Manned-Unmanned Teaming: Training Us Army Unmanned Aircraft System Operators in the Scout-Reconnaissance Role

John E. Stewart

MANNED-UNMANNED TEAMING: TRAINING US ARMY UNMANNED AIRCRAFT SYSTEM OPERATORS IN THE SCOUT-RECONNAISSANCE ROLE

John E. Stewart
US Army Research Institute
Fort Rucker, AL

Until recently, U.S. Army unmanned aircraft systems (UAS) were intelligence-gathering platforms. The UAS mission has recently changed from strategic intelligence, surveillance, and reconnaissance (ISR) to scout-reconnaissance (SR) operations. This shift has produced an increased requirement for coordination between manned and unmanned aircraft. Manned-unmanned teaming (MUM-T) requires that UAS operators become knowledgeable and proficient in the same scout-reconnaissance (SR) skills as pilots of armed helicopters. This paper summarizes the many training challenges consequent to the move from ISR to SR roles. It will review completed and ongoing research efforts by the Army Research Institute (ARI) Fort Rucker element, which investigated (a) preparedness of UAS operators to perform tactical SR missions, (b) the training provided at a Combat Training Center (c) differential perspectives of the manned and unmanned Army aviation communities on the role of UAS in MUM-T, (d) MUM-T skills that must be trained and measured.

Background

Shadow (RQ-7B) is a medium unmanned aircraft system (UAS) and currently the most numerous in the US Army inventory. Other medium to heavy Army UAS are also employed as scout-reconnaissance (SR) assets. These are the MQ-1C Gray Eagle and the MQ-5B Hunter. The Army UAS mission until recently was intelligence, surveillance and reconnaissance (ISR) in which UAS operators proceeded to a predetermined location, collected data, and stayed within the assigned grid until instructed to proceed to another location. Real-time video feed was provided to the Brigade Tactical Operations Center where image analysis was performed. The new SR role is quite different. The tasks include zone and route reconnaissance, in which the RQ-7B flies in increasing, concentric circles to assure that the area is free of potential threats, as well as laser designation and handover of targets to armed helicopters. Although route and zone reconnaissance superficially resemble ISR tasks, they are very different. UAS operators must understand, interpret and develop the tactical situation. *Developing the situation* entails communicating and coordinating with ground forces and/or other aircraft, attribution of target intent, and determining impact of the situation on friendly forces. These SR skills are traditionally performed by crews of scout helicopters, such as the OH-58D.

Manned-Unmanned Teaming (MUM-T)

One advantage of training UAS operators in the SR role is better coverage of the battlespace by combining the complementary strengths of armed helicopters and UAS. The OH-58D and AH-64D can find, designate and destroy targets under day or night conditions, but have limited endurance and typically operate at low altitudes. The RQ-7B, also equipped with a sensor suite (mission payload) can remain airborne for over 6 hours and operate above 6,000 feet, giving it a different vantage point to detect and identify targets, and report changes in the tactical situation to the armed helicopter. The helicopter can attack the target from a more covert location, sometimes without seeing it. MUM-T missions, a result of the shift from ISR to SR, will impact training requirements for the UAS air vehicle and mission payload operators. This paper reviews recent Army Research Institute (ARI) efforts to understand the training implications of these changes.

Current Status of UAS Operator Training

Proficiency of New UAS Operators Reporting to the Unit

ARI asked the principal staff officers (Majors and Lieutenant Colonels) at three selected Brigade Combat Teams (BCT), the extent to which new UAS operators reporting to the BCT were able to perform critical SR tasks (Stewart, Bink, Barker, Tremlett, & Price, 2011). The staff officers interviewed comprised Intelligence (S2), Operations (S3), and Brigade Aviation officers (BAO), as well as senior leaders and trainers of two UAS Platoons (each BCT has one MI Company, which includes a UAS Platoon). Of the three staff officers, only the BAO is an aviator. The S2 and S3 are ground officers, who plan the RQ-7B missions. Interviews revealed that the perspective of the S2 tended to be military intelligence (MI) in terms of UAS employment, in which the mission was ISR. Neither the S2 nor the S3 showed extensive knowledge of how to employ UAS as an SR asset, though they agreed that new UAS operators required additional training at the BCT before they could execute SR missions. BAOs and senior UAS Platoon members had greater knowledge of aviation tactical operations and generally believed that UAS operators lacked the necessary SR skills when reporting to the BCT.

