Understanding System-induced Cognitive Load with Eye Tracking

TREO Talk Paper

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Abstract

Cognitive load is one important contributor to system usability, and minimizing unnecessary cognitive load can help users better process system information. Cognitive load theory, an educational theory, defines three types of cognitive load: intrinsic, extraneous, and germane (Sweller et al. 1998). Intrinsic cognitive load is a necessary part of completing a task. Extraneous cognitive load is introduced by the format and presentation of material, and can be minimized with design help. Germane cognitive load is the effect of the effort learners put into understanding. Important to our study here are intrinsic and extraneous cognitive load.

Systems can be designed to minimize the negative influences of extraneous cognitive load. Using eye tracking, we can understand how system design influences cognitive load, and correlating with reported cognitive load can clarify differences between extraneous and intrinsic cognitive load in system design.

We have designed a novel personal health record pre-visit form. Data from the pre-visit form helps the healthcare team understand the patient's current status and needs, and ensures needs are met. The system consists of 10 sequential screens where patients input their information such as past surgical history, medications, allergies, and family history. As a part of the development of the system, we have conducted usability tests with 32 adult cardiovascular patients from the University of Nebraska Medical Center's Heart and Vascular Center. Patients used the pre-visit form to enter their personal health information. After each screen, patients filled out measures of cognitive load using the NASA Task Load Index (TLX). Throughout the interaction, their gaze was tracked using an EyeTech eye tracker.

Using the combination of self-reported cognitive load (e.g. NASA TLX) during system interaction and eye tracking, we will gain an understanding of how gaze behavior is influenced by cognitive load. Our initial analysis of the TLX data has shown that cognitive load varies depending on the type of information requested from patients, and that tasks requiring significant information recall create cognitive load in patients (Pachunka et al. 2019). By combining this information with our eye tracking data, we will be able to better understand how system design and cognitive load influence gaze behavior.

References

Pachunka, E., Windle, J. R., Schuetzler, R. M., and Fruhling, A. L. 2019. "Natural-Setting PHR Usability Evaluation Using the NASA TLX to Measure Cognitive Load of Patients," in *Proceedings of the 52nd Hawaii International Conference on System Sciences*, Wailea, HI, January 8, pp. 3954–3963. (http://hdl.handle.net/10125/59832).

Sweller, J., van Merrienboer, J. J. G., and Paas, F. G. W. C. 1998. "Cognitive Architecture and Instructional Design," *Educational Psychology Review* (10:3), p. 46.