AIR-GROUND ENGAGEMENT SIMULATION (AGES): REALISTIC AND EFFECTIVE TRAINING FOR AIR DEFENSE PERSONNEL

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INTRODUCTION

The development of team skills of US Army combat units has traditionally involved "by the numbers" crew drills or field training exercises (FTX). In both methods, realism or training fidelity has been marginal. Field training exercises require a rigid adherence to imaginary situations administered by the subjective decision of umpires. The FTX often includes preplanned scenarios where units perform on cue and the tactical behaviors of leaders or individual soldiers have relatively little to do with the mission outcome. As casualties are assessed using an arbitrary decision process, soldiers often engage in behaviors that would be highly impractical in combat (i.e., frontal assaults of prepositioned defenses). There were essentially no incentives to avoid the line of incoming fire, because the consequences were ill defined.

Early attempts at improving realism through simulation in a military context concentrated on individual skills such as the flight training simulator. In a combat situation, however, a tactical unit's performance depends on individual soldier skills and on a complex of team collective skills, the nature of which has been much debated (Collins, 1977). The training of collective skills, including the coordination of activities among unit elements, is the focus of Engagement Simulation (ES).

Engagement Simulation was initially designed for the training of small Army infantry units where emphasis was placed on a realistic training environment and on objective casualty assessment procedures (Root & Erwin, 1976). SCOPES (Squad-Combat Operations Exercises-Simulation) centered on the training of rifle squads. It involved two-sided free-play exercises where outcomes were not preplanned but depended on the collective behavior of the squads and individuals who composed them on both sides of the engagement. SCOPES was enlarged to include platoons and companies of infantry, armor and antiarmor components. It then became known as REALTRAIN.

AGES (Air-Ground Engagement Simulation) was developed based on the groundwork of SCOPES and REALTRAIN. AGES provides a motivating and challenging training environment for short range air defenders. In times where training ammunition is in short supply and training time is at a premium, AGES was felt to offer considerable potential for providing a simulated environment in which air defenders could emit and practice tactically relevant behaviors. It also provides a feedback system to make knowledge of results (KR) available at the end of each training sequence.

AGES has three key dimensions which discriminate it from previous air defense training programs:

- Weapons effects signature simulation
- Near real-time casualty assessment based on clear-cut rules
- After Action Reviews (the feedback system).

Each weapons system for both air defense and for air aggressors (the AH-1Q Cobra attack helicopter normally plays this role) is equipped with a signature simulator. These simulators serve two purposes. First, they place a firing unit in the same condition it would be in a given combat situation. If it fires, it discloses its position. This factor is especially important to ground air defense units, which must decide whether to fire again or move out of harm's way. Without signature simulation,they can unrealistically remain where they are. The second purpose of signature simulation is to provide air defense crews with the impression that they are actually doing something with their weapon besides sitting there and watching aircraft fly by. Three air defense weapons are used in AGES: the Vulcan gun, the Chaparral missile, and the Redeye missile. Each has its own distinctive simulation device. A picture of a Chaparral firing at an incoming aggressor is presented in Figure 1.