Thus the consensus of respondents was that RQ-7B operators arrive at the unit poorly trained for tactical SR mission execution, except for Airspace Operations, which are well-trained institutionally at Fort Huachuca, AZ. The ARI research team also learned that opportunities for unit level training and practice of SR skills while the BCT is at home station are limited due to multiple factors, including airspace restrictions on pilotless aircraft, cost, equipment availability, and inadequate range areas. Respondents added that Combat Training Centers (CTC) provided the only chance for unit-level collective training and practice while still in the United States. Because of limited training opportunities at home station, the most effective SR training must take place on the job while the BCT is deployed.

UAS Operator Collective (Unit Level) Training at a Combat Training Center

The Joint Readiness Training Center (JRTC), Ft Polk, LA, is a CTC where operational units perform live training exercises, facing a skilled role-playing opposing force. JRTC has dedicated senior leaders and Trainer-Mentors (TM) who provide training and feedback to unit leaders and personnel. The ARI research team interviewed TMs at Brigade, Battalion, and Company levels (Stewart, Barker, & Bink, 2010). One most important finding was that UAS operators at JRTC were not evaluated on criteria relevant to performance of the SR mission. Instead, UAS teams were evaluated on launch, operation, and recovery of the aircraft, as well as total hours flown, and often had no clear indication of task and purpose of the mission, (e.g., check on the status of the troops). TMs noted that staff officers at Battalion and Brigade level did not seem to have a strong background in UAS operations. There were indications of the survival of MI culture: the UAS mission plan was still called the (data) collection plan. The S2, sometimes assisted by the S3, usually took the lead in planning the mission. Trainers and leaders at JRTC remarked that the leadership of the BCTs often required coaching in how to employ the RQ-7B as a mission asset, and recommended that education in UAS utilization be elevated all the way to command level.

Roles and Critical Skills Required of UAS Aircrews for MUM-T

Perceived Roles and Status of UAS and Manned Aviation in MUM-T

Stewart, Roberts, and Bink (2012) conducted a survey of 34 US Army helicopter pilots and 31 Army UAS operators. The questionnaire consisted of two parts: (a) present and future effectiveness of UAS in the SR role, (b) which of eight selected SR mission tasks were most appropriately performed by manned aircraft, UAS alone, or UAS and manned aircraft (MUM-T). UAS and manned respondents

agreed that the role of UAS in the SR operations would expand. UAS personnel indicated that UAS would eventually perform many if not all of the SR mission tasks currently performed by armed scout helicopters. By contrast, helicopter pilots indicated that the role of UAS would be to assist, not supplant, armed helicopters in the SR role, (see Table 1).

Table 1.

Perceptions of Future Roles of Manned and Unmanned Aircraft

Item	Subgroup	%Agree	% Disagree
UAS will assume a more active role in SR mission.	Manned	97	3
	Unmanned	90	10
UAS operators will have to learn to develop the situation once the target is identified.	Manned	94	6
	Unmanned	83	17
UAS will eventually become an equal status player in SR operations.	Manned	29	71
	Unmanned	77	23
UAS has made significant contributions to manned helicopter SR operations.	Manned	88	12
	Unmanned	74	26
In the future, UAS will completely take over the SR role in tactical operations	Manned	6	94
	Unmanned	52	48
UAS operators must assume a more active role in SR than merely providing an airborne sensor.	Manned	77	23
	Unmanned	97	3
Replacement of the OH-58D and AH-64D by weaponized UAS is unrealistic notion.	Manned	76	24
	Unmanned	27	73

UAS operators, presented with a list of eight SR mission tasks, indicated that UAS could perform most of these tasks. Pilots saw most tasks as appropriate to manned aircraft. Even with these differences in perceptions of UAS roles, it still appeared that most of the eight mission tasks presented were appropriate to combined manned and unmanned operations. Thus the majority of respondents saw each of the eight SR mission tasks as appropriate to both manned aircraft and UAS, though patterns of responses tended to differ for these two groups (Table 2).

Table 2.

Perceived Appropriateness of Selected Mission Tasks for Manned-Unmanned Team Operations

Mission tasks UAS Respondents considered appropriate for both manned aircraft and UAS.	Actions on Contact Downed Aircraft Recovery Fundamentals of Security
Mission tasks Manned Respondents considered appropriate for both manned aircraft and UAS.	Aerial Observation Fundamentals of Reconnaissance
Mission tasks both UAS and Manned Respondents considered appropriate for both manned aircraft and UAS.	Laser Target Handoff to Ground Target Handover SALT-W *Reports
Note: Size, Activity, Location, Time, What (procedure for reporting targets/activities observed).	

