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Short Range Air Defense (SHORAD) Engagement Performance Criteria Development and Validation

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for

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The purpose of this research was to validate and calibrate performance criteria for Short Range Air Defense task and summary engagements for use in the training, evaluation, and qualification of Career Management Field 16 Series soldiers. In 1989, engagement performance criteria were subjected to multiple field test experiments using the Realistic Air Defense Engagement System (RADES) and the Range Target System (RTS). Participants were soldiers using the Stinger, Chaparral, and Vulcan air defense weapons. Engagement performance varied as a function of experience level, scenario difficulty level, and individual differences in ability and personality. These results enabled the fine tuning of performance and scenario difficulty criteria. Performance standards are proposed.

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SHORT RANGE AIR DEFENSE (SHORAD) ENGAGEMENT PERFORMANCE CRITERIA DEVELOPMENT AND VALIDATION

EXECUTIVE SUMMARY

Requirement:

The requirement was to validate and calibrate Short Range Air Defense (SHORAD) task and summary engagement performance criteria for use in the training, evaluation, and qualification of Career Management Field 16 Series soldiers. Validity was assessed in terms of the sensitivity of the criteria for discriminating between qualified and unqualified personnel. The calibration of the criteria involved establishing cutoff values as a function of scenario difficulty level. Task and summary performance measures and cutoff values were determined for Stinger, Chaparral, and Vulcan weapon systems personnel.

Procedure:

Engagement performance criteria were subjected to multiple field test experiments employing the Realistic Air Defense Engagement System (RADES) and the Range Target System (RTS) during 1989. The tests were conducted by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) and Science Applications International Corporation (SAIC). The participants were soldiers using the Stinger, Chaparral, or Vulcan weapons. Engagement simulation exercises were conducted to investigate the degree to which Task Performance Measures (TPM) and Summary Performance Measures (SPM) varied as a function of soldier proficiency under varying levels of scenario difficulty and experience. Further, TPM and SPM criterion performance cutoff scores were adjusted to reflect difficulty level.

Findings:

Given the results of prior experiments, it was predicted that performance on TPM and SPM would be affected by experience level, scenario difficulty level, and individual differences in ability and personality. These findings were replicated. There were main effects of experience and scenario difficulty level. The interaction of the two was marginally significant. Further, a number of individual abilities were found to be significantly correlated with performance. All of the above results enabled

the fine tuning of performance and scenario difficulty criteria and their integration into the Army Air Defense Artillery training and qualification process. Consequently, the TPM, SPM, and associated cutoff scores could be used as diagnostic tools. This provided an added capability of objective performance assessment to the current system of training and qualification.

Utilization of Findings:

This research enabled the validation and calibration of task and summary performance measure cutoff criteria. These criteria can be used to identify qualified and unqualified soldiers. Additionally, predictors of performance were identified that could be used to screen personnel for certain air defense occupations, career paths, or accelerated training programs. Additional research is recommended to adapt the developed and validated standards for operators of the emerging Forward Area Air Defense System (FAADS) weapons and operators as these weapons are brought into the inventory. The implementation of performance standards will be promulgated by the Directorate of Training and Development (DOTD), U.S. Army Air Defense Artillery School (USAADASCH), Fort Bliss, Texas.

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INTRODUCTION

Operational Problems and Potential Solutions

The current method of training and qualifying Army Air Defense Artillery (ADA) personnel has a number of deficiencies.

- Current training methods and strategies focus on individual gunner tasks and gunner qualification (Headquarters, D.A., 1988). Consequently, squad leader tasks and collective crew tasks are neglected.

- Current trainers (two-dimensional) do not provide the realism or flexibility to ensure attainment and sustainment of individual and collective knowledge and skills. Additionally, current training devices do not exercise collective crews or platoons (USAADASCH, 1989).

- Live fire tests are inadequate for determining qualification of personnel. Further, there are insufficient resources to enable all ADA personnel to fire their weapons to qualify (Headquarters, D.A., 1988).

- The threat has changed rapidly due to the emergence of new technologies and capabilities (Daskal, 1990). Performance standards typically do not reflect the current threat, the presence of friendly and hostile aircraft, or associated doctrinal implications.

- Visual Aircraft Recognition training is limited (Rotchford & Daruwalla, 1987). Training media present two dimensional representations of aircraft, at close range, with high contrast, and with little variability in orientation.

- Thus, crew effectiveness cannot be accurately measured. Additionally, training effectiveness and cost-effectiveness cannot be determined.

Improving upon the current training and qualification process is essential. A proficiency-based training system is needed. The Directorate of Training and Development (DOTD) of the US Army Air Defense Artillery School (USAADASCH), in cooperation with the US Army Research Institute (ARI) and the US Army Missile Command (MICOM), Targets Management Office (TMO) contracted for the integration and demonstration of a Range Target System (RTS). The purpose of the RTS was to provide excellence in ADA by eliminating the above deficiencies.

This would be accomplished by providing cost-effective, collective crew engagement training, proficiency evaluation, qualification testing, and skill sustainment training for all Short Range Air Defense (SHORAD) personnel. A valid, reliable, and realistic simulator and testbed such as the RTS would constitute a proficiency-based training system that could be employed Army-wide. RTS is also meant to support future Forward Area Air Defense Systems (FAADS) with these same simulation and evaluation capabilities, once these weapons systems emerge into the active inventory.

Training standards reflecting current doctrine, tactics, and threat were needed. A critical component of the RTS was the SHORAD engagement task and summary performance measures and associated pass-fail performance criteria (i.e., standards). These criteria needed to be validated and calibrated before being used by the Army. Once approved, these criteria would be incorporated into range tables, to be integrated into the current Army training and qualification process.

Thus, by providing realistic and representative training, updated performance standards, and diagnostic performance evaluation tools, the current deficiencies in the training and qualification process could be eliminated, performance achieved could be determined and compared to standards, and proficiency and its sustainment could be enhanced. The engagement performance and scenario difficulty criterion cutoff levels, defined by prior research efforts, were subjected to validity testing and calibration within the present research effort.

Objectives

This program of research was coordinated between the US Army Air Defense Artillery School (USAADASCH) and the US Army Research Institute (ARI). The primary objectives were to develop and validate realistic, scenario-driven engagement performance criteria (draft standards) as a function of scenario difficulty. Secondary goals were to integrate state-of-the-art target presentation, crew performance measurement, and engagement simulation capabilities into a Range Target System (RTS) for ADA engagement training and evaluation. The scope of the present research was limited to validation and calibration of SHORAD crew and team engagement performance criteria in the RTS. This would be done for Stinger, Chaparral, and Vulcan weapon systems personnel. There were known differences attributable to the weapons and associated mission requirements. Attaining the above objectives would mean the following requirements were met:

- Discriminate ability level as a function of experience.
- Determine the level of performance necessary to declare a soldier qualified or unqualified.
- Test and evaluate crew, team, and operator performance to identify and focus corrective and sustainment training needs.
- Delineate the required operational and experimental test conditions for fair, accurate, and reliable application of the performance criteria.
- Establish (calibrate) the cutoff scores for varying levels of scenario difficulty (low, medium, and high), and determine the subsequent effect on the performance standards for each difficulty level.

Approach

The process of developing standards of performance began with the validation of the Realistic Air Defense Engagement System (RADES). This research demonstrated the validity of using scaled targets in a realistic three-dimensional battle simulation, where performance could be scored in terms of reaction time, aircraft range, and summary outcomes. Four years of research enabled the establishment of summary and task performance measures, baseline performance parameters for SHORAD soldiers, the identification of individual differences affecting performance (especially vision and experience), and the determination of conditional effects (e.g., environment, command and control, difficulty, doctrine, and tactics) on performance.

From this research, preliminary performance criteria and scenario difficulty scaling factors were derived. Factors reflecting scenario difficulty included target visibility (e.g., distance, contrast, aspect angle, etc.), workload (e.g., number of active targets), and cuing (e.g., timeliness, accuracy, and simplicity). The criteria development, validation, and calibration process followed. The requirement addressed by that research effort was to "Determine operator engagement task and summary performance parameters, scenarios, scenario difficulty scaling factors, performance measures, performance scoring, draft performance criteria, and test administrative procedures for applying qualification standards to Career Management Field 16S (Stinger), 16P (Chaparral), and 16R (Vulcan) soldiers." Criteria were established according to scenario difficulty level and were subjected to prevalidation experiments. The current effort was to further validate and calibrate the cutoffs for performance criteria and scenario difficulty levels.

Thus, this research subjected previously developed and tested engagement performance criteria to additional experimental tests. These experiments were conducted using RADES and the RTS prototype configuration. The effort involved the design and administration of field test experiments, reduction and analysis of field test data, interpretation of results, and subsequent validation and calibration of task and summary performance measures and scenario difficulty levels.

The outline which follows provides a synopsis of the air defense research results generated to date by ARI and Science Applications International Corporation (SAIC), and contributing to the development of the standards, difficulty indices, and performance predictors. This research culminated in the validation and calibration of SHORAD engagement standards.

- Drewfs, Barber, Johnson, & Frederickson, 1988
  - Validation of RADES testbed
  - Validation of scaled targets

- Johnson, Barber & Lockhart, 1988
  - Target visibility (background contrast & aspect angle) effects identified

- Barber, 1987
  - Baseline performance parameters established
  - Validity of testbed and targets replicated
  - Early warning and cuing effects identified
  - Command, control, and communications (C3) effects identified (e.g., timeliness, accuracy, and brevity)
  - Effects of different cuing techniques identified (simple, two-dimensional graphics displays provided the minimum essential information required by the fire unit, thereby yielding the best performance)
  - Effects of conflicting C3 inputs caused a degradation in performance (also influenced by personality traits which typically emerge during uncertainty and confusion)
  - Performance improved with practice in RADES
  - Performance influenced by individual differences (in order of importance): experience (training level), visual sensation and perception, cognitive and psychomotor skills, personality attributes
  - Target visibility (size & aspect) effects on performance
  - Environmental conditions (temperature, wind, & visibility) effects identified

- Barber, Drewfs, & Lockhart, 1987
  - Validation of RADES testbed as training device
  - Visual ability effects on performance replicated

- Barber, Drewfs, & Johnson, 1987
  - Validation of RADES testbed as training device replicated

- Drewfs & Barber, 1990
  - Optimum performance test measures and scoring methods identified
  - Preliminary performance criteria established
  - Performance test conditions established
  - Scenario difficulty indices determined
  - Target type (fixed or rotary wing), size, and intent (friend or hostile) effects on performance replicated
  - Multiple target effects on performance replicated
  - Target visibility (aspect, offset, speed, & elevation) effects on performance replicated
  - Scenario difficulty effects on performance identified

- Drewfs & Barber, 1988
  - Cuing effects on performance replicated
  - Weapon type effects on performance determined
  - Environmental conditions (wind, visibility, cloudiness, & temperature) effects on performance replicated
  - Target visibility (range, aspect, speed, & terrain) effects on performance replicated
  - Experience (training) level effects replicated
  - Preliminary calibration and validation of criteria

- Barber, 1990
  - Effects on performance of soldier vision, soldier experience, cuing, weapon type, environmental conditions, and target characteristics (i.e., visibility) replicated

PROCEDURES

Performance in realistic air defense scenarios was evaluated to determine the degree to which Task Performance Measures (TPM) and Summary Performance Measures (SPM) could be used to assess individual operator and collective crew-team proficiency under varying levels of scenario difficulty. Tactical and doctrinal requirements (mission, procedures, and threat) were provided by ARI and DOTD, USAADASCH.

The dependent variables were the TPM and SPM. Independent variables were scenario difficulty level (low, medium, and high), and soldier experience level (low, medium, and high). Scenario difficulty was counterbalanced during execution of test scenarios. Predictor variables consisted of selected soldier individual differences measures.

There were six experiments. Soldiers from three weapon groups (Stinger, Chaparral, and Vulcan) participated in RADES simulations during Summer of 1989. Different soldiers from these same weapon groups participated in RTS simulations during Fall of 1989. All tests were conducted at Condron Field, White Sands Missile Range, NM. This range provided rolling, desert terrain consisting of vegetated sand dunes and mountains in the distance. Figure 1 illustrates the range layout employed in the experiments. The range area was 3 kilometers (km) wide (x), by 3-4 km long (y), by .5 km high (z). This mini-range layout realistically simulated a full scale maximum range of 20 km, and a full scale maximum ceiling (altitude) of 2.5 km.

Weapon teams received 12 scenario presentations, with each scenario having a predesignated difficulty level. Two groups of subjects participated each day, one in the morning and one in the afternoon. While one group participated in the air defense simulations, the other received individual differences testing. Two sets of different but equally difficult scenarios were used so that the group participating in the morning could not help the afternoon group during their lunch break.

Before participating in the simulations, the soldiers were briefed and given an operations order. Soldiers were assigned a 90 degree search sector defined by a left and right search limit, and a primary target line (PTL) at 12 o'clock. All targets were presented within this search sector and cued according to clock azimuth (e.g., 11:00, 12:00, or 1:00). A practice scenario containing one fixed wing (FW) and one rotary wing (RW) target was presented as a warm up trial.