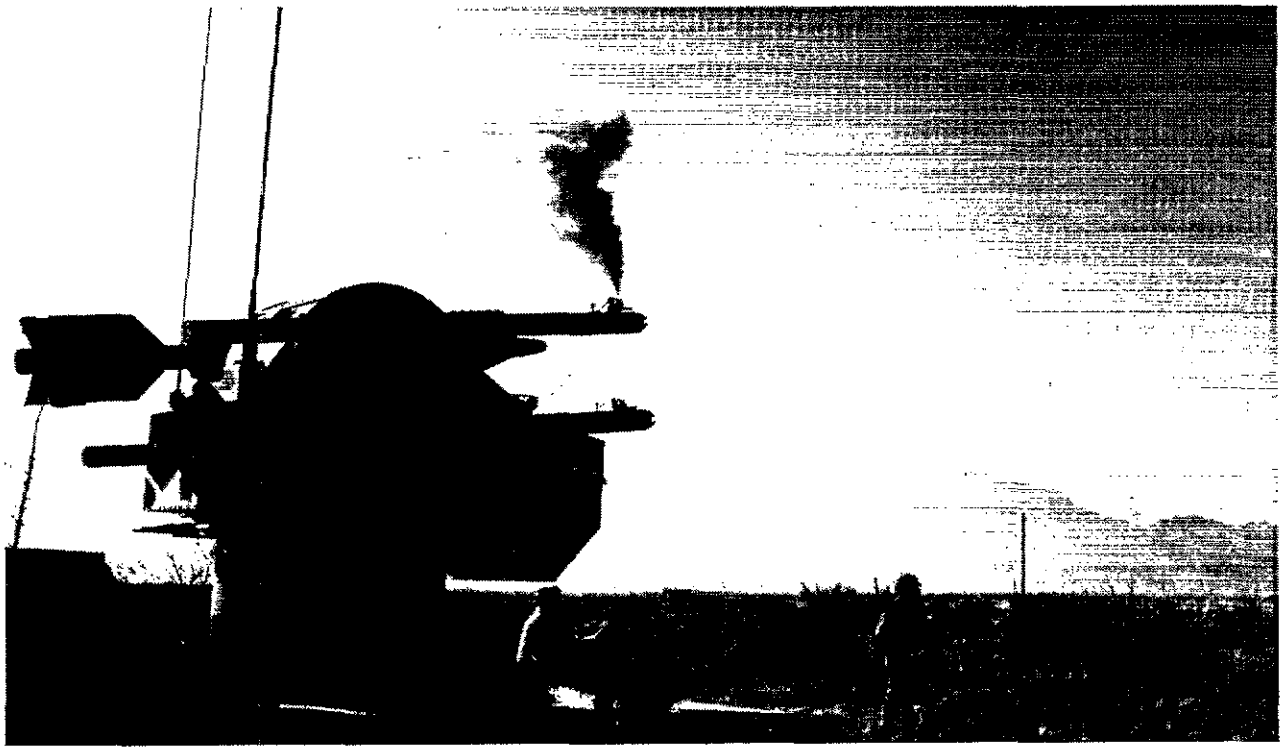

Figure 1. A Chaparral Fires the Signature Simulator

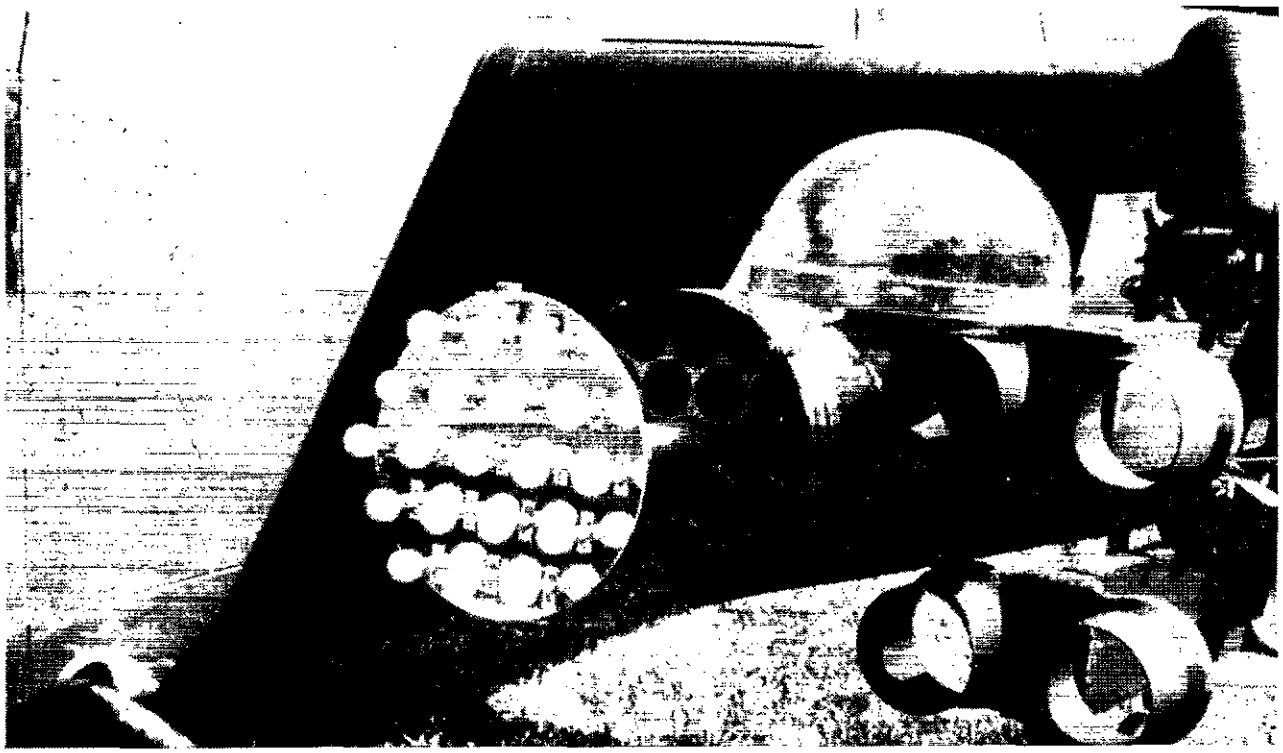

Figure 2. The Signature Simulator for the 2.75 inch Rocket Launcher

The attack helicopters which serve as aggressors are also equipped with signature simulation devices for their three main weapons: 7.62mm minigun, the 2.75-inch rocket launcher and the TOW antitank missile. An example of these simulators is given in Figure 2 which portrays the flashbulb device used in the 2.75-inch rocket launcher pod. These flashbulbs may be ignited by the rocket firing circuit and are visible in excess of 1500 meters if the line of sight is clear.

The key to AGES, as to all engagement simulation, is the control system, which drives the training exercise via administrative control and casualty assessment. The control system consists of a senior controller, who starts the training exercises, supervises exercise play and conducts After Action Reviews; an aviation controller and an air defense controller, who are collocated in the Ground Control Station (GCS); and a controller with each air defense weapon. Using an exercise map with marked locations of ground and airborne weapons systems, the controllers process in the GCS target acquisition information and assess casualties according to probabilistic rules based on capabilities of the firing weapons system and its range to the target. They also identify air defense weapons as being suppressed, which means that firing capability is suspended because they are taking incoming but not lethal fire from "hostile" aircraft. If an air defense artillery (ADA) weapon is assessed as a casualty, the controller at the weapon ignites a smoke grenade providing the aircraft crew with positive feedback for its successful engagement. If an aircraft is assessed as a casualty by the GCS, a smoke grenade is ignited on its skid by radio remote control or the pilot is instructed to pull a tripwire, thus reinforcing the behavior of the air defense crew which did the acquisition and firing. This cueing device is referred to as the hit-kill indicator and is shown in Figure 3.

