Evaluating Information Design for Notification Systems

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As computing platforms continuously grow in processing power, diminish in size, and are creatively integrated into every facet of the human experience, popular demand also increases for unfettered access to information of interest, necessitating insightful design for a variety of displays. While engaged in their daily discourse, occupied with activities such as driving, desktop computing, or interacting with others, people often want to remain notified about news items, collaborative efforts, and other changing information. Decision requirements within new settings or situations may prompt immediate interest in accessing related data. Notification systems in the form of ubiquitous computing devices, to include wearable computers, vehicle information systems, and handheld devices, are relied on support these information needs. Desktop computer users also depend on small-sized secondary display applications to provide similar notification information.

However, information conveyed through these devices and applications is often perceived with short, discrete attention shifts and glances rather than longer periods of full attention perception that has been considered typical of human-computer interaction. Certainly, this paradigm has implications for information design, rooted in cognitive processing and human attention limitations. Adding to this challenge, user goals are difficult to predict and often conflicting. For example, users may not want to be interrupted from a primary task, although they still wish to maintain awareness of information over a period of time or recognize specific information states. In other usage scenarios, users may wish to be alerted about information and attracted to some interaction. Platform capabilities may also mandate minimalist information representation, presenting an imperative for reevaluation of design guidelines for a wide array of emerging computer interfaces within these constraints.

Objectives and Related Work

Through empirical study, we seek to understand how various options for information encoding and design, presented within a dual-task situation, simultaneously affect user interruption while enabling reaction and comprehension of notifications. Although much work has been done to understand relative effectiveness and expressiveness of visual primitives within the human-computer interaction field, there are few empirically established design guidelines available for digital displays that are typically not a user's main attention focus. Cleveland and McGill's ordering of graph attributes provides guidance for primary task displays (1984), and Cleveland has extended consideration of graphical attribute effectiveness to specific information extraction tasks (1994).

However, the dual-task nature of notification systems usage requires evaluation of many other system variables for strong empirical study validity. For example, various combinations of mental and physical workload levels, cross-modal or intramodal presentation of the two tasks, and competing demand for sensory channels and short-term memory (Wickens & Hollands, 2000) will certainly have implications for fulfilling objective information design requirements. Empirical methods allowing reliable replication, measurement, and modeling of these variables are pivotal for creating notification systems guidelines.

Continuing Work

Initial findings from our work show that Cleveland and McGill's guidelines for use of visual attributes do not hold for dual-task situations where a distraction to a primary task requiring high attention and manual interaction must be minimized (Tessendorf et al., 2002). Additionally, we have seen evidence that information design for decision-support notification systems is best accomplished with cross-modal representations as a primary task's visual sensory demand level increases (tasks tested within a CAVE™ virtual environment and on a desktop computer). Continuing studies will lead to development of regression models and tables, supporting rule-based presentation adaptivity, complementary to efforts such as Horvitz's PRIORITIES system, which makes inferences about a user's attention state and calculates expected cost of an interruption to determine the most suitable presentation method (Horvitz, Jacobs & Hovel, 1999).

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