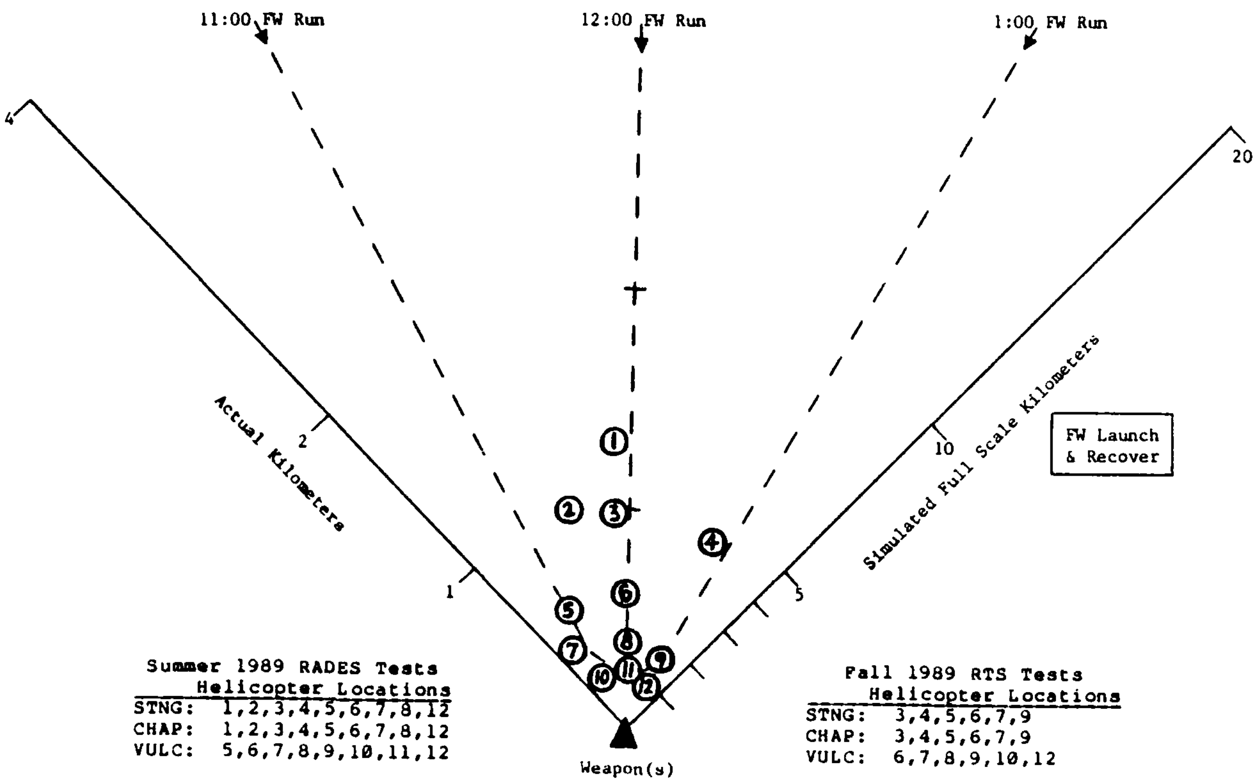

Figure 1. Range Layout

FW scenarios were either ingressing or ingressing-crossing. RW targets popped-up within the search sector at predesignated locations and simulated a hover maneuver. RADES tests used 1/5 scale RW and 1/7 scale FW targets. RTS tests used 1/5 scale RW and FW targets. RW targets were presented 1 to 3 simulated full scale km from gun systems and 2 to 6.5 km from missile systems. FW targets flew within 1 simulated full scale km of gun systems and 2 km of missile systems. This was done because missile systems (i.e., Stinger and Chaparral) have a substantially greater range than gun systems (Vulcan with the simulated use of Product Improved Vulcan Air Defense System (PIVADS) ammunition).

Workload was kept at a moderate level to control for effects of fatigue and vigilance decrements. To control for target visibility, the tests were conducted during daylight, sky background, and clear weather conditions. To control for arousal level and different search strategies, alerting and cuing were employed. For multiple targets, the target cued was always the one posing the greatest threat (i.e., the hostile target, the closest hostile target, or the hostile target nearest the fire unit's PTL). To ensure all aircraft were visually identified, doctrinal controls were employed such as ADA Warning "Red", Weapons Control Status "Tight", and Identification Friend or Foe (IFF) interrogation "Unknown". These and other control specifications, which were necessary for fair application of the standards, are listed below.

- Sky Background
- Clear Day (20+ miles visibility)
- Stationary Weapon Position
- 90 Degree Search Sector
- Unaided Detection
- Aided Recognition (binoculars)
- Clock Azimuth Cuing (+/- 15 degrees)
- Early Warning Voice Message (20-60 seconds before availability)
- Air Defense Warning Red
- Weapons Control Status Tight
- IFF Return Unknown
- One Practice Trial
- No Trial-by-Trial Feedback (end of day feedback only)
- Windspeed Less Than 25 MPH
- Randomized Scenario Order
- Standardized Scenario Sets
- Standard Target Coloration
- Matched Target Sizes
- FW Airspeed: 80 to 90 MPH
- FW Availability: 20 Kilometers (Km)
- RW Range: Stinger = 2 to 6.5 Km; Chaparral = 2 to 6.5 Km; Vulcan = 1 to 3 Km
- 4-Hour Test Periods

Participants

Test participants were Stinger (16S), Chaparral (16P), and Vulcan (16R) personnel from the following military organizations:

May-Jun 1989 (16R) -- 3rd Battalion (Bn), 56th ADA, 56th ADA Brigade (Bde), US Army Training Center (ATC), Ft. Bliss, TX; 5th Bn, 62nd ADA, 11th ADA Bde, Ft. Bliss, TX; 2nd Bn, 6th ADA Regiment (Regt), 6th ADA Bde, Ft. Bliss, TX; and 1st Bn, 188th ADA, North Dakota Army National Guard (ARNG).

Jun 1989 (16P) -- 3rd and 6th Bn, 200th ADA, 111th ADA Bde, New Mexico ARNG.

Jun 1989 (16S) -- 5th Bn, 62nd ADA, 11th ADA Bde.

Sep 1989 (16R) -- 3rd Bn, 56th ADA, 56th Bde, US ATC; 5th Bn, 62nd ADA, 11th ADA Bde; and ADA Training Activity (ADATA), 200th ADA, New Mexico ARNG.

Oct 1989 (16P) -- 2nd Bn, 200th ADA, 111th ADA Bde, New Mexico ARNG; ADATA, 200th ADA, New Mexico ARNG.

Nov 1989 (16S) -- Stinger Platoon, Regimental Headquarters (HQ), HQ Troop, 3rd Armored Cavalry Regt.

Soldiers varied in their degree of experience. There were three experience groups. Teams in the high experience group were comprised of a SSG or SFC Squad Leader and a SGT or SP4 Senior Gunner; teams in the moderate experience group were comprised of a SGT or SP4 acting as Team-Squad Leader, and a PFC Junior Gunner. Teams in the low experience group were comprised of PV1 to PV2 Advanced Individual Training (AIT) personnel.

During Summer 1989 RADES tests and Fall 1989 RTS tests, there were medium and high experience Chaparral troops from the National Guard, and high experience Stinger and Vulcan troops from Ft. Bliss, Texas. Vulcan AIT personnel (from USAADASCH, Ft. Bliss, TX) also participated during the 1989 RADES and RTS tests. Additional data from Stinger and Chaparral AIT personnel were available from prior tests (Spring 1988 RADES tests). Thus, for Chaparral, there were three experience groups (low, medium, and high), and for Vulcan and Stinger there were two experience groups

The following sample sizes were obtained for each test (indicates number of squad leader and gunner teams):

	1988 RADES	1989 RADES	1989 RTS
Stinger	64	10	20
Chaparral	21	24	8
Vulcan	--	24	16

Performance Measures

Table 1 defines the Task Performance Measures (TPM), and Table 2 defines the Summary Performance Measures (SPM) identified in previous research and used in all subsequent experiments (including the current effort). TPM are given in elapsed time (in seconds) or aircraft range (in simulated full scale kilometers). SPM are given in percentages. TPM reflect individual tasks. SPM usually reflect collective tasks, but can also reflect single scenario task performance (i.e. TPM). Individual TPM can be used diagnostically to identify the sources of failure to meet collective SPM pass-fail qualification criteria (standards).

Table 3 provides preliminary engagement performance criteria cutoff scores for TPM, and Table 4 provides preliminary criteria cutoff values for SPM. These preliminary criteria are taken from Drewfs & Barber (1990). As shown in these two tables, the criteria were established according to type of aircraft (e.g., rotary or fixed wing) and level of difficulty (high, medium, or low). Not all TPM and SPM were reliable as performance evaluation measures because they did not vary substantially, were highly correlated with other measures, or did not provide diagnostic information for evaluating performance. The recommended TPM and SPM and associated criteria reflected those measures determined to be most reliable and valid.

Scenarios and Presentation Schemes

Tables 5 and 6 describe the difficulty-indexed scenarios employed in the summer RADES experiments and the scenario presentation sequences, respectively. Tables 7 and 8 describe the scenarios employed during the fall RTS experiments and the scenario presentation sequences, respectively. Some of the scenarios and aircraft were the same and some were different between the RADES and RTS tests. However, difficulty level, overall, was about the same between the two tests, within weapon type. Whenever possible, the sequencing of fixed and rotary wing aircraft trials, and the sequencing of single, double, and triple aircraft trials, were counterbalanced within each of the samples.

Table 1

Candidate Task Performance Measures (TPM)

CODE	EVENT	DESCRIPTION	DUTY
RDET	Detection	FW slant range at detection	SL & SG
RACQ	Acquisition	FW slant range at weapon acquisition (infrared or radar)	SG
RIFF	Interrogation	FW slant range at interrogation	SG
RID	Identification	FW slant range at identify	SL
RENG	Command Engage or Cease Engage	FW slant range at command engage or cease engagement	SL
RLOCK	Lock-on	FW slant range at lock-on	SG
RFIRE	Fire	FW slant range at fire	SG
TDET	Detection	RW time interval from line of sight to detection	SL & SG
TACQ	Acquisition	RW time interval from detect to acquire (infrared or radar)	SG
TIFF	Interrogation	RW time interval from detect to IFF	SG
TID	Identification	RW time interval from detect to identify	SL
TENG	Command Engage or Cease Engage	RW time interval from identify to command engage or cease engagement	SL
TLOCK	Lock-on	RW time interval from acquire to lock-on	SG
TFIRE	Fire	RW time interval from acquire to fire	SG
THAND	Hand-off	RW or FW time interval from identify to fire	SL & SG
TTOT	Total	RW or FW time interval from detect to fire	SL & SG

Table 2

Candidate Summary Performance Measures (SPM)

CODE	EVENT	DESCRIPTION	DUTY
PDET	Proportion of Aircraft Detected	Number of detections divided by presentations	SL & SG
PID	Proportion of Aircraft Identified	Number of identifications divided by presentations	SL
IDCOR	Correctness of Identifications	Number of correct IDs divided by presentations	SL
FIDCOR	Friendly Correct Identifications	Number of correct IDs divided by presentations	SL
HIDCOR	Hostile Correct Identifications	Number of correct IDs divided by presentations	SL
FENG	Friendlies Engaged	Number of engagements divided by presentations	SL & SG
HENG	Hostiles Engaged	Number of engagements divided by presentations	SL & SG
PKILL	Engaged Aircraft Destroyed	Number of kills divided by engagements	SL & SG
FKILL	Fratricide (Friends Killed)	Number of friendly kills divided by f. presentations	SL & SG
HKILL	Attrition (Hostiles Killed)	Number of hostile kills divided by h. presentations	SL & SG
ORD	Hostiles Releasing Ordnance	Number of ordnance releases divided by hostile presentations	SL & SG
TRACK	Tracking Accuracy (Time on Target)	Amount of time infrared acquisition was maintained divided by availability time window (Stinger;Chap.)	SG
AVEMISS	Average Miss Distance in Meters	Degree to which Vulcan or PIVADS rounds are on target	SG
BURSTS	Number of Bursts	Number of Vulcan or PIVADS bursts fired at the target	SG
HITS	Number of Rounds on Target	Number of Vulcan or PIVADS rounds penetrating target volume (10 hits = kill)	SG

Table 3

Preliminary Task Performance Criteria (Drewfs & Barber, 1990)

FIXED WING			ROTARY WING		
TPM	LOD	VALUE	TPM	LOD	VALUE
Detect (RDET)	H	8.0 km	Detect (TDET)	H	10.0 sec
	M	11.0 km		M	6.0 sec
	L	14.0 km		L	4.0 sec
Acquire (RACQ)	H	5.0 km	Acquire (TACQ)	H	6.0 sec
	M	6.0 km		M	5.0 sec
	L	7.0 km		L	4.0 sec
Identify (RID)	H	4.0 km	Identify (TID)	H	9.0 sec
	M	6.0 km		M	7.0 sec
	L	8.0 km		L	5.0 sec
Lock-On (RLOCK)	H	4.0 km	Lock (TLOCK)	H	6.0 sec
	M	5.0 km		M	4.0 sec
	L	6.0 km		L	2.0 sec
Fire (RFIRE)	H	2.0 km	Fire (TFIRE)	H	9.0 sec
	M	4.0 km		M	7.0 sec
	L	5.0 km		L	6.0 sec
LOD = Level of Difficulty			Total (TTOT)	H	15.0 sec
				M	12.0 sec
				L	8.0 sec

Table 4

Preliminary Summary Performance Criteria
(Drewfs & Barber, 1990)

FIXED WING			ROTARY WING		
SPM	LOD	VALUE	SPM	LOD	VALUE
Identity Correctness (IDCOR)	H M L	70% 75% 80%	Identity Correctness (IDCOR)	H M L	70% 75% 80%
Friendly IDCOR (FIDCOR)	H M L	70% 75% 80%	Friendly IDCOR (FIDCOR)	H M L	70% 75% 80%
Hostile IDCOR (HIDCOR)	H M L	75% 80% 85%	Hostile IDCOR (HIDCOR)	H M L	75% 80% 85%
Friends Engaged (FENG)	H M L	30% 25% 20%	Friends Engaged (FENG)	H M L	30% 25% 20%
Hostiles Engaged (HENG)	H M L	75% 80% 85%	Hostiles Engaged (HENG)	H M L	75% 80% 85%
Friendly Kills (FKILL)	H M L	25% 20% 15%	Friendly Kills (FKILL)	H M L	25% 20% 15%
Hostile Kills (HKILL)	H M L	45% 60% 75%	Hostile Kills (HKILL)	H M L	55% 70% 80%
Engaged Air. Destroyed (PKILL)	H M L	60% 75% 90%	Engaged Air. Destroyed (PKILL)	H M L	75% 85% 95%
Ordnance Released (ORD)	H M L	95% 75% 30%	Ordnance Released (ORD)	H M L	95% 75% 30%