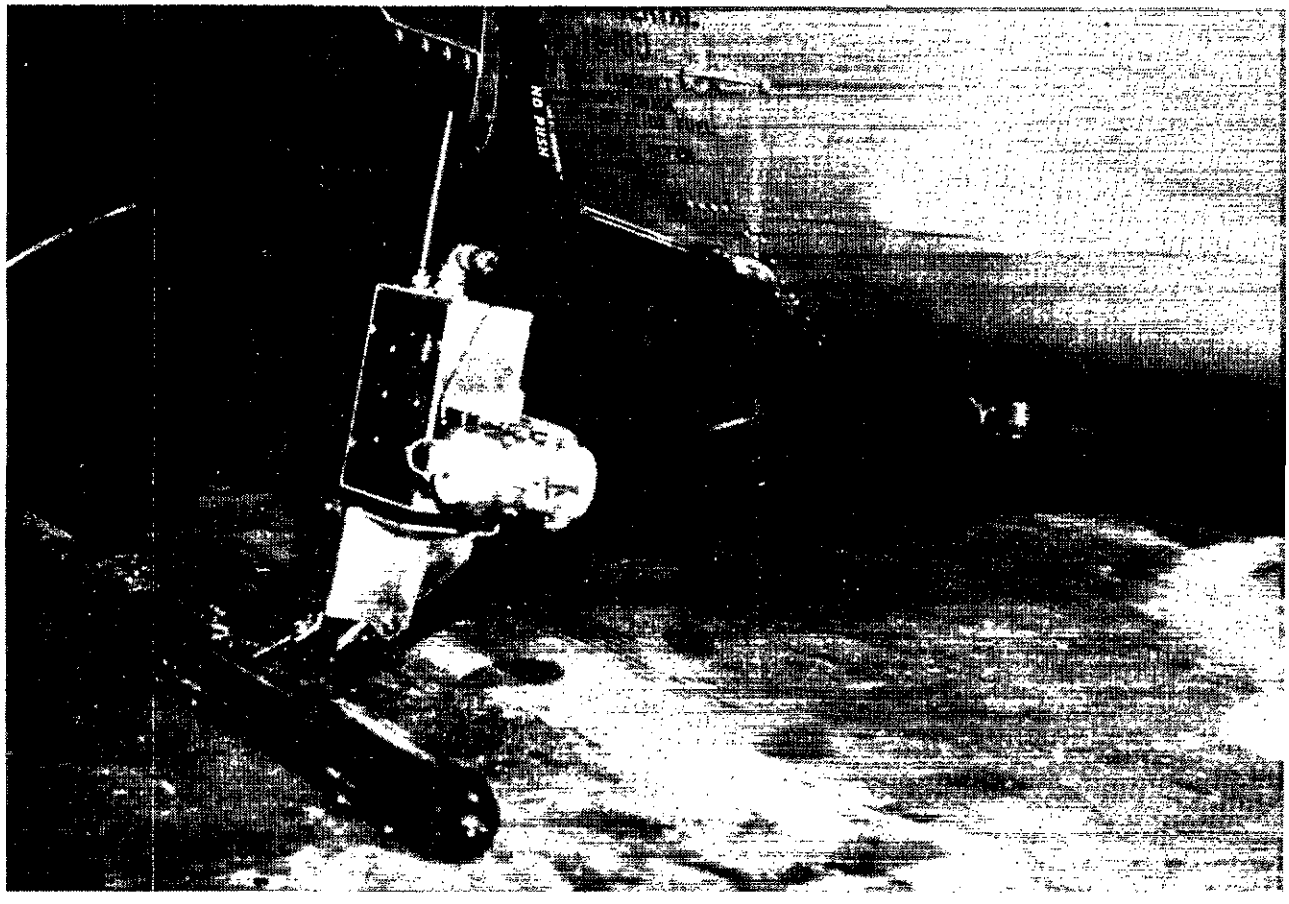

Figure 3. The Aircraft Hit-Kill Indicator

When an AGES exercise is completed, all personnel involved including the control staff and aviators are brought together for an After Action Review (AAR). The purpose of this review is not a traditional critique but rather an exchange of information among those involved. In the AAR, exercise events are reviewed chronologically. The senior controller is trained to act as a discussion facilitator using either a terrain model or a map. Personnel can learn from their own mistakes and vicariously from those who they could not observe directly. Also, positive tactical behaviors are discussed and verbally reinforced.

THE TEST OF AGES IN EUROPE

An empirical test of the AGES concept was accomplished during the summer of 1978 in Europe. Personnel and equipment support was provided by the 8th Infantry Division. The test was run just south of the Lahn River between Koblenz and Frankfurt. The goal of this test was a direct comparison of training effectiveness between AGES and the more traditional field exercise for ADA training.

Two squads of each of the three types of air defense weapons systems were assigned to an AGES training group, and the same number of squads were assigned to a conventional training program. Squad assignment to test conditions was done randomly. The training scenario (missions, orders, terrain) was the same for the two groups. However, the training for the conventional group did not include signature simulation, casualty assessment or After Action Reviews. Personnel accompanying conventional squads served as data collectors performing behavioral observation and data recording with no control-specific duties.

A different set of ADA squads was run through eight exercises each week for two weeks. The aviation aggressors consisted of a pool of approximately ten aviators that remained with the test for its entirety.

METHOD

As with all engagement simulation (ES) exercises, a tactical scenario set the stage for training. The ADA battery commander and the aviation aggressor leader were briefed separately and each was given an operations order. ADA units were told that a large armored force had attacked across an international border, and they were to defend critical assets of the 8th Infantry Division from attack by low and medium altitude aircraft. Air aggressors were ordered to perform reconnaissance in the same general area but were not given any location information on the air defenders. Leaders and subordinates on both sides were allowed to do their own tactical planning and commanding, which provided opportunities for individual initiative. Casualty assessment for the AGES squads was accomplished via the AGES control system. The conventionally trained squads received no casualty assessment, signature simulation, or feedback.

