Information Acquisition and Recall in Location-Aware and Search Engine Retrieval Systems

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ABSTRACT

This paper examines the potential cognitive impact of location aware information systems compared to that of search engines using a dual coding and conjoint retention theoretical framework. Supported by virtual reality or mobile devices, location aware systems deliver information that is relevant for a specific location. Research questions and hypotheses formulated under the assumption that location aware systems are better prepared to contextualize and make information memorable are explored using a planned comparison repeated measures 3 (2 treatment; 1 control) x 3 (pre-test, post-test, one week post-test) design. The results indicate that information acquisition in location-aware systems is just as powerful as that facilitated by search engines and that information recall (after 1 week) of facts is superior when using location-aware systems. The findings reinforce and extend dual coding theory suggesting that spatial and three-dimensional indexing can be one of the channels used in indexing and recalling information. The results also indicate that location-aware applications are a promising technology for distributing information in general and for learning in particular.

Keywords: Learning, Location Aware, Mental Maps, Recall, Search

INTRODUCTION

New communication technologies capable of delivering information when and where we need it have emerged over the past decade (Yang, Okamoto, & Teng, 2008). These tools promise a radical shift in learning strategies by overcoming the current limitations imposed by search engines (Weiler, 2005). Location aware and augmented reality applications powered by mobile devices, such as Wikitude (http://wikitude.org), Layar (http://layar.com), Ubimark (http://ubimark.com), or Junaio (http://metaio.com) will one day provide details about any and all aspects of our physical and social environment (Sandor, Kitahara, Reitmayr, Feiner, & Ohta, 2009). Yet, despite the progress made, more needs to be done until our mobile phones would be able to answer in direct, timely, and accurate manner the question “What is that building with the tall red spire by the grocery store?” A great deal of contextual information...
would need to be added to the location aware systems, while mobile devices would need to be vastly improved in terms of usability, spatial sensitivity, and ability to discern which aspects of physical reality are of interest to the user.

Until then, researchers should make a case for the relevance and superiority of such technologies. Specifically, they need to provide a convincing answer to the question if location-aware delivery of information is more likely to foster learning than traditional, keyword-driven retrieval of information. Some researchers have already investigated some aspects of location aware learning and information retrieval, yet much more needs to be done. From the earlier studies on how location-aware systems can suggest points of interest in buildings, such as printers, elevators, or vending machines (Koo, Rosenberg, Chan, & Lee, 2003), we have advanced to massive, city, region, or worldwide projects or studies that focus on the role of space in delivering information (Anand, Harrington, & Agostinho, 2008; Armstrong & Bennett, 2005; Borriello, Chalmers, Lamarca, & Nixon, 2005; Matei, Miller, Arns, Rauh, Hartman, & Bruno, 2007). In fact, an incipient and solid research program is budding out in the field of location aware information diffusion (Anand et al., 2008; Barbosa, Hahn, Rabello, & Barbosa, 2008; Yang, Okamoto, & Tseng, 2008).

Yet researchers interested in studying contextually-defined information delivery, especially information acquired by visitors and newcomers (Abowd et al., 1997), have primarily focused their attention on device usability, infrastructure architecture, and information delivery (De Jong, Specht, & Koper, 2008) rather than on understanding how location-aware systems can facilitate deeper cognitive processes. A search on Google Scholar for business, engineering, and social sciences papers that contain “location aware” in their title retrieved for 2009-2010 63 articles (http://bit.ly/locaware), of which only one dealt with spatial learning in an explicit way (Kim et al., 2009).

The present paper is an attempt to address this knowledge gap by providing answers to some basic questions related to how humans might learn in location-aware contexts. We are interested to learn not only if location-aware applications are feasible (Armstrong & Bennett, 2005; Borriello et al., 2005), but also whether or not these location-aware systems actually increase a person’s ability to remember the information they receive in a location-aware context. Furthermore, the paper strives to bridge the gap between traditional research on spatial cognition with recent research related to the learning advantages of location-aware technology.

Previous research suggests that knowledge acquisition and retention are significantly improved when information is presented in a location-aware delivery system (Matei, Madsen, Arns, Bertoline, & Davidson, 2005; Mayer & Anderson, 1991). The present paper extends this line of research by comparing location-aware communication systems with other methods of information delivery. Consistent with a number of spatio-cognitive theories, it is anticipated that those who use a location-aware communication system might recall information better than those who learn through comparable technologies, such as search engines.

The basic assumption is that location-aware systems present three specific advantages over other, more traditional, methods of information delivery: 1) enhanced capacity to organize information focused on a specific physical space, 2) superior ability to convey this information while the user is in this specific physical space, and 3) unique ability to simultaneously deliver information through a number of channels (Anand et al., 2008; Barbosa et al., 2008). Of these three advantages the current paper focuses on the third, which will be explored in view of dual coding theory (Paivio, 1990) and the conjoint retention hypothesis (Kulhavy, Lee, & Caterino, 1985). According to dual coding theory, location-aware information should be easier to remember because it activates two cognitive systems simultaneously: the verbal and the imagery system. The interaction of these two systems enhances the ability to remember both types of information. The conjoint retention hypothesis suggests that the use of internalized
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