LOD = Level of Difficulty

Table 5

Summer 1989 RADES Test Scenarios

STINGER AND CHAPARRAL SCENARIOS										
SCEN	NTARG	TYPE	INTENT	MODEL	DUR	ORDER	AZIMUTH	RANGE	ASPECT	DIF
* 0	1	FW	H	Su7	60	---	1	20	45	4FW
1	1	FW	H	MiG27	60	---	1	20	45	4FW
2	1	FW	H	Su25	60	---	12	20	0	4FW
3	2	MIX	F/H	A7/Ka?	60/40	SEQ	11/12	20/5	315/315	4FW
4	2	MIX	H/H	Su24/Mi8	60/40	SEQ	11/11	20/3	315/315	4FW
5	1	RW	H	Mi28	20	---	1	1	90	1RW
6	1	RW	H	Mi24	20	---	12	2	45	1RW
7	2	RW	F/H	UH1/Mi24	25	SEQ	12/12	3/2	0/0	2RW
8	1	RW	F	CH3	25	---	1	4.5	45	2RW
9	1	RW	F	AH64	25	---	12	6.5	45	3RW
10	2	RW	H/H	Mi8/CH3	40	SIM	11/1	3/4.5	315/45	4RW
11	3	RW	H/H/F	Mi8/Ka?/UH1	60	SIM	11/12/12	5/5/3	270/270/90	5RW
12	3	RW	H/H/H	Mi8/Mi8/Mi28	60	SIM	11/11/1	5/3/1	45/315/45	5RW

VULCAN SCENARIOS										
SCEN	NTARG	TYPE	INTENT	MODEL	DUR	ORDER	AZIMUTH	RANGE	ASPECT	DIF
* 0	1	FW	H	Su7	60	---	1	20	45	4FW
1	1	FW	H	MiG27	60	---	1	20	45	4FW
2	1	FW	H	Su25	60	---	12	20	0	4FW
3	2	MIX	F/H	A7/Ka?	60/40	SEQ	11/12	20/2	315/315	4FW
4	2	MIX	H/H	Su24/Mi28	60/40	SEQ	11/1	20/1	315/45	4FW
5	1	RW	H	Mi28	20	---	1	1	90	1RW
6	1	RW	H	Mi24	20	---	12	1.3	45	1RW
7	1	RW	F	CH3	20	---	1	2	45	1RW
8	2	RW	F/H	UH1/Mi24	25	SEQ	12/12	3/1.3	0/0	2RW
9	2	RW	H/F	Mi8/CH3	40	SIM	11/1	2/2	315/45	4RW
10	2	RW	H/F	Mi8/AH1	40	SIM	11/11	3/1.3	0/0	4RW
11	3	RW	H/H/F	Mi8/Ka?/UH1	60	SIM	11/12/12	2/2/3	270/270/90	5RW
12	3	RW	H/H/H	Mi8/Mi24/Mi28	60	SIM	11/12/1	2/1.3/1	315/45/45	5RW

* 0 was a practice scenario that all participants received (no data were collected)

Note. 1st target to appear was cued; for multiple targets, cue given is underlined.

Table 6

Summer 1989 RADES Tests: Scenario Presentation Scheme

STINGER AND CHAPARRAL SCENARIO SEQUENCES

DAY	GROUP	PRESENTATION ORDER											
1	AM/PM	7	10	1	8	12	3	9	7	2	11	6	4
2	AM/PM	12	8	3	10	9	1	11	6	4	5	7	2
3	AM/PM	9	11	4	7	6	2	10	5	1	12	8	3
4	AM/PM	7	6	2	5	11	4	8	12	3	9	10	1
SEQUENCE		1	2	3	4	5	6	7	8	9	10	11	12

VULCAN SCENARIO SEQUENCES

DAY	GROUP	PRESENTATION ORDER											
1	AM/PM	5	10	1	8	12	3	7	9	2	11	6	4
2	AM/PM	12	8	3	10	7	1	11	6	4	5	9	2
3	AM/PM	7	11	4	9	6	2	10	5	1	12	8	3
4	AM/PM	9	6	2	5	11	4	8	12	3	7	10	1
SEQUENCE		1	2	3	4	5	6	7	8	9	10	11	12

Table 7

Fall 1989 RTS Test Scenarios

STINGER, CHAPARRAL, AND VULCAN SCENARIOS										
SCEN	NTARG	TYPE	INTENT	MODEL	DUR	ORDER	AZIMUTH	RANGE	ASPECT	DIF
* 0	2	MIX	F/H	F111/Ka?	60/40	SEQ	12/1	20/2	0/45	4FW
1	1	FW	F	F16	60	---	11	20	315	4FW
2	1	FW	H	MiG27	60	---	1	20	45	4FW
3	1	FW	H	Su25	60	---	12	20	0	4FW
4	2	MIX	F/H	A7/Mi8	60/40	SEQ	1/11	20/2	45/315	4FW
5	2	MIX	H/H	Su17/Mi28	60/40	SEQ	11/1	20/2	315/0	4FW
6	3	MIX	F/H/H	A10/Mi8/Mi28	60/60	SQ/SM	12/11/1	20/2/2	0/270/45	4FW
7	3	MIX	H/F/H	MiG27/AH64/Mi24	60/60	SQ/SM	11/12/1	20/3/4.5	315/45/90	4FW
8	1	RW	H	Su24 **	60	---	11	20	315	4FW
9	1	RW	H	Mi28	20	---	11	1.3	315	1RW
10	1	RW	H	Mi24	20	---	1	1	45	1RW
11	1	RW	F	CH3	20	---	12	2	315	1RW
12	1	RW	H	Mi8	20	---	11	2	45	1RW
13	1	RW	H	Mi28	20	---	1	2	315	1RW
14	1	RW	F	CH3	20	---	12	3	45	2RW
15	1	RW	H	Mi28	20	---	11	3	45	2RW
16	1	RW	H	Mi24	20	---	12	3	315	2RW
17	1	RW	H	Mi24	20	---	12	5	45	3RW
18	2	RW	F/H/F	AH1/Mi8/UH1	20	SEQ	12/1/11	3/2/2	315/315/90	3RW
19	2	RW	H/F	Mi24/UH1	40	SIM	12/1	2/1	315/0	4RW
20	2	RW	F/H	UH1/Mi28	40	SIM	12/1	5/2	315/0	4RW
21	2	RW	H/H	Mi8/Mi8	40	SIM	11/12	2/2	0/90	4RW
22	2	RW	H/H	Mi24/Mi28	40	SIM	11/1	1.3/1	45/0	4RW
23	2	RW	H/H	Mi24/Mi28	40	SIM	12/1	5/4.5	270/315	4RW
24	2	RW	H/H	Mi8/Mi24	40	SIM	11/1	3/4.5	0/315	4RW
25	3	RW	F/H/F	AH1/Mi24/AH64	60	SIM	11/12/1	2/2/2	315/0/270	5RW
26	3	RW	F/H/H	UH1/Mi24/Mi8	60	SIM	11/12/1	2/2/2	315/45/45	5RW
27	3	RW	H/F/H	Mi8/AH64/Mi28	60	SIM	11/12/1	3/3/4.5	315/90/270	5RW
28	3	RW	F/H/H	CH3/Mi24/Mi28	60	SIM	11/12/1	3/3/4.5	315/45/90	5RW
29	3	RW	H/H/H	Mi24/Mi24/Mi28	60	SIM	11/12/1	1.3/2/1	270/0/315	5RW
30	3	RW	H/H/H	Mi28/Mi8/Mi24	60	SIM	11/12/1	1.3/2/1	45/45/0	5RW
31	3	RW	H/H/H	Mi28/Mi24/Mi28	60	SIM	11/12/1	3/5/4.5	90/315/0	5RW
32	3	RW	H/H/H	Mi28/Mi24/Mi8	60	SIM	11/12/1	3/5/2	0/0/0	5RW

* 0 was a practice scenario that all participants received (no data were collected)
** Su24 (1/7 scale) was substituted; originally was to be a flying RW gyro (Mi24)
Note: 1st target to appear was cued; for multiple targets, cue given is underlined.

Table 3

Fall 1989 RTS Tests: Scenario Presentation Scheme

STINGER AND CHAPARRAL SCENARIO SEQUENCES

SET A: 1, 2, 4, 7, 8, 12, 13, 17, 20, 24, 27, 31
SET B: 1, 3, 5, 6, 8, 12, 15, 16, 18, 23, 28, 32

DAY	GROUP	SET	SEQUENCE
1	1 AM	A	13, 8, 27, 4, 17, 12, 2, 31, 1, 20, 24, 7
1	2 PM	B	16, 5, 28, 8, 15, 3, 12, 6, 32, 1, 18, 23
2	1 AM	B	23, 18, 1, 32, 6, 12, 3, 15, 8, 28, 5, 16
2	2 PM	A	20, 1, 31, 2, 27, 8, 13, 7, 12, 24, 4, 17
3	1 AM	A	17, 4, 24, 12, 7, 13, 8, 27, 2, 31, 1, 20
3	2 PM	B	18, 8, 12, 1, 32, 5, 15, 16, 6, 23, 3, 28
4	1 AM	B	28, 3, 23, 6, 16, 15, 5, 32, 1, 12, 8, 18
4	2 PM	A	7, 24, 20, 1, 31, 2, 12, 17, 4, 27, 8, 13

VULCAN SCENARIO SEQUENCES *

SET A: 1, 2, 5, 6, 8, 9, 10, 14, 19, 21, 25, 30
SET B: 1, 3, 4, 5, 8, 11, 12, 13, 18, 22, 26, 29

DAY	GROUP	SET	SEQUENCE
1	1 AM	A	14, 19, 1, 25, 2, 9, 30, 5, 21, 8, 10, 6
1	2 PM	B	11, 3, 22, 18, 1, 26, 8, 12, 5, 29, 4, 13
2	1 AM	B	13, 4, 29, 5, 12, 8, 26, 1, 18, 22, 3, 11
2	2 PM	A	30, 5, 21, 1, 10, 14, 6, 19, 8, 25, 2, 9
3	1 AM	A	9, 2, 25, 8. 19, 6, 14, 10, 1, 21, 5, 30
3	2 PM	B	5, 12, 3, 11, 13, 29, 4, 22, 18, 8, 26, 1
4	1 AM	B	1, 26, 8, 18, 22, 4, 29, 13, 11, 3, 12, 5
4	2 PM	A	6, 10, 8, 21, 5, 30, 9, 2, 25, 1, 19, 14

* Due to a system malfunction, the position-location system failed; thus, FW scenarios could not be presented to Vulcan

In the scenario tables (Tables 5 and 7), single and multiple target scenario information is repeated for each target. "NTARG" refers to the number of targets presented in the scenario. In the "TYPE" column, "FW" refers to flying fixed wing and "RW" refers to pop-up rotary wing targets. "INTENT" refers either to hostile (H) or friendly (F) targets. "MODEL" refers to aircraft model type. "DUR" refers to the duration of time (in seconds) targets were available (unmasked) to the weapon position. "ORDER" refers to multiple target scenario presentations which were either sequential (SEQ), simultaneous (SIM), or both (SQ/SM); both refers to a FW target followed sequentially by two simultaneous RW targets. "AZIMUTH" refers to the o'clock position of the target as referenced from the search sector. The PTL was at 12:00, facing south, at 180°. "RANGE" values indicate ranges at which the targets were first presented (RW targets did not vary in range). "ASPECT" refers to the orientation angle at which the targets were presented, as observed from the weapon position. For RW targets: 0 degrees is head-on, 45 degrees is an oblique left view, 90 degrees is a full left view, 270 is a full right view, and 315 is an oblique right view. For FW, all targets began at 0 aspect (head-on), but then may have crossed at identification range, thereby becoming an oblique (45° or 315°) view. "LOD" or Level of Difficulty defines the scenario performance difficulty index (high=5, medium=3, low=1). FW scenarios were considered more difficult than RW, so the LOD indices were dealt with separately. The techniques employed to determine scenario difficulty level were described and empirically validated in Drewfs and Barber (1990).

Individual Difference Variables

Soldiers were administered a battery of tests and questionnaires (see Table 9), either before or after engagement exercises (AM or PM). For 16S soldiers, teams exchanged roles at midday during the fall test, for a different set of equally difficult scenarios, and therefore did not recieve these tests. Variables represented the following domains: visual perception, psychomotor, personality (predispositions), and recent training. Armed Services Vocational Aptitude Battery (ASVAB) scale scores were also used as predictors: Armed Forces Qualification Test (AFQT), Electronics (EL), Mechanical Maintenance (MM), and Operator and Food Handling (OF). Individual differences were correlated with performance. It was anticipated that variance unexplained by the independent variables (e.g., experience and scenario difficulty) would be largely explained by individual difference variables.

