

Background

In clearing operations, law enforcement must secure an area by responding to threats [1]. Using a drone swarm can increase officers' safety during clearing operations because multiple drones can provide information about the area from multiple paths [2]. This study evaluated how officers interpreted drone video feed data on different monitor set-ups.

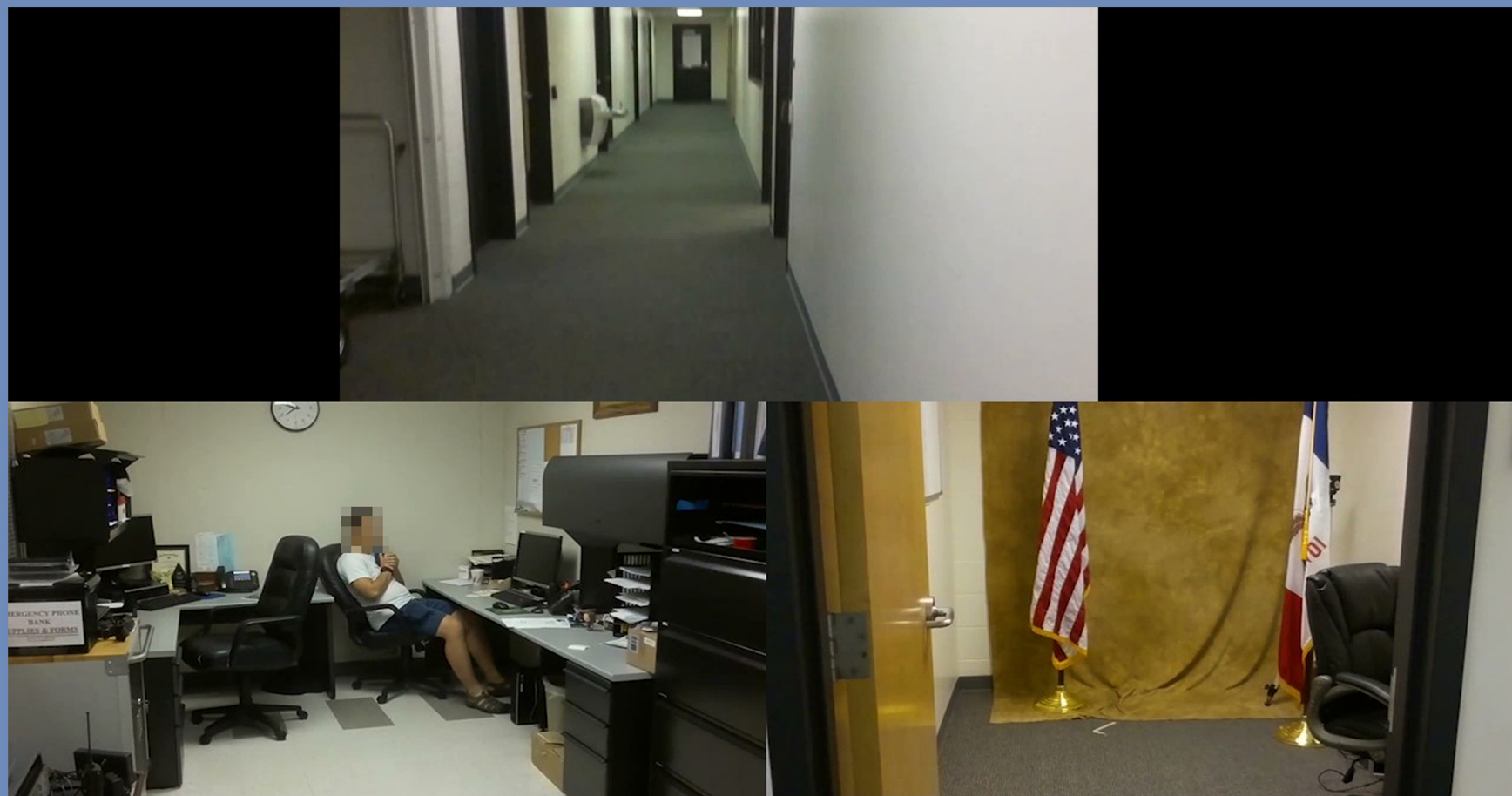


Figure 1. Screenshot of video feed from multiple drone clearing operation

Research Question: Does using a multiple monitor set-up to display drone swarm footage affect officers' mental state or their interpretation of such footage?

