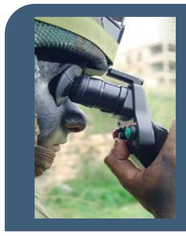

# Display type effects in military operational tasks using Unmanned Vehicle (UV) video images: Comparison between color and B/W video feeds

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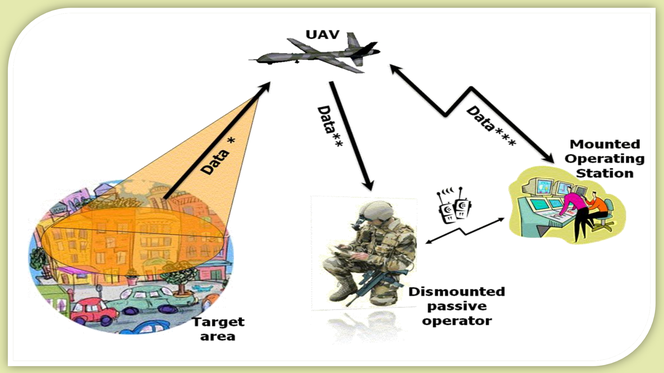
**Background**: The use of UV imagery in combat has become essential for mission success. Factors that may affect the UV video feeds' utilization are color and quality of the feed. Specifically, the use of black and white feeds or colored ones is considered both from technical aspects and cognitive aspects. Operationally, B/W is often used due to band width limitations, or payload selection.

Previously (Oron-Gilad, Redden & Minkov, 2011) we have shown task dependent differences among display types with regard to soldiers' performances on intelligence gathering type tasks.



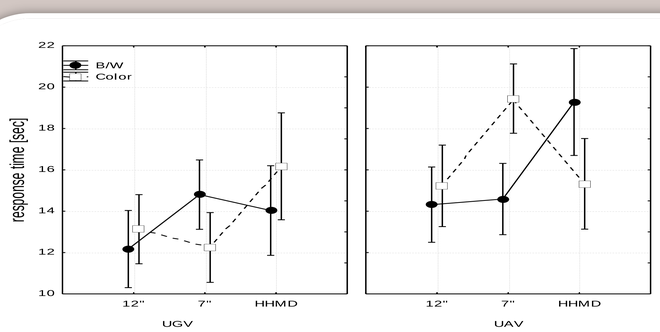

*A typical scenario for the passive dismounted soldier*

**Method:** 16 former infantry soldiers with MOUT experience but no prior experience using UV video feed participated. Three displays were examined in two feed variations (color and B/W) in three Intelligence gathering task types (orientation, identification and response to a movement), all using simulated UAV and UGV video images. Performance, workload and subjective data were collected.

***Example of scenario elements and tasks. Participants were asked to (left) navigate between waypoints using a predefined route, (center) identify static parked vehicles or (right) detect movements of soldiers from the UAV (top) or UGV (bottom) feeds.***

**Results:** Accuracy – only main effects UV type and task type were statistically significant (Wald $\chi 21=14.5$; $p<0.001$, and Wald $\chi 22=325.5$; $p<0.001$ ). Accuracy with the UGV feed was higher than with the UAV feed (Mean=3.6, SE=.07 and Mean=3.3, SE=.07, respectively). The movement detection scores were highest (Mean=3.8, SE=.08) followed by vehicle identification Mean=3.5, SE=.09) and orientation (Mean=3.0, SE=.08).

Response time - The three-way interaction display type by UV by feed color was significant ($F2, 307=11.5$, $p<.0001$). The combination of B/W feed with the HHMD generated longer response times than the colored feed. An inverse trend was seen with the 7" HHD.




***Three-way interaction for response time among Display type, UV type and feed color.***
*Vertical bars denote 0.95 confidence intervals*

Workload estimates were moderate. Workload was higher when colored feed was presented on the 12" and HHMD than B/W feed. The 7"display generated the opposite.

**Discussion:** Results showed superiority for the UGV feed. Although consistent with our previous study, in operational contexts generally, aerial vertical views are considered more informative and easy to understand than ground horizontal ones, due to their holistic view and similarity to aerial maps.

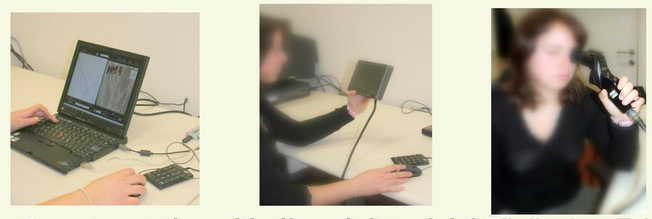
- The experimental scenarios may have contributed to the superiority of the UGV. If the task can be conducted from both ground and aerial perspective feeds then it is reasonable to assume that the ground view (which is more compatible with the soldier's point of view) will be preferred.
- Nevertheless, one should keep in mind that oftentimes in operational settings the UGV is not capable of viewing the same information as the UAV and the two sources provide complementary feed (see Ophir-Arbelle, Oron-Gilad, Borowsky and Parmet, in press).


***The experimental system interface. (Right) video feed. (Left) topographic image of the area, from a (top) UAV B/W perspective Vs. UGV colored one***

## Conclusions and future work:

Evidence had shown that for video and map based missions a larger display has its superiority, and that B/W feeds may be good enough to perform certain tasks in larger displays. Experimental design considerations may have influenced the results, e.g., the simulation conditions, the (high) quality of the simulated feeds, the lack of role for color in the operational tasks and scenarios, and the partial-balance of the experimental design. Amongst other factors, future studies should focus on how the cognitive state of the operator e.g., mental or physical fatigue and extreme stress affect performance.

**Acknowledgments**. This work was supported by the US Army Research Laboratory through the Micro-Analysis and Design CTA Grant DAAD19-01C0065, Michael Barnes, Technical Monitor. The views expressed in this work are those of the authors and do not necessarily reflect official Army policy.



***Operator station with (from left to right) 7" display, Tablet and HHMD. Participants were free to hold the display to their own comfort***