Table 9

Individual Differences Measures

VISUAL SENSATION			
VARIABLE	DESCRIPTION	CODE	UNIT OF MEASUREMENT
Foveal Visual Acuity	Visual acuity measured with a Tumbling E chart presented at 20 feet	FVA	Scores range from 6 to 30 with 20=20/20
Contrast Sensitivity	Sensitivity to sine wave gratings varying in cycles per degree (cpd) of spatial frequency and contrast ratio (5 frequencies with 8 contrast intervals each; score for each frequency recorded as 1 .... 8)	CS1	Lowest detectable contrast interval for 1.5 cpd
		CS2	Lowest detectable contrast for 3 cpd
		CS3	Lowest detectable contrast for 6 cpd
		CS4	Lowest detectable contrast for 12 cpd
		CS5	Lowest detectable contrast for 18 cpd
		CSL	Mean of CS1 and CS2
		CSH	Mean of CS4 and CS5
Resting Focus	Focal point when eyes are at rest; also corresponds to point of clearest focus (i.e., fulcrum of focal range)	DF	Dark focus measured with a polarized vernier optometer in diopters
		CF	Clear focus measured in diopters using a focus stimulator
		RF	Mean of DF and CF
Visual Flexibility	Accommodation range of the eyes (lens)	NP	Nearest clear focal point measured in diopters
		FP	Farthest clear focal point
		FR	Focal range (NP-FP)

Table 9 (Continued)

VISUAL SENSATION			
VARIABLE	DESCRIPTION	CODE	UNIT OF MEASUREMENT
Blur Interpretation	Ability to interpret images presented with a slide projector which are blurred using a focus stimulator (score is the distance in diopters from the resting focus when the image is discriminated)	BI1	Identification of a picture of a rose
		BI2	Identification of a picture of a jet
		BIP	Identification of the letter P
		BIW	Identification of the letter W
		BIZ	Identification of the letter Z
		BIA	Mean of BI1 and BI2
		BIB	Mean of BIP, BIW and BIZ

PERCEPTION			
VARIABLE	DESCRIPTION	CODE	UNIT OF MEASUREMENT
Field Independent/Dependent	Tendency to view scene in detail or as a whole	GEF	Group Embedded Figures Test
Spatial Ability	Ability to interpret spatial relations	SV	Space Visualization Test
Visual Pursuit	Ability to follow a schematic diagram	VP	Visual Pursuit Test

PSYCHOMOTOR			
VARIABLE	DESCRIPTION	CODE	UNIT OF MEASUREMENT
Eye-Hand Coordination	Speed and accuracy of tracking by placing pencil dots in shapes in specific order	MSA	Manual Speed and Accuracy Test
		TSA	Tracking Speed and Accuracy Test

Table 9 (Continued)

PERSONALITY			
VARIABLE	DESCRIPTION	CODE	UNIT OF MEASUREMENT
Gambling	Gambling Propensity	GAMB	Playing the Odds Questionnaire

EXPERIENCE			
VARIABLE	DESCRIPTION	CODE	UNIT OF MEASUREMENT
Age	Years of age	AGE	Years
Service Grade	Military rank	RANK	E1, E2, ... E7
Time Served	Months in military	TSERV	E1, E2, ... E7
Time in MOS	Months in current job	TMOS	E1, E2, ... E7
Time in Grade	Months in current rank	TRANK	E1, E2, ... E7
Tracking Practice (SG)	Tracking of aerial targets with weapon	TAT	Days of practice over the last year
Live Fire Practice (SG)	Engaging aerial targets with live rounds	LFR	Days of practice over the last year
Detection Practice (SL)	Detecting aerial targets	DET	Days of practice over the last year
Identification Practice (SL)	Identifying aerial targets	ID	Days of practice over the last year
Hand-off Practice (SL)	Handing-off aerial targets to gunner	HND	Days of practice over the last year
Command Practice (SL)	Issuing engagement commands to gunner	CMD	Days of practice over the last year

Note. SG=Senior Gunner; SL=Squad Leader.

Data Analysis

The primary goal of this research was to generate performance standards which differentiated qualified from unqualified soldiers. Thus, validation reflected the degree to which the performance criteria discriminated differences in performance (i.e., level of ability). Differences due to experience were the primary criteria. Three levels of experience were employed (see Participants section). These levels differed with respect to recency and intensity of training. Performance on the TPM and SPM was compared as a function of these variables. Significant differences in performance were predicted.

Another goal of this research was to determine criteria cutoff scores for different levels of scenario difficulty. Thus, the second principal validation criterion was the degree to which performance on the TPM and SPM differed as a function of scenario difficulty. The three levels of difficulty were also to be calibrated (i.e., determine where to draw the line between levels in terms of the effects on performance). It was necessary to determine which TPM and SPM were affected by difficulty level, in what direction, and to what extent. The interaction of difficulty and experience level was also to be examined.

It was anticipated that the vast majority of variance not accounted for by the independent variables of experience and difficulty would be accounted for by the individual differences predictor measures. It was expected that experienced soldiers not meeting the performance standards would be those scoring lower on certain abilities. Validation of the performance criteria (standards) included the examination of individual differences variables.

Analysis of variance and t-tests were used to identify main and interaction effects of independent variables. However, if sample sizes were very small, nonparametric tests were performed (Mann-Whitney, Sign, Fisher, or Cochran). Two-tailed probabilities were employed while investigating main effects because of uncertainty as to which performance variables would be affected by the independent measures and the direction of these effects and because of small sample sizes and sampling bias. Correlation (Pearson and Spearman) analysis was used to identify individual difference predictors (one-tailed probabilities). Principal components and correlation analyses were employed to determine the degree to which predictor variables clustered together.

Analyses were performed according to weapon system because of differences in weapons, procedures, tactics, and performance. For example, while target detection and identification performance standards may be similar for all SHORAD personnel, range of engagement and probability of kill differ widely for different weapons. Thus, range tables had to be generated separately for each of the three weapons being tested.

RESULTS AND DISCUSSION

Summary Statistics

The most noteworthy finding from the descriptive statistics was the variability in aircraft identification accuracy. There are three possible reasons for this: aircraft familiarity (some aircraft are emphasized more in current training); aircraft discriminability (some aircraft have features in common with their hostile-friendly counterparts) (see FM 44-30, Headquarters, US Army, 1986); and a lack of current Visual Aircraft Recognition (VACR) training (Rotchford & Daruwalla, 1987). Overall identification accuracy (high, medium, or low) across the samples obtained for this research, and associated familiarity and discriminabilty of aircraft, are summarized in Table 10. There is an apparent relationship among familiarity, discriminability, and overall identification accuracy. Descriptive statistics on all TPM and SPM are provided in Appendices A and B. Appendix A provides performance data on Stinger, Chaparral, and Vulcan scenarios for the Summer 1989 RADES tests. Appendix B provides these same data for the Fall 1989 RTS tests.

In general, the average identification performance for all samples was below the recommended standards. This is reflected in Tables 11 and 12 (note that data are compared to revised standards presented at the end of this report). Table 12 demonstrates that the soldiers were not detecting and identifying aircraft soon enough to complete the engagement in time to maximize hostile kills and prevent hostile ordnance release. Table 11 demonstrates the deficiencies in accurately identifying the aircraft. These deficiencies resulted in fewer hostiles engaged, low hostile attrition and ordnance prevention, and more friends engaged with accompanying higher fratricide.

These tables also illustrate large differences in TPM and SPM performance between weapon groups. These differences were attributed to differences in training level and ability. Stinger troops performed slightly better than Vulcan. Both performed considerably better than Chaparral during the Summer RADES tests. During the Fall RTS tests, the Vulcan troops performed slightly better than Stinger. Again, both performed considerably better than Chaparral. This reflected the lack of training received by the National Guard Chaparral personnel.

Table 10

Aircraft Familiarity, Discriminability, and Identification Accuracy

Aircraft Familiarity and Discriminability
(Numerical order in soldier evaluation guide, Headquarters, US Army, 1989)

Hostile Aircraft		Friendly Aircraft	
Fixed Wing	Rotary Wing	Fixed Wing	Rotary Wing
MiG27 (4)*	Mi24 (2)	A10 (3)	AH1 (1)
Su17 (8)*	Mi8 (6)*	A7 (12)	UH1 (5)
Su25 (10)*	Mi28 (41)*	F16 (17)*	CH3 (38)*
Su24 (16)*	Ka?? (N/A)		AH64 (39)*

* Denotes aircraft having features in common with a counterpart

Overall Observed Identification Accuracy

Hostile Aircraft		Friendly Aircraft	
Fixed Wing	Rotary Wing	Fixed Wing	Rotary Wing
MiG27 (H)	Mi24 (MH)	A10 (H)	UH1 (M)
Su17 (H)	Mi8 (M)	A7 (M)	AH1 (M)
Su24 (MH)	Mi28 (ML)	F16 (ML)	AH64 (L)
Su25 (MH)	Ka??** (L)		CH3 (L)

** The Hokum aircraft has not been numerically designated

Table 11

Air Defense Summary Performance as Compared to Recommended Standards

Average Observed Summary Performance

FW Scenarios		Summer, 1989 RADES Tests			Fall, 1989 RTS Tests		
Variable	Stndrd	STNG	CHAP	VULC	STNG	CHAP	VULC
IDCOR	.70	.84	.73	.70	.82	.72	--
FIDCOR	.70	.43*	.35*	.26*	.69*	.62*	--
HIDCOR	.75	.98	.83	.86	.95	.92	--
FENG	.30	.50*	.45*	.78*	.18	.43*	--
HENG	.75	.93	.56*	.78	.50*	.64*	--
PKILL	.65/.20	.65	.78	.04*	.86	.87	--
FKILL	.30	.29	.35*	.04	.16	.29	--
HKILL	.50/.10	.77	.41*	.03*	.34*	.64	--
ORD	.55/.00	.98*	.92*	N/A	.34	.71*	--
RW Scenarios		**Summer, 1989 RADES Tests**			**Fall, 1989 RTS Tests**		
Variable	Stndrd	STNG	CHAP	VULC	STNG	CHAP	VULC
IDCOR	.75	.70*	.61*	.66*	.68*	.64*	.76
FIDCOR	.75	.47*	.38*	.51*	.37*	.50*	.56*
HIDCOR	.80	.84	.78*	.75*	.95	.92	.83
FENG	.25	.39*	.30*	.34*	.44*	.20	.60*
HENG	.80	.75*	.53*	.73*	.67*	.50*	.84
PKILL	.75	.91	.59*	.73*	.99	.99	.30*
FKILL	.25	.37*	.08	.25	.44*	.25	.04
HKILL	.70	.68*	.37*	.63*	.66*	.50*	.28*
ORD	.35	.54*	.72*	.42*	.68*	.67*	.73*
HITS	8.0	--	--	7.2*	--	--	8.0

* Indicates average performance falls below the recommended standard

Note. Results reflect first or single target performance.

Note. Standards for FW variables PKILL, HKILL and ORD are different between STNG-CHAP and VULC.

Note. For Summer VULC, the average performance exceeded the criterion for the following RW variables after eliminating low experience subjects: HIDCOR (.89), PKILL (.83), HITS (10.8).

Table 12

Air Defense Task Performance as Compared to Recommended Standards

Average Observed Task Performance (Percentage Exceeding the Criteria)

FW Scenarios		Summer, 1989 RADES Tests			Fall, 1989 RTS Tests		
Variable	Stndrd	STNG	CHAP	VULC	STNG	CHAP	VULC
RDET	8/6.5 km	9.4(.57)	5.4(.22)	6.3(.36)	9.5(.58)	8.3(.56)	--
RID	4/2.5 km	3.8(.40)	2.9(.23)	2.5(.41)	3.8(.30)	4.4(.44)	--
RACQ	5 km	4.7(.30)	3.4(.20)	--	6.3(.53)	2.9(.00)	--
RFIRE	2/1.5 km	2.7(.64)	3.1(.45)	1.8(.57)	4.0(.53)	3.7(.72)	--

RW Scenarios		Summer, 1989 RADES Tests			Fall, 1989 RTS Tests		
Variable	Stndrd	STNG	CHAP	VULC	STNG	CHAP	VULC
TDET	6 sec	8.2(.52)	8.2(.52)	6.5(.62)	6.3(.68)	6.3(.63)	6.5(.57)
TID	7 sec	8.5(.62)	10.6(.47	7.7(.61)	11.0(.46	9.8(.37)	6.7(.71)
TACQ	5 sec	6.6(.60)	8.7(.82)	--	6.6(.69)	5.1(.50)	--
TFIRE	7 sec	9.3(.52)	8.6(.61)	--	9.2(.49)	9.4(.47)	--
TTOT	12 sec	11.3(.65	14.2(.49	8.4(.82)	14.5(.44	13.5(.60	8.8(.82)

Note. Results reflect first or single target performance.

Note. Standard for FW variables RDET, RID, and RFIRE are different between STNG-CHAP and VULC.

Note. Standards represent medium (RW) to medium-high (FW) difficulty.

It was anticipated that Vulcan squad leaders would have shorter FW identification ranges due to the range limits of their weapon, and this was found. Vulcan FW identifications averaged about 2.5 kilometers. The maximum range reach of the weapon is about 2 kilometers. Thus, the squad leaders were waiting until the aircraft was closer to increase identification accuracy. Chaparral and Stinger systems are capable of engaging at hostile ordnance delivery range. To realize this capability, commanders must necessarily identify the target farther away. The mission requirements are different because of the different ranges of the weapons, and this is the principal reason that the recommended criteria differ between gun and missile systems.

Past and current research indicate that experienced air defense soldiers are capable of achieving the criteria. This is particularly true for gunner performance. Research has shown little variation in gunner tasks and negligible deficiencies in gunner performance (Barber, 1990; Barber, et al., 1987). In the current research, undesirable performance appeared to reflect insufficient training rather than poorly selected criteria. This is likely because current training methods do not adequately address the observed performance deficiencies: identification accuracy, fratricide, hostile attrition and ordnance prevention, and collective crew-team interactions. Current training and training devices focus primarily on gunnery tasks, which is probably why gunner performance met the criteria.

Experimental Effects

Effects of scenario difficulty factors and soldier experience level are discussed in turn, followed by interaction effects. Main and interaction effects are presented in Tables 13 through 18 at the end of this section. In these tables, effects of scenario difficulty are indicated as "DIF" and effects of soldier experience are indicated as "EXP".