Variables Measured:

- Situational Awareness: Perception and comprehension of environment depicted in drone feed [3]
- Mental Workload: Subjective workload assessment; how much mental resources needed to understand drone feed [4]
- Trust in Human-Robot Interaction: How much officers trust drone feed to be useful [5]



Figure 2. Three monitor set-up displaying drone swarm footage

Materials and Methods

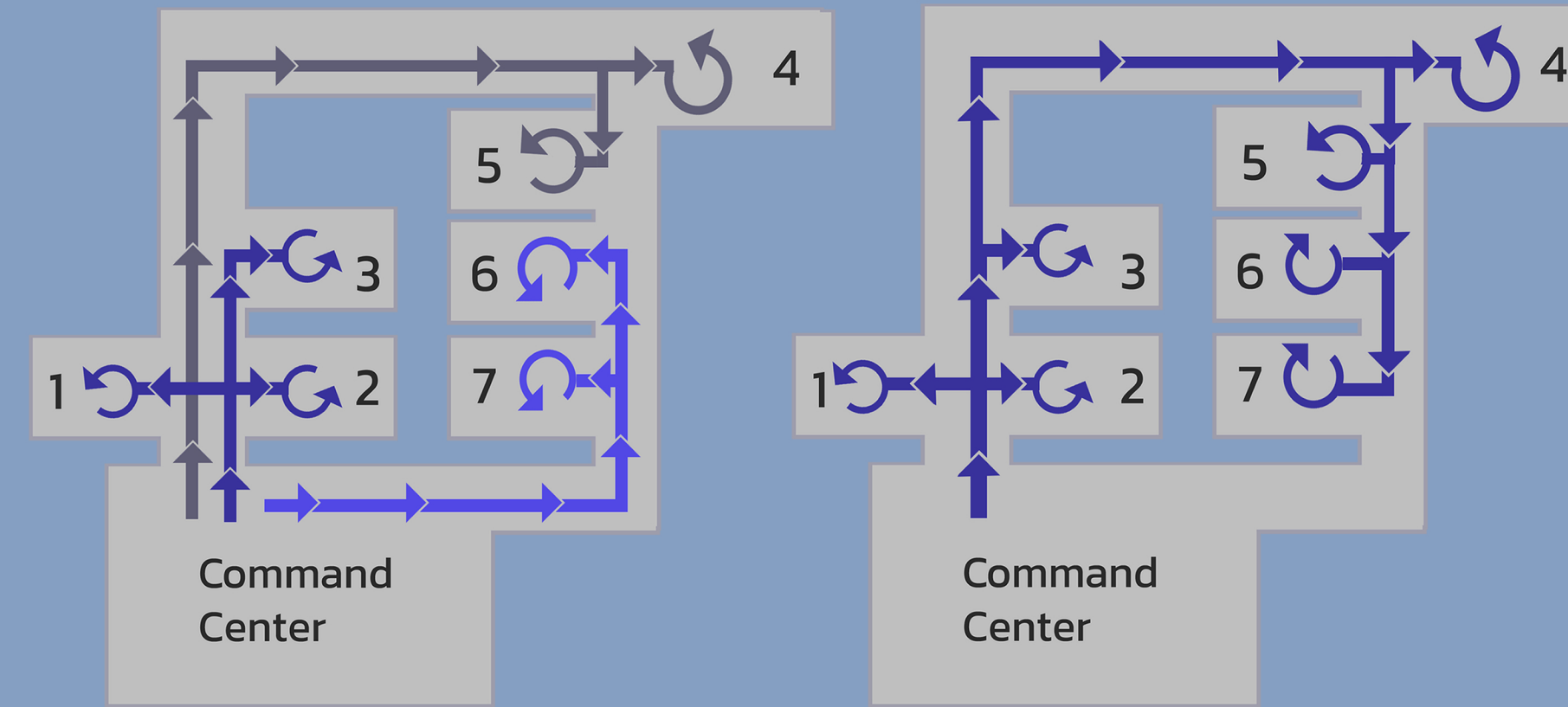


Figure 3. Flight search paths of the swarm (left) and single drone (right)

Ten law enforcement officers participated in this study by watching pre-recorded feeds of a single-story drone clearing operation (paths found in Figure 3) of a familiar area. After watching the videos, they identified targets they saw (if any) on a map of the area.

Participant Trials (Figure 4):

- Control: Feed of a single drone search from one monitor
- Group 1: Feed of a swarm search from three monitors
- Group 2: Feed of a swarm search from one monitor

In each trial, participants watched two videos— one containing a target to detect and one with no target— in random order. After watching the feeds, participants filled out the following modified surveys and answered questions in an informal interview.

