



U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND ARMAMENTS CENTER

Warfighter Systems Integration of Robotic Combat Vehicle Controllers

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Human-Machine Integrated Formations (HMI-F)



"[Human-Machine Integrated Formations (HMI-F)] will bring robotic systems into units alongside humans, with the goal of always having robots, not soldiers, make first contact with the enemy."

~Secretary of the Army Christine Wormuth

• GEN James Rainey has mobilized the U.S. Army Futures Command (AFC) under a unified goal of accelerated delivery on HMI-F.

Human-Machine Integrated Formations (HMI-F)



• Optimizing the interface between the "H" and "M" in HMI-F is critical for a successful "I" into existing Army "F".

• This optimization inherently requires <u>Soldier Touch Point Data</u>.

BACKGROUND

Robots under Soldier operation may require a physical controller







What factors determine the type of controller is fielded?







BACKGROUND



Consider the Mission/Task



Controllers offer Different Advantages/Disadvantages

BACKGROUND





Evolution of the Video Game Controller

Consider the population

This generation of Warfighters grew up with different video game controllers than those born in the 60s/70s.





Questions:

Which Controllers are most effective for Robotic Combat Vehicles (RCV)?

Which Controllers are preferred by Soldiers for operation of RCVs?





Participants

Who: Twenty active-duty Soldiers (18 males, 2 females, age: 23.85 ± 0.76 years).

Average years of service: 4.15 ± 0.66 years.

Military Occupational Specialty (MOS): nineteen 11B and one 11A, and three have deployed.

Where: DEVCOM AC - Tactical Behavior Research Lab's (TBRL) Experimental Verification and Validation Assessment Laboratory (EVVAL)



Materials

Controllers: Eight controllers were tested and compared in Mobility and Gunnery Tasks





Location

Experimental Verification and Validation Assessment Laboratory (EVVAL)



One of three crew stations used to test Soldiers



Mobility Task

Navigate their RCV through an obstacle course with several challenges (e.g., speed control, left/right hand turn).

Gunnery Task

Engage and hit 20 stationary targets (one at a time) that randomly appear at various distances.



Soldier Performance (Dependent Variables)

Mobility

- Time to Complete Course
- Number of Collisions
- Average Speed



Gunnery

- Time to Defeat All Targets
- Rounds Fired



Soldier Preference (Surveys)



Controller: C1	0	1	2	3	4	5	6	7	8	9	10
Please indicate how well the description fits the controller or how you feel about the controller (0 – Not <u>At</u> All to 10 - Extremely Accurate)											
Overall, I had a positive experience with this controller.	0	0	0	0	0	ο	0	0	0	0	0
The buttons of the controller were difficult to use.	о	о	ο	о	о	о	о	о	о	о	ο
The controller caused significant fatigue during initial operation.	о	о	ο	о	ο	ο	о	о	о	о	ο
The controller caused significant fatigue during the <u>middle of operation</u> .	0	0	0	0	0	0	0	0	0	0	ο
The controller caused significant fatigue at the end of operation.	о	0	0	0	0	0	ο	0	0	о	ο
Overall, I was comfortable using the controller.	0	0	0	0	0	0	0	0	0	0	ο

Please rank each controller (1 - best, 7 - worst)

FOR MOBILITY	RANK
C1	
C2	
C3	
C4	
C5	
C6	
C7	

Please rank each controller (1 – best, 5 – worst)

FOR GUNNERY	RANK
C1	
C2	
C3	
C6	
C8	



Gunnery: Time to Defeat



***** p < 0.05

† p < 0.09



Gunnery: Rounds Fired



Further targets took more rounds to defeat (All Controllers)

No statistically significant differences in rounds fired between Controllers

***** p < 0.05



Mobility: Time to Complete Course



Soldiers <u>were faster</u> to complete the course using C3 and C5 relative to C4.

***** p < 0.05



Mobility: Number of Collisions



***** p < 0.05





Questions:

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Soldier Preference



Lower Rankings Represent Greater Preference

Soldier Preference





Mobility Rankings



Soldier Preference and Performance





Gunnery Performance

PREFERENCE ≠ **PERFORMANCE**

DISCUSSION



 The results of the present study suggest that RCV Controllers differentially affected Soldiers' performance of Gunnery and Mobility tasks. In particular, C3 outperformed several other Controllers.



DISCUSSION



• Soldiers **PREFERRED** C8 but **PERFORMED** better using C3 during Gunnery.



• Follow up studies should increase realism (fatigue, sensory conflict, targets).

TAKE HOME MESSAGES



• These findings argue for a more comprehensive evaluation and consideration of new technologies because Soldier subjective feedback may be in direct contrast to their objective performance.

 This work nicely complements Army Futures Command's (AFC) current push to find solutions for the development of Human-Machine Integrated Formations (HMI-F), which is the integration of robots into existing Army formations to alleviate cognitive burden and unnecessary risks to Soldiers.

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QUESTIONS?

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