



Changes in operators' attention allocation patterns due to the presence of alerts and their reliability

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Introduction. Technology development lead to new challenges relating to the connection between humans and machines. Users use automated systems in different ways. Systems that are designed to help the operator, like alert systems, could harm if they are not fitted to users needs and not reliable enough. This is particularly relevant for displays for dismounted soldiers who operate in dangerous and high tempo environments. In this study, four levels of reliability of an alert system were examined by analyzing operators' performance and their eye scanning pattern. It was hypothesized that the level of reliability and not merely the presence of an alert will determine the way participants scanned the information.

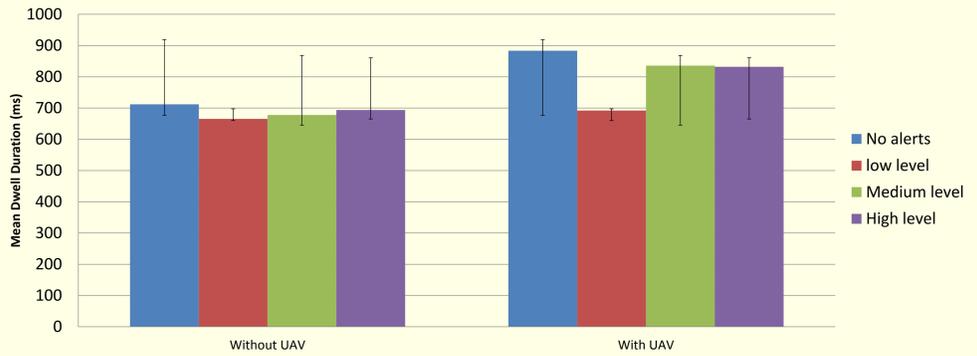


Fig. 3. The interaction alert level reliability and presence of UAV feed in the scenario for mean Dwell duration

An additional analysis of Dwells was made by looking at dwell proportion in each AOI, for each participant, using Dirichlet regression. Fig. 4 presents the proportion for scenarios where the UAV was present.

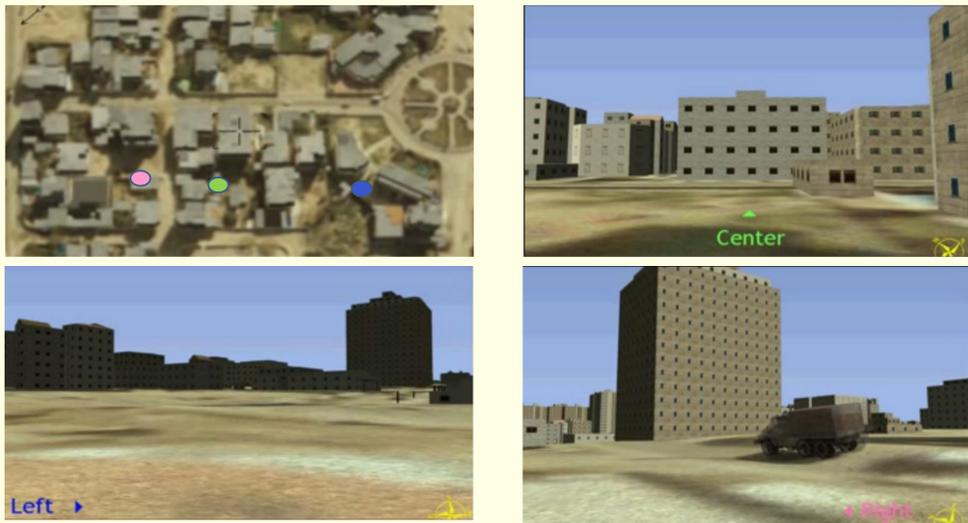


Fig. 1. Aerial and ground views of the conflict area, as seen from unmanned sensors located in the vicinity of the hostile building (unmanned aerial UAV and ground vehicles UGV). Location of ground sensors is marked on aerial view for illustration.