The final pattern of responses showed both manned and unmanned respondents likely to indicate three mission tasks as appropriate for both UAS and manned aircraft. The tasks that represent this pattern of responses were Laser Target Handoff to Ground, SALT-W Reports, and Target Handover. Of all eight tasks, the outlier seems to be Actions on Contact, which 62% of manned respondents perceived as appropriate primarily to manned aircraft. Similarly, though 88% of manned respondents saw Aerial Observation as a mission task for both UAS and manned aircraft, unmanned

respondents were split evenly with 48% stating it was primarily a UAS mission, and 48%, a mission for both aircraft types.

These findings provide important feedback to decision makers regarding the perceived present and future tactical roles of manned and unmanned aircraft. Knowing the current attitudes toward capabilities of UAS could provide insight for training developers who must devise strategies for training manned and unmanned aircrews to work together as players in MUM-T. The findings also point to the need to specify more precisely the respective roles of manned and unmanned team members before UAS can fully participate in MUM-T.

Identifying and prioritizing critical MUM-T skills

Sticha, Howse, Stewart, Conzelman, and Thibodeaux (2012), used a method similar to the Air Force Mission Essential Competencies (MEC) approach (Colegrove & Bennett, 2006) to identify and prioritize the most critical individual skills supporting MUM-T, and to pinpoint performance indicators for these skills. The investigators began with a review of Army doctrinal materials to identify (a) missions in which UAS operators would need to coordinate with helicopter pilots, (b) specific tasks required to perform these missions, and (c) MUM-T skills involved in executing these tasks. Training-critical skills were defined by two criteria: (a) inadequate performance would lead to mission failure or serious risk to personnel and/or equipment, (b) UAS operators recently graduated from training do not possess these skills.

Three workshops were conducted with small groups of doctrine developers, scout-attack helicopter pilots, and UAS senior instructor-operators to determine the relative importance of the skills as to training criticality, and to derive behavioral indicators of performance. The list of 25 skills was confirmed as relevant to MUM-T and doctrinally correct in a focus group attended by UAS operators, scout-attack helicopter pilots, and doctrine developers. Ratings and rank-orderings by participants indicated that all 25 skills were at least moderately important to SR missions, and present serious risks if performed incorrectly. Perceived levels of competency of UAS operators to perform the skills varied greatly, indicating that many were not addressed in training. Some skills, though highly important, were not rated as training-critical because they were adequately trained. Table 3 presents the 10 most training-critical skills.

Table 3.

Rank Ordering of Ten Most Training-Critical MUM-T Skills

Rank	Skill
1	Deconflict munition trajectories from airframe.
2	Utilize standard execution commands to initiate attack.
3	Transmit information on method of attack.
4	Switch roles of laser designator.
5	Conduct call for direct fires.
6	Select best weapon system.
7	Develop/send common operating picture information.
8	Utilize joint, Army, & civilian personnel recovery terminology.
9	Prioritize engagement of targets.
10	Gain and maintain enemy contact.

The final list of MUM-T skills was reduced to 20 (some were redundant with others, or judged as holdovers from ISR). For these, 140 performance indicators were derived. These skills and indicators support the development of two ongoing ARI efforts: a PC-based training tool for practicing the identified cognitive and procedural skills in the unit, and benchmarked performance measures, designed for use in networked, virtual environments, as well as live field exercises, where much of MUM-T training will take place. Table 4 presents an example of behavioral indicators for the skill ranked most important of all 20 remaining skills.

Table 4.

Performance Indicators for Skill: Deconflict Munition Trajectories from Airframe

Call for fire is complete and accurate.
Operator is aware that deconfliction of airspace is taking place.
Operator is aware of positions of friendly assets (e.g., aircraft and ground units).
Operator confirms when (friendly aircraft and/or ground assets) clear.
Operator determines if rounds are accurately placed on target.

Discussion

It is evident that much needs to be done in the development of SR training for the Army UAS operator. Most tasks that operators will be called on to perform in the operational unit are not those acquired institutionally during advanced individual training. These are tactical skills, supporting unit-level mission tasks that typify Army scout-attack and reconnaissance operations. Most SR training for UAS operators must take place in the operational unit at home station, or during deployment. Most collective MUM-T training at home station will of necessity have to take place in networked, shared virtual environments. In addition to knowing what skills are most critical, it will also be necessary to develop behaviorally-anchored performance measures for each skill. This will assist trainers and Company commanders in assessing efficiency and effectiveness of collective MUM-T training. Individual training of cognitive and procedural skills not requiring simulators can be executed on new-generation portable training devices, such as Tablet PCs. The technology of handheld devices is evolving rapidly; hence, it is likely that training apps allowing for wireless networking will allow some degree of team-level practice on these devices at home station.