Scenario Difficulty Level. Past research (Barber, 1987; Drewfs & Barber, 1990) suggested which factors made a scenario easier or harder. These factors were incorporated into the difficulty indices ascribed to scenarios prior to the tests. These indices produced occasional main effects in the predicted direction. In this research, the difficulty factors which seemed to contribute the most to variations in performance were target visibility, number of targets, and aircraft model type. The influence of each of these factors will be discussed in turn.

Target visibility can be varied by changing any of the following variables: target aspect angle, range, elevation (above mask), offset (from PTL or cued azimuth), size, velocity, contrast and coloration (background and camouflage), and weather conditions (i.e., atmospheric transmissivity). Effects of these variables on air defense performance have been found on numerous occasions (Barber, 1987; Barber, 1990; Drewfs & Barber, 1988; Drewfs & Barber, 1990, Johnson, Barber, & Lockhart, 1988). The current study was no exception.

For example, increases in aircraft range and decreases in aircraft size were associated with increases in RW detection times (TDET) and RW identification times (TID). As shown in Table 15, it took longer to detect and identify the Mi28 when it was more distant, resulting in more hostile ordnance releases (scenario 13 versus 15). It took longer to identify (TID) and to complete the engagement (TTOT) on the Mi24 when it was more distant, resulting in more incorrect identifications and fewer hostile kills (scenario 16 versus 17).

Further, increases in offset affected detection time as shown in Table 14. This is evidenced by the fact that when the second target of a multiple target scenario appeared at the same azimuth as the first target (as in scenario 10), detection occurred more quickly than when the second target appeared at the other side of the search sector (as in scenario 9).

Multiple targets appearing simultaneously can adversely affect performance in two distinct ways: hesitation or haste. The soldier may become confused about which target to engage, or may hasten his responses in order to engage as many as possible. The more targets per unit time to deal with, the more difficult the scenario becomes, producing a negative effect on performance.

In this research, first RW target detection times (TDET) were longer when there were multiple targets (Table 14, scenarios 5, 6 versus 11, 12; and Table 15, scenario 12 versus 24, 27, 32). The more targets, the more delay in communicating detection. This was also true for second RW target detections (see Table 14, scenarios 9, 10 versus 11, 12). Perhaps confusion or distraction as to which target to engage first caused a delay in the detection response.

Second and third RW target identifications (TID) were significantly faster than first target identifications, for all three weapons, for both summer and fall tests, as shown in Table 17. Total engagement times (TTOT) were also shorter for subsequent targets (see Table 17). Apparently, subsequent identification decisions and engagements were hastened due to time pressure. Consequently, performance in identifying aircraft and obtaining hostile kills decreased with second and third targets (see Table 17).

Familiarity and discriminability of the aircraft was another primary factor in determining the outcome of the engagement. The participants were generally poorer at identifying friends than hostiles. This result is consistent with the interpretation that participants identified aircraft as hostile when they were in doubt. Some model types were more familiar than others and some were easier to identify (i.e., had obvious features) making those scenarios less difficult.

For example, the most familiar and salient RW model type was the hostile Mi24, so it was no surprise that this model yielded the highest identification accuracy. The Mi8 was also a familiar target and yielded high identification accuracy. However, the accuracy in identifying the hostile Mi28 (Havoc) and Ka? (Hokum) was much lower. While they have obvious features, they are newer targets and are less familiar. Further, with respect to friendly RW aircraft, the AH1 and UH1 are the most familiar and oldest. These aircraft yielded better identification accuracy than the AH64 and CH3 models. Also, AH64 and CH3 features tend to resemble those of the hostile Mi28 and Mi8, respectively. For FW targets, the familiar MiG27 (and hostile FW in general) yielded high identification accuracy. The friendly A1Ø with its obvious features (dual engines and dual tail) yielded better identification accuracy than the A7 and F16.

Support for these effects on aircraft identification accuracy is provided in Tables 13 and 14. The more familiar and discriminable the aircraft model, the more accurate the identification. The less familiar and discriminable the aircraft, the more likely it was called a hostile. More familiar and discriminable aircraft also elicited faster identification times and farther identification ranges. This consequently resulted in more hostile kills and fewer fratricides.

Soldier Experience Level. Experience, as measured in terms of service grade and time in service, was not a strong predictor. Experience, as measured in terms of extent and intensity of recent training or practice, was a strong predictor. While the former produced some of the predicted effects, effects attributed to the latter prevailed. Soldiers receiving recent and intense training performed better than those with insufficient training and were therefore more apt to meet the performance standards (see Table 11). It was necessary to determine the extent of this difference in order to establish where the performance standard cutoffs should be placed.

Typically, large variations in single target detection time and gunner tracking ability have not been found (Barber, 199Ø; Barber, et al., 1987). There are two likely reasons for this: (1) These tasks can be performed with basic or average skills (as evidenced by very little variance or effect of psychomotor ability on gunner performance). (2) These tasks are currently stressed in training, at the neglect of other important tasks such as visual aircraft recognition, engagement of aircraft (simulated or live fire), and collective crew tasks. Consequently, there is usually more variance in these latter tasks. Identification, being the most critical task, tends to affect all subsequent tasks and outcomes. The more experienced and better trained soldiers tended to be faster and more accurate in identifying aircraft, and better at obtaining kills.

The expected effect of experience (EXP) on fast and accurate identifications occurred for Vulcan (Table 14). Experienced Vulcan troops also detected the second of multiple targets sooner (Table 14), completed the engagement sooner (Table 16), and were more on target when firing the weapon (Table 14), thereby obtaining more kills (Table 14). Stinger experience comparisons produced mixed results (Table 18). The RADES high experience group performed better than their AIT counterparts in identifying and engaging aircraft. The RTS high experience group performed about the same as their AIT counterparts with two exceptions: (1) Experienced troops were more accurate in identifying the Mi24. (2) Inexperienced (AIT) troops detected FW targets farther out and engaged more FW targets.

The reverse trend occurred for Chaparral. Higher ranking Chaparral observers took longer to detect and identify aircraft than lower ranking ones (see Tables 13 and 18) and engaged fewer hostile aircraft (Table 18). This may have occurred due to the more experienced group having recently transitioned to Chaparral. This may also have been a result of the less experienced soldiers taking less time, by defaulting to a decision of hostile.

The best performance was exhibited by the Summer 1989 Stinger troops and the Fall 1989 Vulcan troops (for example, see Tables 11, 12, and 19). These soldiers were from active duty air defense units. AIT troops performed at a level below them but commensurate with the Summer Vulcan and Fall Stinger personnel. National Guard (i.e., Chaparral) troops performed the poorest. The above differences have been ascribed to the degree of recent training. All of these groups would benefit from more focused and extensive sustainment training.

Interaction Effects. It was hypothesized that the effects of experience and difficulty on engagement performance would interact on those tasks with which experienced personnel receive concentrated training or inexperienced personnel receive little or no training. The hypothesis was supported on the fire task for Vulcan gunners (see Table 14). Superior firing accuracy (AVEMISS) exhibited by experienced gunners was unaffected with increased scenario difficulty. Average or poor firing accuracy exhibited by less experienced gunners worsened with increased difficulty.

Individual Differences Effects

Ability and attribute variables grouped into logical factors suggested from previous research (Barber, 1987; 1990). Results of principal components analyses are provided in Appendix C (Table C2). The six primary domains are as follows: sensory, perceptual, cognitive, psychomotor, personality, and experience. It was anticipated that soldier differences would account for variance in performance not accounted for by the independent variables and could help explain the results when reverse effects emerged. These predictions were supported. Significant relationships found have been summarized in Table 20. The importance ascribed to the relationships in this table (L, M, or H) reflects the extent to which the relationship could be demonstrated repeatedly and the magnitude of the correlation. Descriptive statistics on individual differences measures are provided in Appendix C (Table C1).

The variables demonstrating consistent and significant relationships related to the following domains (in order of importance). Specific correlations are provided in Appendix C (Table C3).

- Sensory (i.e., vision) -- resting focus (RF), nearest focal point (NP), foveal visual acuity (FVA), contrast sensitivity (CS), blur interpretation (BIZ);
- Experience -- age, time in service (TSERV), live fire practice (LFR);
- Perceptual -- field independence (GEF);
- Psychomotor -- manual speed and accuracy (MSA).

The best predictors related to the visual ability of the soldier, thereby replicating previous research findings (Barber, 1987; 1990). The resting focus was highly related to RW detection. Those with an intermediate RF detected the target faster. Further, those with a higher near point (more flexible focal range) detected the RW target earlier. Foveal acuity was an excellent predictor of performance. Better acuity was associated with more accurate FW and RW identifications, and faster RW identification reaction time. Contrast sensitivity, which is correlated with acuity, was also associated with farther FW engagement ranges (RFIRE), more accurate RW identifications, and shorter engagement times (TTOT). Good blur interpretation performance was associated with slower RW detection times, and with better RW identification accuracy, more hostile RW kills, and more hostile RW ordnance prevention.

In past research (Barber, 1987; 1990), field dependent people (GEF) and those low in blur interpretation ability (BIZ) tended to acquire static RW targets more quickly but were slower in detecting and identifying dynamic FW targets. Field independent people and those high in blur interpretation ability tended to identify targets at a greater range and with better accuracy. These findings were somewhat supported in the current research. Further, field independence and blur interpretation ability have been found to be correlated (Barber, 1990).

Better eye-hand coordination (MSA) was associated with faster RW detection times.

Older soldiers detected the FW target at a closer range and were slower in detecting the RW target than the younger ones. However, the older and more experienced soldiers (AGE, TSERV) were more accurate in their RW identifications and obtained more hostile RW kills. Also those receiving more live fire practice obtained more hostile kills. Therefore, realistic engagement practice would appear to be beneficial.

Finally, ASVAB scale scores predicted performance. Farther FW detection ranges were associated with high scores on the AFQT scale (and somewhat with the EL, MM, and OF scales). Faster RW detections were also associated with these ASVAB scales (especially the MM scale).

Table 13

Chaparral Experimental Effects (Summer, 1989 RADES Test)

FIXED WING SCENARIOS

Scens	Effect	Var	F	DF	P	Means	SDs	Ns
1,2 & 3,4	DIF	RID	4.3	49,1	.04	3.2,2.5	1.9,1.2	51,51
1,2 & 3,4	DIF	IDCOR	16.4	49,1	.001	.84,.49	.37,.53	51,51

ROTARY WING SCENARIOS (Target = 1)

Scens	Effect	Var	F	DF	P	Means	SDs	Ns
8 & 9	DIF	TID	3.5	18,1	.08	10.2,12.5	2.9,4.0	20,20
10 & 11	DIF*	TDET	5.1	22,1	.03	8.9,13.0	7.2,8.0	24,24
10 & 11	EXP*	TID	4.3	20,1	.05	8.7,14.1	7.5,8.0	22,22
5,6 & 8,9	DIF	TDET	27.6	44,1	.001	4.8,9.9	3.0,6.6	46,46
5,6 & 8,9	DIF	IDCOR	23.5	48,1	.001	.69,.26	.46,.44	50,50
5,6 & 8,9	DIF	TID	37.7	41,1	.000	7.6,11.4	4.5,3.5	43,43
5,6 & 8,9	EXP*	TID	8.4	41,1	.006	8.1,10.9	3.1,4.2	42,44
5,6 & 8,9	DIF-EXP*	TID	3.6	41,1	.07			

	E2	E3
D1	5.5	9.5
D2	10.6	12.2

DIF (1 = Low, 2 = High); EXP (2 = Medium, 3 = High)
* Indicates Reverse Effect

Table 14

Vulcan Experimental Effects (Summer, 1989 RADES Test)

FIXED WING SCENARIOS

Scens	Effect	Var	F	DF	P	Means	SDs	Ns
1,2 & 3,4	DIF	RID	3.1	40,1	.09	2.2,2.7	1.1,1.5	42,42
1,2 & 3,4	DIF	RFIRE	7.5	41,1	.04	1.6,2.1	1.4,1.5	43,43
1,2 & 3,4	DIF	IDCOR	2.0	41,1	.001	.84,.53	.37,.51	43,43
1,2 & 3,4	EXP	IDCOR	4.5	41,1	.04	.57,.80	.47,.39	42,44
1,2 & 3,4	EXP	PKILL	4.1	32,1	.05	.47,.75	.50,.42	36,32
1,2 & 3,4	EXP	AVEMISS	6.5	41,1	.02	3.2,1.5	4.3,1.6	42,44

ROTARY WING SCENARIOS (Target = 1)

Scens	Effect	Var	F	DF	P	Means	SDs	Ns
6 & 5	DIF	TID	7.1	22,1	.01	6.2,9.1	4.1,5.5	24,24
6 & 5	EXP	TID	4.4	22,1	.05	9.3,6.0	4.7,4.3	24,24
6 & 5	DIF	IDCOR	7.5	23,1	.01	.83,.48	.37,.51	25,25
6 & 5	DIF	HKILL	9.4	23,1	.005	.83,.48	.37,.51	25,25
6 & 7	EXP	TID	11.6	22,1	.003	8.1,4.5	3.6,3.2	24,24
6 & 7	DIF	IDCOR	6.0	22,1	.001	.83,.13	.38,.34	24,24
9 & 10	EXP	HIDCOR	3.3	22,1	.08	.67,.87	.48,.34	24,24
5,6 & 11,12	DIF	TDET	36.7	46,1	.001	3.3,6.0	2.0,3.0	48,48
5,6 & 11,12	EXP	TID	3.0	45,1	.09	9.1,6.5	6.1,6.0	48,46
5,6 & 11,12	DIF*	HIDCOR	5.7	47,1	.02	.65,.83	.48,.37	49,49
5,6 & 11,12	DIF	AVEMISS	4.7	47,1	.03	.49,.68	.51,.74	49,49
5,6 & 11,12	EXP	AVEMISS	7.8	47,1	.007	.79,.37	.61,.57	48,50
5,6 & 11,12	DIF-EXP	AVEMISS	5.9	47,1	.02	(see below)		