Data collection instruments used in this study included a controller behavioral observation form and rating scales and a leaders'/controllers' questionnaire. Due to the design of the study, more product oriented data such as casualties inflicted by the respective training groups was not possible. Assessing casualties for the conventional group would have confounded the results. However, as will be seen shortly, the process variables employed were able to demonstrate a training effectiveness difference for some weapons systems.

A brief description of the key elements of each of the measuring instruments to be discussed in the results section follows. A Controller Evaluation Form was designed for each of the major air defense weapons systems: Vulcan, Chaparral, and Redeye. Separate forms were required because the job specific behaviors involved with each weapon varied due to employment doctrine and due to the characteristics of the hardware itself. Controllers or behavioral observers were asked to rate performance of weapons crews either on dichotomous yes-no checklists or on nine point semantic differential rating scales. An example of the dichotomous scale is:

Rate local security upon occupation of position.

a. Communication hot loop established? Yes No
b. Ground defense plan established? Yes No

An example of a nine point rating included:

Rate the smoothness of (target) tracking.

Very inadequate 1 2 3 4 5 6 7 8 9 Very Adequate

The controller evaluation forms focused on over 50 specific behaviors associated with proficient tactical performance. Behaviors were drawn from technical manuals and from subject matter experts. Squad and platoon leaders expressed informal opinions that these forms were useful in helping them evaluate crew performance and for use as a training guide.

The Leaders and Controllers Questionnaire was an effort to collect opinion/attitude data from ADA personnel who had been most closely involved in the training. It was administered once at the end of each training week and asked how personnel would prefer to apportion training time across different training techniques to include engagement simulation, live fire exercises, field exercises and battle drills.

RESULTS AND DISCUSSION

Data for the performance of ADA crews drawn from the controller evaluation forms is summarized by producing composite or average summary scores. Data were averaged across the two training weeks so bars in the graph presented in Figures 4, 5 and 6 represent the average ratings for four AGES and four conventionally trained crews respectively.

In Figure 4, the average summary scores for Chaparral crew performance is presented.

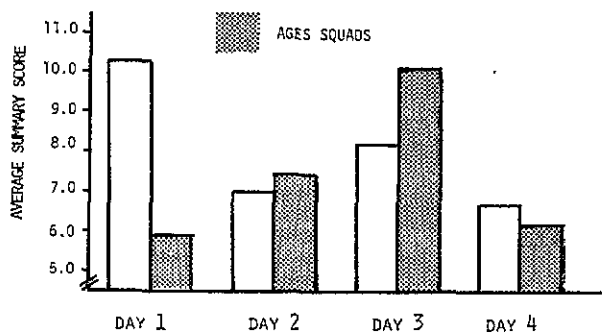

Figure 4
Chaparral Crew Performande Scores

Since the crews were assigned randomly and were not prematched, the divergence on the first day between AGES and non-AGES performance is not surprising. What was surprising, however, was how well the non-AGES crews performed on the first training day as compared to the reaminder of the week. While the AGES crews showed a steady overall improvement through the third day, conventionally trained crew performance declined in the second day and improved slightly in the third, but never reached the first day's level. Both sets of crews showed decreasing tactical performance in the fourth day. This may have been a function of fatigue, crews having been in the field for five days and/or the fact that training ended on Friday afternoons when soldiers were contemplating their weekends. This result was not as pronounced with Vulcan crews and Redeye teams.

As can be seen from Figure 5, the AGES and conventionally trained Vulcan squads began training on the first day with relatively

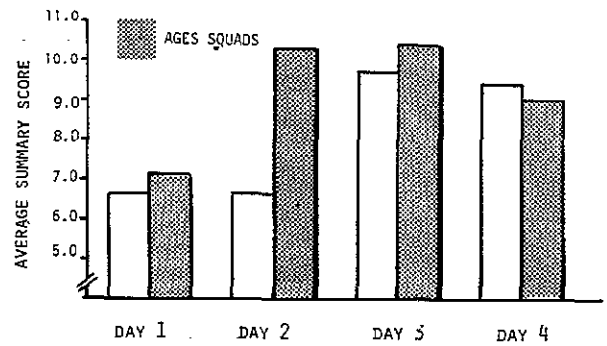

Figure 5
Vulcan Crew Performance Scores

similar performance ratings. Both sets of crews showed improvement from day 1 through the third training day with a slight decrement on the fourth day. It took the conventionally trained crews an extra day of training to reach the level of proficiency of AGES crews. An examination of the crew performance on the two air defense systems discussed so far leads to a hypothesis that the effectiveness of AGES may be system-specific.