These technologies for implementation exist at present, but the real challenge to implementation may be due to differences in organizational culture. Army Pilots and UAS operators come from quite different backgrounds in terms of formal education, training, required aptitudes and rank. UAS operators are enlisted personnel and noncommissioned officers. Pilots are either commissioned or warrant officers. Our research efforts have shown that perceptions by members of these two groups of the relative roles and capabilities of UAS and manned aviation differ in many ways. Senior UAS instructor-operators generally believed that UAS air vehicle and mission payload operators could acquire the critical skills necessary to execute most if not all of the SR tasks that armed helicopter crews can perform. By contrast, most manned helicopter pilots perceived UAS as helping the "shooter" find and attack targets. This is an important role, but nonetheless subordinate to manned aviation. Among the open-ended statements by senior members of the UAS community was that UAS can successfully assume the tactical role, if the manned community would allow it to do so. Looking at the present state of UAS operator training, it is apparent that newly-trained UAS operators cannot perform the most critical of the SR skills called for by the MUM-T mission, for the simple reason that these are not trained as part of their common core and aircraft qualification training. The explanation of this is two-fold: (a) institutional (i.e., schoolhouse) training time is limited, and there is little opportunity to learn SR skills during primary and advanced

individual training, and (b) a vestige of MI climate is still evident at the institutional phase of training. Stewart, et al. (2011) found that unit leaders and trainers believed that more training in SR fundamentals could take place at the institution. In short, more institutional training in the foundations of SR would enhance preparation of UAS operators for training in the unit, but more opportunities for home station training would also have to be provided at the unit. The training institution at Fort Huachuca is striving to revise its curriculum to include more material pertinent to SR operations, using multimedia approaches tailored to the cognitive processes of student operators. Stewart, Roberts, and Bink (2012) have suggested that UAS aircrews spend part of their training time at the Army Aviation Center at Fort Rucker, AL, planning and rehearsing simulated missions alongside instructors and students from the scout-attack helicopter community. This would also serve another purpose of integrating UAS into aviation training. The formation of UAS-manned aviation teams is being facilitated by the stand-up of the Full Spectrum Combat Aviation Brigade (FSCAB), starting with the 101st at Fort Campbell, KY. The 101st has one Battalion of OH-58D and RQ-7B aircraft, whose mission is to execute cooperative engagements as manned-unmanned teams. By requiring UAS and manned helicopter crews to interact during the mission planning and execution processes, this will likely be the initial step in successfully assimilating UAS into the world of tactical Army Aviation.

Acknowledgments

We are grateful to the Training and Doctrine Command Capabilities Managers for UAS and Reconnaissance-Attack, as well as the Directorate of Training and Doctrine at Fort Rucker, AL, for their support and assistance at all phases of this research, especially for the superb quality of subject-matter expertise provided. We thank the intelligence, operators, and Brigade aviation officers from three unnamed Brigade Combat Teams, and members of two RQ-7B Platoons for their valuable insights on unit level training of UAS aircrews. We are indebted to military and civilian personnel from various Army installations in the United States for their participation in the UAS-manned aviation survey.

References

Colegrove, C. M., & Bennett, W. (2006). *Competency-based training: adapting to warfighter needs*. (AFRL -HE-AZ-TR-2006-14). Air Force Research Laboratory: 711th Human Performance Wing.

Stewart, J. E., Barker, W. C., & Bink, M. L. (2010). *Army RQ-&B unit training issues*. Paper presented at 63rd meeting of Department of Defense Human Factors Engineering Technical Advisory Group, Tempe, AZ.

Stewart, J. E., Bink, M. L., Barker, W. C., Tremlett, M. L., & Price, D. (2011). *Training needs for RQ-7B unmanned aircraft system operators in the scout-reconnaissance role* (Research Report 1940). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Stewart, J.E., Roberts, K.R., & Bink, M.L. (2012). *Unmanned aircraft systems in the scout-reconnaissance role: perceptions of the U.S. Army manned and unmanned aircraft communities* (Research Report 1956). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Sitcha, P.J., Howse, W.R., Stewart, J.E., Conzelman, C.E., & Thibodeaux, C. (2012). *Identifying critical manned-unmanned teaming skills for unmanned aircraft system operator*s. (Research Report 1962). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.