- NASA-TLX: to assess mental workload
- SART 10D: to measure situational awareness
- Trust-Perception Scale in HRI: to measure trust in HRI

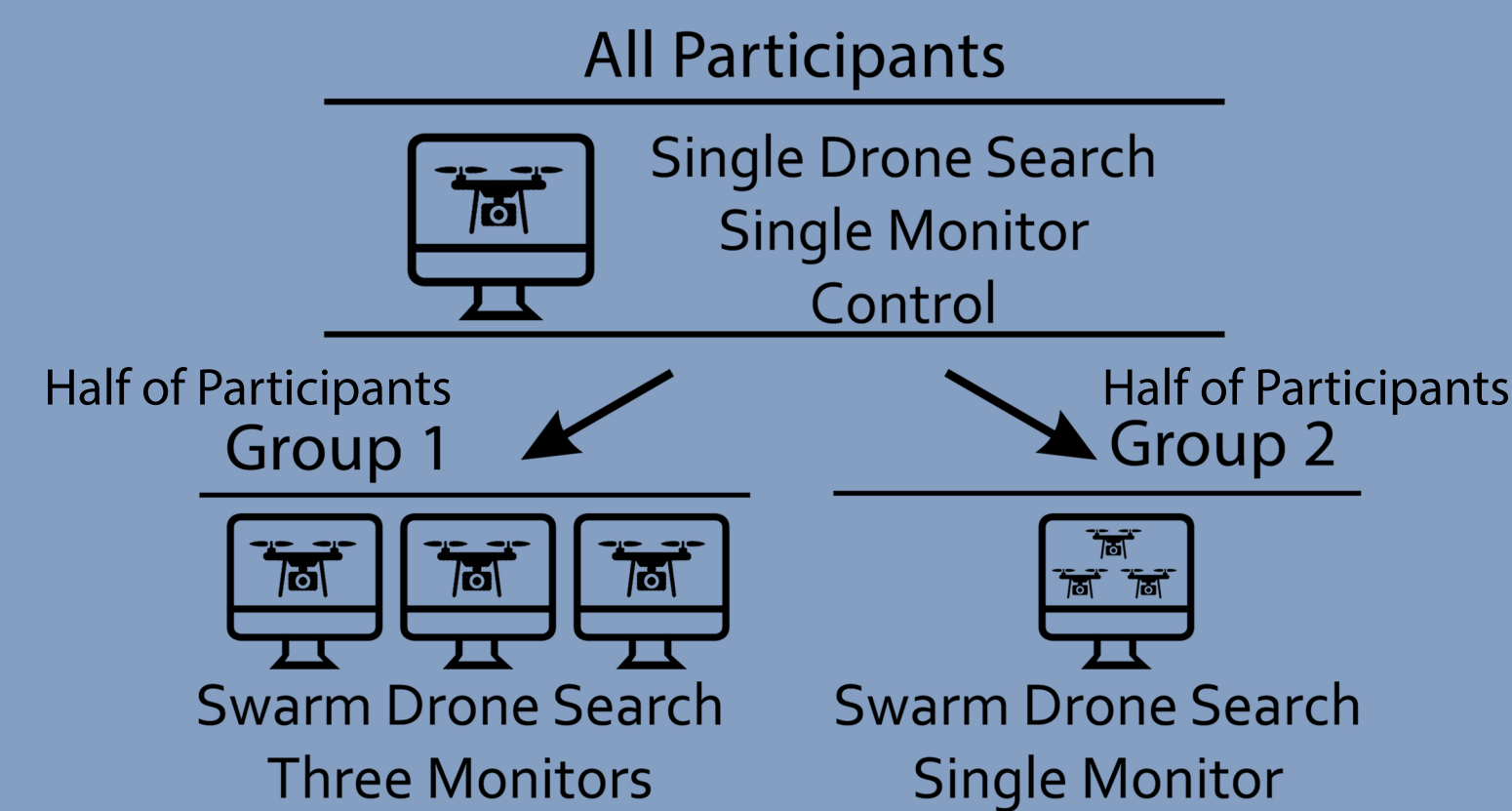


Figure 4. How participants were sorted for video trials

Results

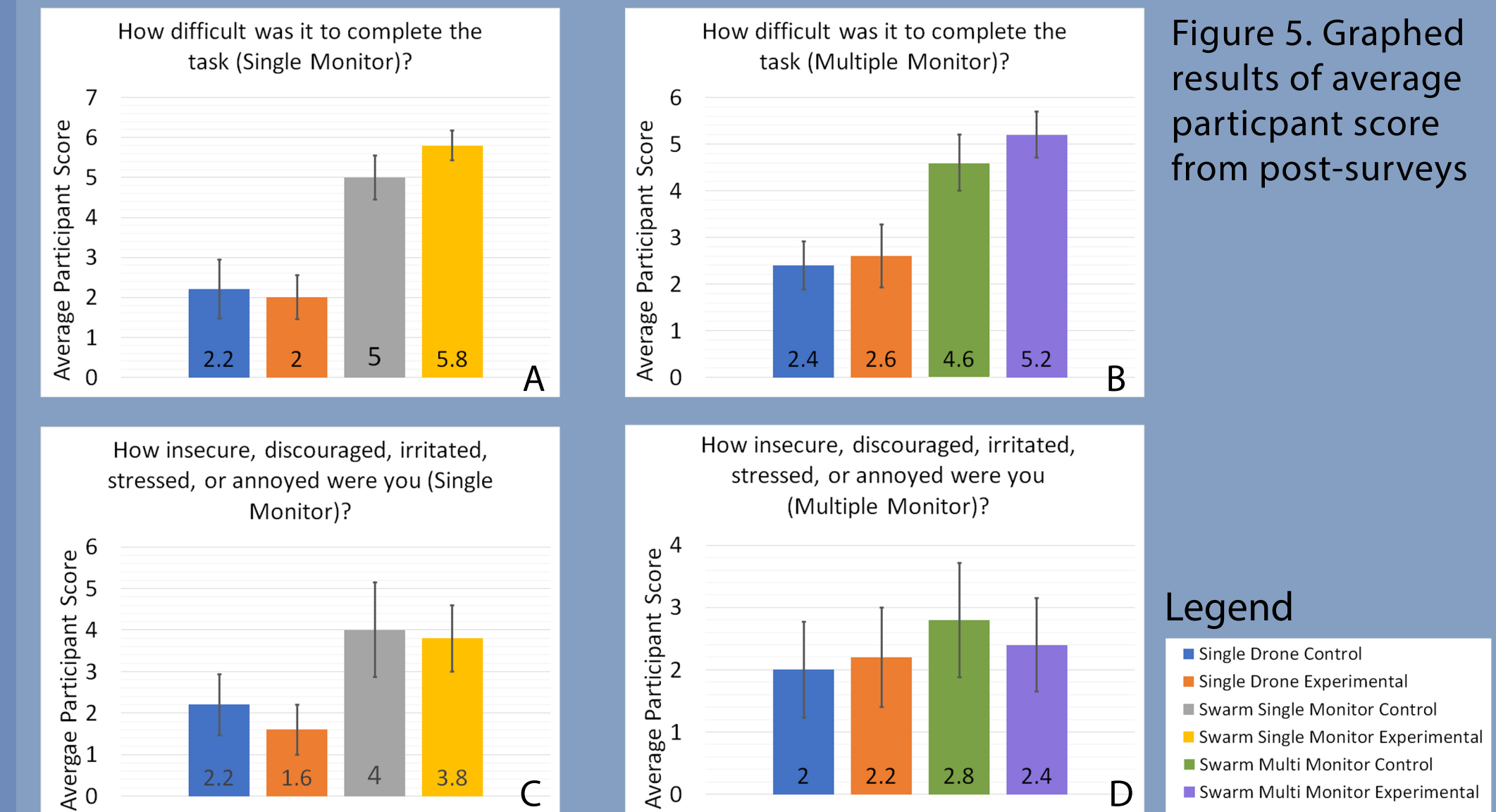


Figure 5. Graphed results of average participant score from post-surveys

Results were analyzed using a one-way between subjects ANOVA test. P-values less than .05 were considered significant. A Spearman correlation analysis was used to compare data between single monitor and multi-monitor swarm cases.

- Results suggest looking at a single monitor swarm feed is more difficult than watching a single drone feed [F(3,16) = 11.679, p = 0.0003] (Figure 5A)
- Results suggest looking at a multiple monitor swarm feed is more difficult than watching a single drone feed [F(3,16) = 6.020, p = .0060] (Figure 5B)
- Results suggest a negative correlation in irritation/stress in the multi-monitor and single monitor swarm cases (p = -0.8871). One can surmise that participants are more comfortable watching drone swarm feed on multiple monitors.

Accuracy of finding target/location: 87.5%. No significant difference in the single monitor and multi monitor case, nor single drone and drone swarm case

Conclusion

- Officers have more difficulty monitoring the video feed for a drone swarm than watching an individual drone search
- Difficulty of understanding spatial relations using drone feed increases because attention was concentrated on the screen content rather than keeping track of drone paths
- Further research should be done with drone feeds in unfamiliar environments. Also, future work can be done for different police operations such as search and rescue and wanted persons

References

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