	E1	E3
D1	.58	.40
D2	1.0	.38

ROTARY WING SCENARIOS (Target = 2)

Scens	Effect	Var	F	DF	P	Means	SDs	Ns
10 & 9	DIF	TDET	17.6	19,1	.001	16.8,23.4	4.3,5.0	21,21
9,10 & 11,12	DIF	TDET	9.0	44,1	.004	19.7,24.2	5.3,10.6	46,46
9,10 & 11,12	EXP	TDET	6.8	44,1	.01	24.3,19.6	8.1,7.1	46,46
9,10 & 11,12	DIF-EXP	TDET	2.4	44,1	.13	(see below)		

	E1	E3
D1	21.0	13.5
D2	27.7	20.7

DIF (1 = Low, 2 = High); EXP (1 = Low, 3 = High)
* Indicates Reverse Effect

Table 15

Stinger Experimental Effects (Fall, 1989 RTS Test)

ROTARY WING SCENARIOS (Target=1)							
Scens	Effect	Var	Test	Stats	P	Means	Ns
13 & 15	DIF	TDET	M-W	Z=3.5	.001	4.1,7.5	11,10
13 & 15	DIF	TID	M-W	Z=2.9	.003	7.4,13.0	10,10
13 & 15	DIF	ORD	Fisher	Phi=.52	.06	.40,.90	10,10
16 & 17	DIF	TID	M-W	Z=2.1	.03	9.4,14.8	9,10
16 & 17	DIF	TTOT	M-W	Z=1.8	.07	13.1,17.0	8,4
16 & 17	DIF	HIDCOR	Fisher	Phi=.57	.03	1.0,.50	9,10
16 & 17	DIF	HKILL	Fisher	Phi=.51	.06	.80,.40	9,10
12 & 24	DIF	TDET	Sign	0(-),10(+),0(=)	.002	2.1,6.5	10
12 & 24	DIF	TID	Sign	1(-),8(+),1(=)	.04	5.3,8.4	10
12 & 24	DIF	TTOT	Sign	0(-),7(+),2(=)	.02	8.8,14.8	9
12 & 24	DIF	ORD	Cochran	Q=6.0	.01	.10,.85	10
16 & 23	DIF	HIDCOR	Cochran	Q=5.0	.03	1.0,.40	10
12 & 27	DIF	TDET	Sign	0(-),9(+),0(=)	.004	2.1,6.7	9
12 & 27	DIF	TID	Sign	1(-),8(+),0(=)	.04	5.3,9.9	9
12 & 27	DIF	ORD	Cochran	Q=5.0	.03	.10,.75	9
12 & 32	DIF	TDET	Sign	1(-),9(+),0(=)	.02	2.1,3.9	10
12 & 32	DIF	TID	Sign	1(-),9(+),0(=)	.02	5.3,14.8	10
13 & 31	DIF	TDET	Sign	0(-),9(+),1(=)	.04	4.1,13.3	10
13 & 31	DIF	ORD	Cochran	Q=5.0	.03	.40,.97	10
20 & 31	DIF	TDET	Sign	1(-),7(+),2(=)	.07	4.2,13.3	10

DIF (1 = Low, 2 = High)

Table 16

Vulcan Experimental Effects (Fall, 1989 RTS Test)

ROTARY WING SCENARIOS (Target=1)							
Scens	Effect	Var	Test	Stats	P	Means	Ns
11 & 14	DIF	TDET	M-W	Z=3.1	.002	5.0,10.0	8,8
12 & 21	DIF*	TDET	M-W	Z=1.8	.07	7.9,5.8	8,4
9 & 13	EXP	TTOT	M-W	Z=2.1	.03	10.7,4.3	3,4
10 & 19	DIF	TDET	Sign	0(-),5(+),3(=)	.06	4.1,5.9	8
10 & 25	DIF	TDET	Sign	0(-),6(+),0(=)	.03	4.1,7.0	6

DIF (1 = Low, 2 = High); EXP (1 = Low, 3 = High)

* **Indicates Reverse Effect**

Table 17

Overall Experimental Effects of Single Versus Multiple Targets

Targets	Weapon	Var	T	DF	P	Means	SDs	Ns
(Summer, 1989 RADES Tests)								
1 vs 2	STNG	TID	2.7	146.5	.01	8.5,6.0	7.1,4.3	89,62
1 vs 3	STNG	TID	2.5	36.4	.05	8.5,5.7	7.1,3.0	89,13
1 vs 2	CHAP	TID	4.3	241.6	.001	10.6,6.9	8.2,5.5	163,90
1 vs 3	CHAP	TID	3.0	12.8	.05	10.6,5.8	8.2,4.6	163,10
1 vs 2	VULC	TID	2.6	309	.01	7.7,5.9	6.0,4.1	178,133
1 vs 3	VULC	TID	4.4	50.4	.001	7.7,4.3	6.0,3.1	178,24
1 vs 2	STNG	TTOT	2.4	105	.05	11.3,8.6	6.2,5.2	60,47
1 vs 2	CHAP	TTOT	2.2	126	.05	14.2,10.7	9.4,8.1	79,49
1 vs 2	CHAP	HIDCOR	2.6	198	.01	.78,.61	.43,.49	111,89
2 vs 3	CHAP	HIDCOR	4.6	123	.001	.61,.19	.49,.40	89,36
1 vs 3	CHAP	HIDCOR	7.3	145	.001	.78,.19	.43,.40	111,36
2 vs 3	VULC	HIDCOR	3.1	163	.01	.73,.47	.45,.50	124,41
1 vs 3	VULC	HIDCOR	3.4	156	.001	.75,.47	.43,.50	117,41
2 vs 3	CHAP	HKILL	2.6	98.1	.05	.25,.08	.43,.28	89,36
1 vs 3	CHAP	HKILL	4.4	103.6	.001	.37,.08	.48,.28	111,36
2 vs 3	VULC	HKILL	2.2	163	.05	.54,.34	.50,.48	124,41
1 vs 3	VULC	HKILL	3.3	156	.001	.63,.34	.48,.48	117,41
2 vs 3	VULC	AVEMISS*	2.6	140.2	.01	.48,.24	.82,.45	162,47
1 vs 3	VULC	AVEMISS*	2.8	238	.01	.48,.24	.54,.45	193,47

Targets	Weapon	Var	T	DF	P	Means	SDs	Ns
(Fall, 1989 RTS Tests)								
1 vs 2	STNG	TID	3.4	222.9	.001	11.0,8.1	8.3,4.8	136,106
1 vs 3	STNG	TID	2.9	143.0	.01	11.0,8.2	8.3,4.5	136,47
1 vs 2	CHAP	TID	2.6	83	.01	9.8,6.8	4.7,5.7	51,34
1 vs 3	CHAP	TID	3.0	66	.01	9.8,5.8	4.7,5.0	51,17
1 vs 2	VULC	TID	4.8	134.0	.001	6.7,2.9	6.4,2.9	94,42
1 vs 3	VULC	TID	4.0	96.7	.001	6.7,3.2	6.4,2.9	94,27
1 vs 2	STNG	TTOT	2.4	148.6	.05	14.5,11.8	8.1,5.8	92,60
1 vs 2	CHAP	TTOT	2.8	40.7	.01	13.5,8.4	7.2,4.7	25,18
1 vs 2	VULC	TTOT	3.5	102.9	.001	8.8,5.1	7.3,3.6	71,34
1 vs 3	STNG	HIDCOR	2.5	158	.05	.70,.47	.46,.51	128,32
2 vs 3	STNG	HIDCOR	2.2	110	.05	.69,.47	.47,.51	80,32
1 vs 3	STNG	HKILL	4.4	88.1	.001	.66,.31	.48,.47	130,49
2 vs 3	STNG	HKILL	3.4	133	.001	.60,.31	.49,.47	86,49
1 vs 3	CHAP	HKILL	2.8	66	.01	.50,.15	.51,.37	48,20
2 vs 3	CHAP	HKILL	2.3	47	.05	.45,.15	.51,.37	29,20
1 vs 2	VULC	HKILL*	2.1	116	.05	.28,.47	.45,.50	75,43
2 vs 3	VULC	HKILL	2.2	62	.05	.47,.19	.50,.40	43,21
1 vs 2	VULC	HITS*	2.1	151	.05	8.0,14.5	16.3,20.7	101,52
2 vs 3	VULC	HITS	2.1	86	.05	14.5,5.7	20.7,16.8	52,36

* Indicates Reverse Effect

Table 18

Additional Performance Comparisons by Skill Level (1,2,3) for Medium Difficulty Scenarios

Spring, 1988 RADES AIT Tests Versus Summer, 1989 RADES Tests							
Weapon	Levels	Scen	Var	Means	T	DF	P
Stinger	1 vs 3	Mi24	TID	7.3,3.7	5.0	47.8	.001
Stinger	1 vs 3	Su25	IDCOR	.79,1.0	2.9	33.0	.01
Stinger	1 vs 3	Su25	HENG	.79,1.0	2.9	33.0	.01
Stinger	1 vs 3	MiG27	IDCOR	.72,1.0	3.2	34.0	.01
Stinger	1 vs 3	MiG27	HENG	.69,1.0	3.9	34.0	.001
Chaparral	1 vs 2	MiG27	RDET*	8.2,5.1	3.6	20.1	.01
Chaparral	1 vs 2	MiG27	RID*	5.1,3.5	2.3	21.1	.05
Chaparral	1 vs 3	Mi24	TID*	7.1,10.6	2.2	40	.05
Chaparral	1 vs 2	Mi24	HENG*	.85,.42	3.1	43	.01
Chaparral	1 vs 3	Mi24	HENG*	.85,.50	2.5	43	.05

Spring, 1988 RADES AIT Tests Versus Fall, 1989 RTS Tests							
Weapon	Levels	Scen	Var	Means	T	DF	P
Stinger	1 vs 3	Su17	RDET*	10.8,6.9	2.8	36	.01
Stinger	1 vs 3	MiG27	HENG*	.81,.33	3.1	44	.01
Stinger	1 vs 3	Su17	HENG*	.91,.30	3.8	11.1	.01
Stinger	1 vs 3	Mi24	HIDCOR	.89,1.0	2.2	36.0	.05

* Indicates Reverse Effect

Scenarios Used for Comparisons	
Above Comparisons	Below Comparisons
Su25 -- 12:00 Ingressing	Su25 -- 12:00 Ingressing
MiG27 -- 1:00 Ingress & Cross	MiG27 -- 1:00 Ingress & Cross
Mi24 -- 12:00, 2-3 Km., 45 deg.	Su17 -- 11:00, Ingress & Cross
CH3 -- 1:00, 5 Km., 45 deg.	Mi24 -- 12:00, 3 Km., 45 deg.

Table 19

Performance Comparisons By Weapon Type for Low to Medium Difficulty Scenarios (Summer 1989 RADES Test)

WEAPONS	TYPE	TARG	VAR	MEANS	t	df	p
STNG vs CHAP	FW	1	RDET	9.4,5.4	6.9	148	.001
STNG vs VULC	FW	1	RDET	9.4,6.3	4.6	138	.001
STNG vs CHAP	FW	1	RID	3.8,2.9	2.5	88.8	.05
STNG vs VULC	FW	1	RID	3.8,2.5	3.8	80.8	.001
STNG vs VULC	FW	ALL	IDCOR	.84,.70	2.0	135.7	.05
STNG vs CHAP	FW	ALL	HKILL	.77,.41	4.0	116	.001
STNG vs CHAP	RW	1	TID	8.5,10.6	2.0	250	.05
STNG vs CHAP	RW	1	TTOT	11.3,14.2	2.2	134.6	.05
STNG vs CHAP	RW	ALL	HIDCOR	.79,.58	4.6	371.1	.001
VULC vs CHAP	RW	ALL	HIDCOR	.70,.58	2.9	539	.01
STNG vs CHAP	RW	ALL	PKILL	.86,.56	5.7	239.4	.001
STNG vs CHAP	RW	ALL	HKILL	.64,.26	8.2	411	.001
STNG vs CHAP	RW	ALL	FKILL	.33,.07	4.3	95.5	.001
STNG vs CHAP	RW	ALL	ORD	.74,.85	2.6	262.8	.01

Table 20

Summary of Individual Differences Correlates

	Fixed Wing						Rotary Wing					
	RDET	RID	RFIRE	IDCOR	KILLS	ORD	TDET	TID	TTOT	IDCOR	KILLS	ORD
RF							H -		M +			
NP							L -					
FVA		L -		L -				H +		M -		
CS			M +						M -	L +		
BIZ							M +			H +	H +	M -
GEF		L +										
MSA							M -					
AGE	M -						L +				M +	
TSERV	M -						L +			L +	L +	
LFR											L +	
AFQT	H +						L -					
EL	L +						L -					
MM	L +						M -					
OF	L +						L -					

Key: Consistency and magnitude of relationship -- L = low; M = moderate; H = high; Direction of relationship -- (+) = positive; (-) = negative

CONCLUSIONS

Scenario Difficulty

Difficulty indices identified in past research continued to be employed successfully in defining scenario difficulty. Scenario difficulty was found to affect air defense engagement performance in the current effort. Performance criteria recommended for use have been based on three difficulty levels (e.g., low, medium, and high). The recommended scenario specifications listed in Table 21 reflect these levels of difficulty. Significant deviation from these specifications could render a scenario as higher or lower in difficulty and the performance criteria should be applied accordingly.

