for different knowledge domains and creative problem-solving scenarios (Jensen, Weaver, Wood, Linsey, & Wood, 2009; Jensen et al., 2012; Weisberg, 1993, 2009).

Design process and method development, such as ideation, for the area of services (e.g., transactional processes) are an important and growing area of research. The importance of analyzing idea generation as part of the design process in service companies (defined in OECD, 2010 as 'retail and wholesale trade; transport and communications; real estate, finance, insurance and business services; education, health and other personal services; public administration; and defense') lies in the fact that services as an economic activity has increased by 10% compared to products and agriculture during the last three decades. By 2008, services accounted for more than 65% of the economic activity reported by the Organization for Economic Cooperation and Development (OECD, 2010, 2011), while in the US in 2009 services comprised more than 77% (Chesbrough, 2011; World Bank, 2011). Based on this growth, suitable design approaches for services, and in particular transactional processes, are needed to ensure competitiveness and the development of innovation processes for this economic sector.

To understand the meaning of a transactional process or problem in these types of economies, consider a banking institution. A bank does not provide

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