Performance of Redeye teams did not follow the same pattern as that of Chaparral and Vulcan crews. The Redeye squads were divergent in initial proficiency from conventionally trained squads based on previous training and/or experience. Figure 6 indicates that AGES squads performed better on the first training day and maintained that advantage over all training days. There appeared to be no difference between AGES and conventionally trained squads in terms of relative improvement as compared to the first day's performance. Redeye teams did not retain personnel over the training days in a consistent fashion. This personnel turbulence alone may explain the lack of

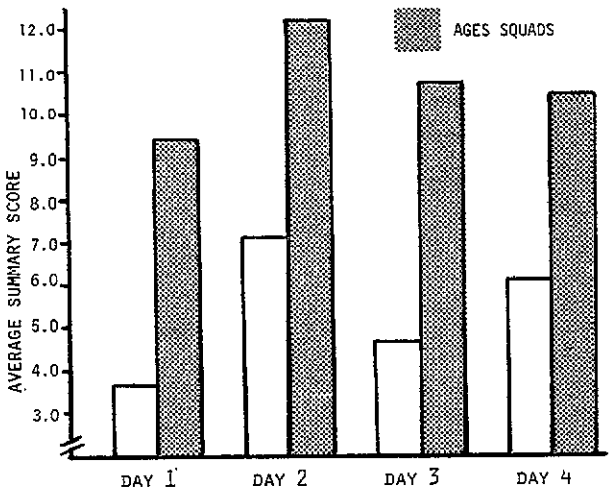

Figure 6
Redeye Crew Performance Scores

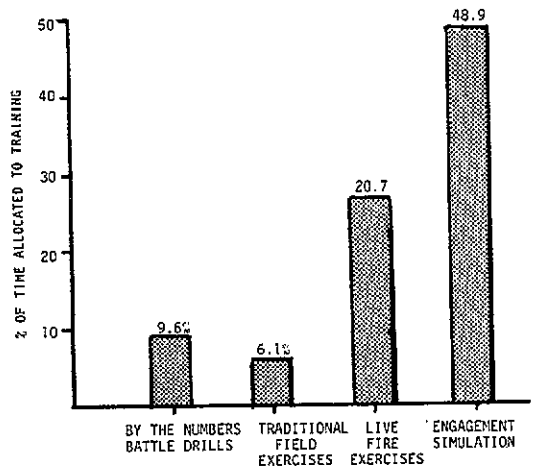

Figure 7. Time Allocated to Training Methods by Participants

differences. However, another possible explanation for the difference between Redeye and the other two weapons systems relates to the sizes of the respective crews and command and control considerations. The Redeye missile is generally crewed by only two men, who are collocated. Communication is simple and straightforward. The crews for Chaparral and Vulcan are more complex, which may complicate coordination. The key to the effectiveness of ES may be in its influence on interpersonal coordination. This again is a speculation which warrants further research.

In the Leaders and Controllers Questionnaire, participants were asked, "If you had a limited time for a training program, how would you divide your time?" Four alternatives were given and the task was to allocate the total time available over the four choices. The results are presented in Figure 7. Fifteen leaders and controllers indicated that they would spend nearly half their available training time using AGES as the principal method. They allocated twice as much time to AGES as they did to live fire and eight times as much time to traditional field exercises. Leaders and controllers were convinced of the value of AGES for training short range air defenders.

SUMMARY

The AGES training system and hardware has been described. AGES differs from conventional training in that it employs (1) weapons effects signature simulation, (2) near real-time casualty assessment, and (3) after action reviews. Descriptive data from an empirical study in Europe indicated that AGES had performance advantages for Chaparral and Vulcan systems. The results for the Redeye system were inconclusive. One factor which has been evident since the beginning of engagement simulation is the enthusiasm which it generates in soldiers. If a training system stimulates people to a point where they want to learn, then a large portion of the training problem is solved.

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