The specific indices having the greatest effect on scenario difficulty were as follows (in order of importance):

- Target Visibility (decreases or increases in target aspect, range, elevation, offset, size, velocity, contrast)
- Multiple Targets (introducing multiple, simultaneous targets within engagement range increases load stress and time stress)
- Model Type (while the soldier should be familiar with all modern military aircraft, some models will be more familiar or discriminable than others and some are more often confused with their counterparts)

While there are numerous other factors influencing difficulty, it is recommended that they be controlled (i.e., held constant) when applying the criteria to evaluate and qualify soldiers. These factors include command and control (e.g., alerting and cuing), weather (e.g., clear weather, daylight conditions), fatigue level (i.e., moderate conditions of vigilance, boredom, and saturation), and terrain (e.g., sky background). The criteria are subject to drastic changes as new conditions are introduced. For example, the likelihood of detecting a target with a terrain background, at zero aspect, at 5 kilometers, on a day with poor visibility, without cuing, is extremely low.

Table 21

Scenario Specifications by Difficulty Level

Fixed Wing		
LOW	MEDIUM	HIGH
Single, ingressing or crossing FW (plus*) - visible at maximum range (15-20 km) - medium-high alt. - slow speed (400-500 mph) - 90 deg. aspect - Cued to +/- 15 deg. - Familiar target with unique features	Single, ingressing FW - available at 20 km (beyond visible range) - medium altitude (1000 ft.) - mach speed (600 mph) - 0 to 45 deg. aspect - Cued to +/- 15 deg. - Familiar target with unique features	Ingressing FW (plus*) - presented simultaneously with another FW or 1-2 RW - closer range (avail.) - lower than 1000 ft. - faster than mach (700+ mph) - Cuing exceeds +/- 30 deg. accuracy - Low familiarity or discriminability

Rotary Wing		
LOW	MEDIUM	HIGH
- Single, hovering RW (plus*) - 1-3 km range - 5+ deg. elevation - 45-90 deg. aspect - Cued to +/- 15 deg. - Available 30 seconds - Familiar target with unique features	Single, hovering or multiple, sequential RW - 1-3 km range - 3-5 deg. elevation (above mask) - 0-90 deg. aspect - Cued to +/- 15 deg. - Available 20 seconds - Familiar target with unique features	Single, hovering RW (plus*) - presented simultaneously with 1-2 RW - 5-7 km range - 1-2 deg. elevation - 0 deg. aspect - Cuing exceeds +/- 60 deg. accuracy - Available 10 seconds - Low familiarity or discriminability

* Indicates some or all of the conditions which follow exist (variations from medium difficulty specifications)

Of course, some conditions (such as weather) cannot be controlled. Hence, the evaluator may need to take into consideration weather conditions, especially those affecting visibility (wind, clouds, haze, etc.), when evaluating soldiers. Other factors such as the search sector, the flight path of targets, the presence of multiple aircraft, and terrain variations may also inhibit soldiers in detecting and identifying aircraft at maximum visible range, thereby influencing performance outcomes. There are several factors that influence performance during the execution of a field test exercise that must be considered to ensure fair application of the standards (i.e, selection of the correct tables). Thus, the standards should be interpreted with some flexibility due to the unpredictability of the field test environment.

Criteria Calibration

Based on the results from this research effort, a few modifications to the preliminary criteria have been recommended. Some of the criteria appeared to be unachievable due to limitations of the weapons, the personnel, or the doctrine. For example, the probability of kill (Pk) and effective range of the Vulcan and PIVADS weapon systems limit the ability of troops to obtain hostile kills and prevent ordnance release, particularly for FW aircraft. While the Pk for the weapon may be higher, it is unrealistic to expect this weapon system to achieve maximum Pk on FW aircraft.

The criteria provided in Tables 22 and 23 reflect the best tradeoff between what is humanly achievable and what is required in terms of the threat, the tactics, and the doctrine. The medium difficulty criteria are based on the "average" scenario. Low difficulty criteria imply the scenario specifications have become less stringent, such as making the target easier to see (e.g., closer, slower, etc.) and identify (e.g., enhanced or unique features and familiarity). High difficulty criteria imply more stringent scenario specifications, such as making the target harder to see (farther, faster, less aspect, less contrast, etc.), or by making the task more difficult (multiple targets, low discriminability or familiarity, etc.).

Individual Differences

A number of individual differences have repeatedly emerged as reliable correlates of air defense performance. The best predictors appear to be the vision measures. Visual acuity and contrast sensitivity, resting focus, and blur interpretation predicted visual tasks such as detection and identification quite well.

Table 22

Recommended Task Performance Criteria

Fixed Wing (Ranges in Fullscale Kilometers)									
Task	Stinger			Chaparral			Vulcan		
	L	M	H	L	M	H	L	M	H
RDET	11	9	7	11	9	7	9	7	6
RACQ	8	6	4	8	6	4	-	-	-
RID	7	5	3	7	5	3	4	3	2
RFIRE	5	3	1	5	3	1	2	2	1

Rotary Wing (Elapsed Time in Seconds)									
Task	Stinger			Chaparral			Vulcan		
	L	M	H	L	M	H	L	M	H
TDET	4	6	10	4	6	10	4	6	10
TACQ	4	5	6	4	5	6	-	-	-
TID	5	7	9	5	7	9	5	7	9
TFIRE	5	7	9	5	7	9	5	7	9
TTOT	9	12	15	9	12	15	9	12	15

Table 23

Recommended Summary Performance Criteria

Fixed Wing (Percentages)

Outcome	Stinger L	Stinger M	Stinger H	Chaparral L	Chaparral M	Chaparral H	Vulcan L	Vulcan M	Vulcan H
IDCOR	80	75	70	80	75	70	80	75	70
FIDCOR	80	75	70	80	75	70	80	75	70
HIDCOR	85	80	75	85	80	75	85	80	75
FENG	20	25	30	20	25	30	20	25	30
HENG	85	80	75	85	80	75	85	80	75
PKILL	80	75	65	80	75	65	40	30	20
FKILL	20	25	30	20	25	30	20	25	30
HKILL	70	60	50	70	60	50	30	20	10
ORD	55	35	15	55	35	15	-	-	-
HITS*	-	-	-	-	-	-	5	4	3

Rotary Wing (Percentages)

Outcome	Stinger L	Stinger M	Stinger H	Chaparral L	Chaparral M	Chaparral H	Vulcan L	Vulcan M	Vulcan H
IDCOR	80	75	70	80	75	70	80	75	70
FIDCOR	80	75	70	80	75	70	80	75	70
HIDCOR	85	80	75	85	80	75	85	80	75
FENG	20	25	30	20	25	30	20	25	30
HENG	85	80	75	85	80	75	85	80	75
PKILL	80	75	65	80	75	65	80	75	65
FKILL	20	25	30	20	25	30	20	25	30
HKILL	70	60	50	70	60	50	70	60	50
ORD	55	35	15	55	35	15	55	35	15
HITS*	-	-	-	-	-	-	10	8	6

* Refers to Vulcan weapon (Number represents rounds on target)

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APPENDIX A: SUMMARY STATISTICS FOR SUMMER, 1989 RADES TESTS

Table A-1

Identification Accuracy

WEAPON	TYPE	TARGET	MODEL	MEAN	SD	N
STNG	FW	---	A7	.43	.51	14
STNG	FW	---	MiG27	1.0	0	15
STNG	FW	---	Su24	.93	.27	14
STNG	FW	---	Su25	1.0	0	14
CHAP	FW	---	A7	.35	.49	20
CHAP	FW	---	MiG27	.89	.32	27
CHAP	FW	---	Su24	.79	.41	24
CHAP	FW	---	Su25	.79	.41	24
VULC	FW	---	A7	.26	.45	23
VULC	FW	---	MiG27	.89	.32	18
VULC	FW	---	Su24	.90	.30	21
VULC	FW	---	Su25	.79	.41	24
STNG	RW	1	AH64	.44	.51	16
STNG	RW	1	CH3	.44	.51	16
STNG	RW	2	CH3	.45	.52	11
STNG	RW	1	UH1	.56	.53	9
STNG	RW	2	UH1	.42	.51	12
STNG	RW	1	Mi8	.92	.28	13
STNG	RW	2	Mi8	.81	.40	32
STNG	RW	3	Mi8	.68	.48	25
STNG	RW	1	Mi24	.93	.27	14
STNG	RW	2	Mi24	.85	.38	13
STNG	RW	1	Mi28	.86	.36	28
STNG	RW	1	Ka?	.64	.51	13
STNG	RW	2	Ka?	.77	.44	13
CHAP	RW	1	AH64	.22	.42	27
CHAP	RW	1	CH3	.30	.47	23
CHAP	RW	2	CH3	.10	.30	21
CHAP	RW	1	UH1	.59	.50	27
CHAP	RW	2	UH1	.50	.52	12
CHAP	RW	3	UH1	.33	.58	3
CHAP	RW	1	Mi8	.85	.34	24
CHAP	RW	2	Mi8	.66	.48	44
CHAP	RW	3	Mi8	.19	.40	36
CHAP	RW	1	Mi24	.71	.46	24
CHAP	RW	2	Mi24	.82	.39	22
CHAP	RW	1	Mi28	.73	.45	48
CHAP	RW	1	Ka?	.80	.41	15
CHAP	RW	2	Ka?	.30	.47	23

Table A-1 (Continued)

WEAPON	TYPE	TARGET	MODEL	MEAN	SD	N
VULC	RW	1	AH1	.87	.34	23
VULC	RW	1	CH3	.14	.35	29
VULC	RW	2	CH3	.11	.32	19
VULC	RW	1	UH1	.62	.49	24
VULC	RW	2	UH1	.78	.43	18
VULC	RW	3	UH1	.50	.55	6
VULC	RW	1	Mi8	.81	.40	21
VULC	RW	2	Mi8	.84	.37	38
VULC	RW	3	Mi8	.49	.51	37
VULC	RW	1	Mi24	.83	.38	48
VULC	RW	2	Mi24	.96	.21	23
VULC	RW	1	Mi28	.52	.51	27
VULC	RW	2	Mi28	.52	.51	40
VULC	RW	3	Mi28	.00	0	3
VULC	RW	1	Ka?	.81	.40	21
VULC	RW	2	Ka?	.62	.49	24

Table A-2

Descriptive Statistics: Stinger FW Event Ranges

VAR	SCEN	MEAN	SD	N
RDET	ALL	9.4	3.7	56
	1	6.7	1.6	15
	2	12.Ø	2.4	14
	3	1Ø.8	4.Ø	13
	4	8.4	3.8	14
RIFF	ALL	8.1	4.2	57
	1	6.4	3.Ø	15
	2	9.9	4.6	14
	3	1Ø.5	3.8	14
	4	5.9	3.7	14
RID	ALL	3.8	2.3	55
	1	3.4	2.1	15
	2	3.9	1.5	14
	3	4.3	2.4	12
	4	3.7	3.1	14
RACQ	ALL	4.7	3.Ø	4Ø
	1	3.6	2.3	1Ø
	2	5.Ø	3.6	12
	3	6.3	2.8	8
	4	4.2	2.8	1Ø
RLOCK*	ALL	2.9	1.7	51
	1	3.2	2.1	15
	2	3.3(1.8)	2.Ø(Ø.3)	11(3)
	3	2.7	1.7	9
	4	2.5	Ø.8	13
RFIRE*	ALL	2.7	1.5	47
	1	3.1(3.5)	2.1(Ø)	14(1)
	2	2.6(2.2)	1.3(Ø.4)	11(3)
	3	3.3	1.6	7
	4	2.1	Ø.6	11

* Represents aircraft ranges which were either ingressing or egressing

Table A-3

Descriptive Statistics: Chaparral FW Event Ranges

VAR	SCEN	MEAN	SD	N
RDET	ALL	5.4	3.3	94
	1	5.1	2.6	27
	2	6.6	4.1	24
	3	5.3	3.4	19
	4	4.7	2.7	24
RIFF	ALL	3.8	2.7	59
	1	4.Ø	2.1	15
	2	4.6	3.6	16
	3	3.4	2.5	12
	4	3.5	2.4	15
RID*	ALL	2.9	1.7	94
	1	3.4	2.1	27
	2	3.3(2.4)	1.9(Ø.8)	17(7)
	3	2.7(4.8)	1.7(Ø)	18(1)
	4	2.3	1.Ø	24
RACQ	ALL	3.4	2.2	49
	1	3.8	2.2	13
	2	3.8	2.9	15
	3	2.5	1.5	9
	4	3.Ø	1.4	11
RFIRE*	ALL	3.1	2.2	51
	1	3.5(3.9)	2.Ø(Ø)	16(1)
	2	3.7(2.Ø)	3.1(1.Ø)	13(3)
	3	2.6(4.Ø)	1.3(3.2)	7(2)
	4	1.8	Ø.7	9

* Represents aircraft ranges which were either ingressing or egressing

Table A-4

Descriptive Statistics: Vulcan FW Event Ranges

VAR	SCEN	MEAN	SD	N
RDET	ALL	6.3	4.1	84
	1	4.1	3.2	18
	2	7.6	4.2	24
	3	8.1	4.4	19
	4	5.2	3.4	21
RID	ALL	2.5	1.4	82
	1	1.9	0.9	17
	2	2.5	1.2	23
	3	2.6	1.6	19
	4	2.9	1.5	21
RFIRE*	ALL	1.8(2.3)	1.4(1.1)	86(67)
	1	1.9(2.0)	1.4(0.9)	18(16)
	2	1.2(2.1)	1.1(1.0)	23(15)
	3	2.0(2.2)	1.2(0.9)	21(16)
	4	2.2(2.5)	1.8(1.4)	21(17)

* Represents aircraft ranges from BT-53 output versus MRADES.