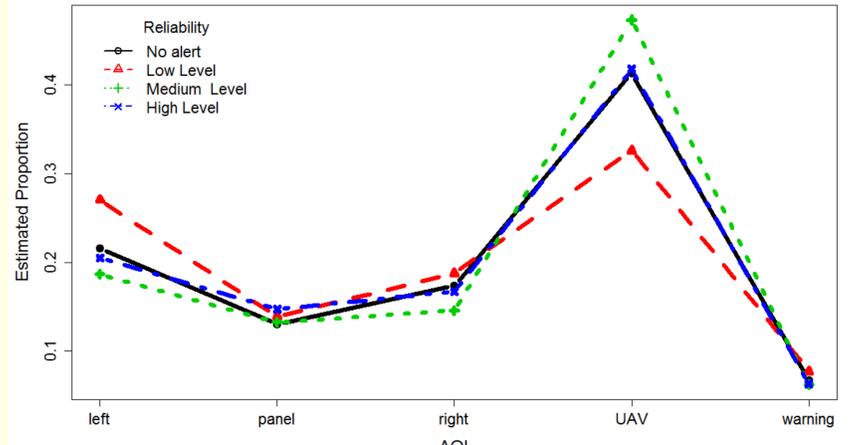


Fig. 4. Proportions of dwells by areas of interest (AOIs) on the screen, in scenarios where the aerial view from UAV was present.

Method. In 4 operational scenarios, 40 participants, all infantry soldiers with combat experience, were asked to detect and identify suspicious vehicles entering and leaving a hostile building via an interface that presented video feeds derived from unmanned ground and aerial views (Fig. 1). A visual alert system (yellow rectangle, Fig. 2), in one of four levels of reliability: High level, Medium level, Low level and no alerts was available. The alerts conveyed the occurrence of events that required operators' immediate attention.

Discussion and Implications. The reliability level of the alert system influenced how operators scanned the information and their operational performance. The main concern is with the low level reliability; scanning differed from higher levels of reliability and from no alert system. In this case when UAV was present, participants' average dwell was shorter and the number of transitions between AOIs was higher. If the reliability level of the system is insufficient for the use case (user and task), users become distracted. For infantry soldiers who operate in difficult conditions, high tempo and uncertainty, the alert system can make a crucial difference in mental load. As shown before, the aerial view from the UAV is advantageous to soldiers but is also more complex to apprehend. Hence, their susceptibility for error when the alert reliability is low is elevated, up to the point where no alert may be better. Implementation of an alerting system needs to be done with caution, training soldiers on its limitations and strengths.

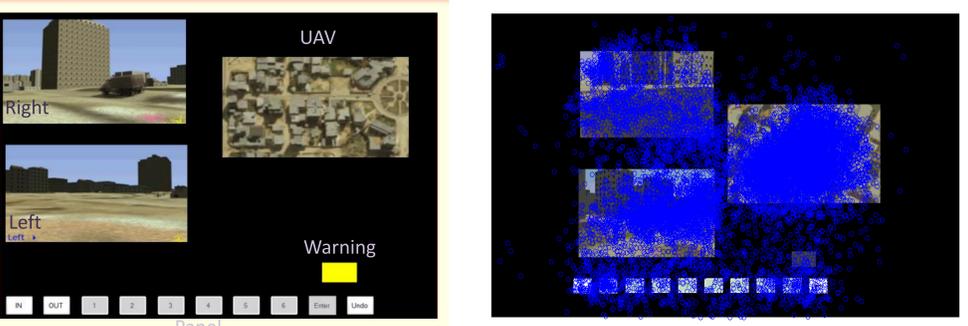


Fig. 2. Left: Sample screen layout when the aerial view was present. Note the yellow alert indicating the presence of a moving suspicious truck in the scene. Right: an example of dwells derived from the eye tracker superimposed on the screen.

Results. Dwell time represents the sum of all consecutive fixations' duration within an area of interest. Using the LMM (Linear Mixed Model) analyses, analysis was made in two steps: first the influence of reliability level of the alarm for all scenarios together and then, scenarios were separated to two groups: with UAV feed and without UAV feed due to understanding that using display from UAV changes operators' scanning pattern (Ophir-Arbelle et al., 2012). The interaction between reliability level of the alarm system and the presence of the UAV display is shown in Fig. 3.

References
Ophir-Arbelle, R., Oron-Gilad, T., Borowsky, A. & Parmet, Y. (2012). Is more information better? How dismounted soldiers utilize video feed from unmanned vehicles - attention allocation and information extraction considerations. *Journal of Cognitive Ergonomics and Decision Making*, 7 (1), 26-48

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