Table A-5

Descriptive Statistics: Stinger RW Event Times

VAR	SCEN	TARGET	MEAN	SD	N
TDET	ALL	1	8.2	6.6	103
	5	1	5.2	3.4	13
	6	1	5.6	5.1	13
	7	1	11.4	6.5	8
	8	1	7.5	6.9	13
	9	1	5.8	2.0	15
	10	1	5.1	9.1	14
	11	1	10.8	6.5	14
	12	1	5.4	4.3	13
	ALL	2	39.5	15.5	71
	3	2	60.7	7.4	12
	4	2	53.6	7.1	12
	7	2	29.1	7.6	13
	10	2	32.5	4.2	8
	11	2	30.7	13.9	13
	12	2	30.5	8.3	13
	ALL	3	41.7	7.1	15
	11	3	41.8	6.2	6
	12	3	41.6	8.0	9
TIFF	ALL	1	5.0	6.4	73
	5	1	3.2	3.4	10
	6	1	3.7	4.8	10
	7	1	5.2	4.4	6
	8	1	5.7	8.1	9
	9	1	4.2	4.7	11
	10	1	4.4	5.4	8
	11	1	4.9	7.7	8
	12	1	8.4	9.7	11
	ALL	2	4.5	5.1	56
	3	2	7.5	6.1	11
	4	2	4.6	5.1	10
	7	2	2.6	4.0	8
	10	2	1.6	1.8	7
	11	2	4.6	6.6	9
	12	2	4.8	4.1	11
	ALL	3	4.8	8.1	13
	11	3	1.6	1.5	5
	12	3	6.9	10.0	8

Table A-5 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TID	ALL	1	8.5	7.1	89
	5	1	5.8	4.0	13
	6	1	3.7	1.4	13
	7	1	8.4	6.1	5
	8	1	11.2	6.1	11
	9	1	17.3	8.7	12
	10	1	7.6	2.4	13
	11	1	9.5	11.5	10
	12	1	5.8	3.2	12
	ALL	2	6.0	4.3	62
	3	2	8.9	5.7	10
	4	2	5.0	2.6	11
	7	2	3.5	1.8	12
	10	2	8.6	4.9	8
	11	2	6.3	4.2	12
	12	2	4.6	3.6	9
	ALL	3	5.7	3.0	13
	11	3	6.3	2.1	6
	12	3	5.1	3.6	7
TACQ	ALL	1	6.6	5.3	35
	5	1	7.2	5.1	5
	6	1	3.6	1.7	5
	7	1	2.0	0	1
	8	1	6.4	6.8	7
	9	1	8.4	7.6	5
	10	1	7.1	4.9	9
	11	1	13.0	0	1
	12	1	5.5	3.5	2
	ALL	2	6.8	6.6	17
	3	2	4.0	2.6	3
	4	2	5.5	4.1	4
	7	2	5.7	2.1	3
	10	2	3.0	0	1
	11	2	7.3	5.8	3
	12	2	13.0	13.9	3

Table A-5 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TLOCK	ALL	1	5.7	3.4	31
	5	1	7.8	6.9	5
	6	1	5.0	1.5	6
	7	1	4.0	0	1
	8	1	6.8	3.0	4
	9	1	6.8	3.8	4
	10	1	4.7	1.0	8
	11	1	4.0	0	2
	12	1	3.0	0	1
	ALL	2	9.0	8.8	13
	3	2	13.3	10.7	3
	4	2	5.0	1.0	3
	7	2	7.5	2.1	2
	11	2	12.7	15.9	3
	12	2	4.5	2.1	2
	12	3	5.0	1.7	3
THAND	ALL	1	5.3	3.8	60
	5	1	5.3	4.4	9
	6	1	6.1	4.4	13
	7	1	3.0	0	1
	8	1	5.7	3.3	6
	9	1	5.5	4.1	4
	10	1	6.4	4.8	11
	11	1	3.2	1.6	5
	12	1	3.9	2.3	11
	ALL	2	4.9	3.8	44
	3	2	6.3	4.4	7
	4	2	3.6	2.1	11
	7	2	5.0	4.7	9
	10	2	2.0	0	1
	11	2	7.4	4.9	7
	12	2	3.6	2.2	9
	ALL	3	6.3	5.2	12
	11	3	5.0	2.8	6
	12	3	7.7	6.8	6

Table A-5 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TFIRE	ALL	1	9.3	5.6	27
	5	1	8.0	2.6	5
	6	1	8.5	4.2	6
	7	1	5.0	0	1
	8	1	8.5	0.7	2
	9	1	8.3	4.0	3
	10	1	10.0	4.8	7
	11	1	19.5	16.3	2
	12	1	5.0	0	1
	ALL	2	5.8	4.3	16
	3	2	8.5	6.4	2
	4	2	6.5	0.7	3
	7	2	8.3	5.0	3
	11	2	6.3	2.5	3
	12	2	6.5	2.1	2
	12	3	10.3	9.1	3
TTOT	ALL	1	11.3	6.2	60
	5	1	9.8	8.0	9
	6	1	9.6	4.6	12
	7	1	7.5	4.9	2
	8	1	14.2	3.4	6
	9	1	17.3	4.9	4
	10	1	14.0	5.0	11
	11	1	9.3	9.8	7
	12	1	9.9	4.2	9
	ALL	2	8.6	5.2	47
	3	2	12.9	6.5	7
	4	2	7.6	3.1	11
	7	2	8.3	5.6	9
	10	2	13.0	0	1
	11	2	11.6	4.6	8
	12	2	4.6	3.1	11
	ALL	3	10.5	5.8	11
	11	3	12.2	3.8	5
	12	3	9.0	7.2	6

Table A-6

Descriptive Statistics: Chaparral RW Event Times

VAR	SCEN	TARGET	MEAN	SD	N
TDET	ALL	1	8.2	6.4	181
	5	1	3.9	2.8	23
	6	1	5.7	3.0	23
	7	1	10.4	5.4	20
	8	1	10.4	5.4	22
	9	1	9.5	7.9	23
	10	1	9.0	7.3	23
	11	1	13.0	8.0	24
	12	1	4.0	1.0	23
	ALL	2	39.5	14.2	96
	3	2	59.3	7.5	10
	4	2	52.0	8.5	21
	7	2	32.2	6.6	21
	10	2	25.4	7.0	8
	11	2	34.0	12.1	22
	12	2	34.1	12.5	14
	ALL	3	43.2	10.0	16
	11	3	40.1	9.5	11
	12	3	50.0	8.1	5
TIFF	ALL	1	6.7	6.7	112
	5	1	6.3	5.1	14
	6	1	4.3	3.8	16
	7	1	8.3	5.4	13
	8	1	8.8	7.7	12
	9	1	4.7	3.5	15
	10	1	6.3	8.8	15
	11	1	7.1	5.3	11
	12	1	8.8	10.4	16
	ALL	2	7.7	6.8	51
	3	2	14.7	11.7	3
	4	2	7.7	4.4	14
	7	2	4.2	3.8	11
	10	2	5.6	3.0	5
	11	2	12.0	8.6	6
	12	2	7.8	8.6	12
	ALL	3	9.2	6.8	6
	11	3	12.3	8.5	3
	12	3	6.0	3.6	3

Table A-6 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TID	ALL	1	10.6	8.2	163
	5	1	6.7	5.1	20
	6	1	8.3	3.9	23
	7	1	13.8	7.2	19
	8	1	10.1	3.1	18
	9	1	12.6	4.1	19
	10	1	10.0	7.0	22
	11	1	12.9	10.7	19
	12	1	11.2	14.9	23
	ALL	2	6.9	5.5	90
	3	2	7.3	5.5	8
	4	2	8.4	6.4	21
	7	2	3.9	2.9	19
	10	2	7.1	1.4	8
	11	2	8.9	7.3	20
	12	2	5.7	3.5	14
	ALL	3	5.8	4.6	10
	11	3	4.0	3.6	7
	12	3	10.0	4.6	3
TACQ	ALL	1	8.7	7.9	61
	5	1	5.1	4.6	8
	6	1	10.1	6.4	9
	7	1	9.0	6.0	7
	8	1	10.7	9.0	7
	9	1	5.6	4.2	9
	10	1	4.4	3.4	7
	11	1	8.5	7.2	6
	12	1	15.8	13.9	8
	ALL	2	11.9	7.6	29
	3	2	14.7	11.7	3
	4	2	11.0	5.8	8
	7	2	9.0	6.7	5
	10	2	5.0	3.0	3
	11	2	16.0	9.0	3
	12	2	15.0	8.4	7

Table A-6 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
THAND	ALL	1	8.2	8.1	60
	5	1	8.2	6.3	9
	6	1	4.6	5.6	9
	7	1	2.7	2.3	3
	8	1	9.0	2.5	6
	9	1	5.1	2.5	7
	10	1	9.8	9.7	8
	11	1	14.8	9.4	5
	12	1	9.8	11.6	13
	ALL	2	6.2	6.2	37
	3	2	1.0	1.4	2
	4	2	8.8	10.3	6
	7	2	5.7	4.9	12
	10	2	1.0	0	1
	11	2	7.5	5.7	6
	12	2	6.1	5.8	10
	11	3	5.3	0.6	3
TFIRE	ALL	1	8.6	7.5	33
	5	1	3.0	1.4	4
	6	1	8.8	7.7	5
	7	1	4.0	4.2	2
	8	1	12.0	10.5	3
	9	1	10.2	6.1	5
	10	1	12.0	11.8	6
	11	1	8.3	4.0	3
	12	1	7.0	6.2	5
	ALL	2	6.9	5.7	13
	3	2	9.0	0	1
	4	2	5.0	1.4	2
	7	2	6.8	5.3	4
	10	2	3.5	4.9	2
	11	2	7.7	9.9	3
	12	2	14.0	0	1
TTOT	ALL	1	14.2	9.4	79
	5	1	11.5	6.4	14
	6	1	10.8	8.0	11
	7	1	9.5	4.5	6
	8	1	19.3	3.9	6
	9	1	16.3	4.9	8
	10	1	18.1	12.3	11
	11	1	14.3	8.0	8
	12	1	15.0	13.8	15
	ALL	2	10.7	8.1	49
	3	2	5.0	4.3	5
	4	2	11.6	8.2	10
	7	2	9.0	5.9	14
	10	2	7.0	2.8	2
	11	2	16.4	13.5	8
	12	2	11.4	4.9	10
	11	3	7.5	3.7	4

Table A-7

Descriptive Statistics: Vulcan RW Event Times

VAR	SCEN	TARGET	MEAN	SD	N
TDET	ALL	1	6.5	5.2	188
	5	1	3.9	2.5	24
	6	1	2.8	1.0	24
	7	1	6.1	2.6	21
	8	1	12.8	8.3	24
	9	1	9.0	6.5	23
	10	1	5.6	3.1	24
	11	1	7.8	2.8	24
	12	1	4.2	2.1	24
	ALL	2	33.4	17.8	145
	3	2	64.6	6.6	18
	4	2	53.6	7.1	21
	8	2	31.3	4.1	23
	9	2	23.4	5.8	16
	10	2	16.8	4.3	21
	11	2	25.4	9.2	23
	12	2	23.0	11.8	23
	ALL	3	33.3	11.2	26
	11	3	35.9	9.5	12
	12	3	31.0	12.4	14
TID	ALL	1	7.7	6.0	178
	5	1	9.1	5.6	23
	6	1	6.2	4.1	24
	7	1	6.2	3.8	21
	8	1	11.6	6.7	19
	9	1	6.5	4.6	23
	10	1	6.5	6.3	22
	11	1	10.0	9.2	23
	12	1	6.0	4.1	23
	ALL	2	5.9	5.9	133
	3	2	7.3	6.2	16
	4	2	6.6	3.7	19
	8	2	3.8	3.7	20
	9	2	5.4	3.2	16
	10	2	8.0	8.1	21
	11	2	5.1	6.5	20
	12	2	5.4	6.8	21
	ALL	3	4.3	3.1	24
	11	3	4.4	2.7	11
	12	3	4.2	3.4	13

Table A-7 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
THAND	ALL	1	3.7	3.5	81
	5	1	3.8	3.3	10
	6	1	3.7	2.8	19
	7	1	4.8	5.0	10
	8	1	0.3	0.6	3
	9	1	4.1	3.2	14
	10	1	4.0	4.2	2
	11	1	3.2	2.0	9
	12	1	3.3	4.4	14
	ALL	2	5.5	4.9	68
	3	2	4.6	4.4	11
	4	2	8.3	4.9	7
	8	2	5.5	5.2	14
	9	2	3.5	2.8	10
	10	2	8.1	5.8	14
	11	2	3.5	5.0	6
	12	2	3.0	2.5	6
	ALL	3	4.5	3.7	8
	11	3	5.5	3.7	6
	12	3	1.5	2.1	2
TFIRE	ALL	1	9.0	5.5	40
	5	1	11.3	5.6	7
	6	1	6.9	3.5	9
	7	1	7.3	3.8	7
	9	1	12.0	5.7	7
	11	1	4.0	5.7	2
	12	1	9.3	7.2	8
	ALL	2	8.6	5.7	24
	3	2	8.5	4.0	4
	4	2	13.4	8.4	5
	8	2	8.9	5.3	7
	9	2	6.7	3.2	3
	11	2	1.0	0	1
	12	2	5.8	1.9	4
	11	3	9.0	1.7	3

Table A-7 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TTOT	ALL	1	8.4	5.3	107
	5	1	9.8	6.3	15
	6	1	8.3	3.7	20
	7	1	7.7	4.8	15
	8	1	11.8	11.3	4
	9	1	9.3	5.9	19
	10	1	7.7	2.5	3
	11	1	6.0	3.2	13
	12	1	8.3	5.9	18
	ALL	2	7.8	6.7	92
	3	2	8.8	4.2	14
	4	2	9.5	9.3	10
	8	2	6.3	5.6	19
	9	2	7.7	2.7	11
	10	2	12.4	9.6	16
	11	2	4.4	5.5	11
	12	2	4.4	2.6	11
	ALL	3	6.5	3.7	10
	11	3	8.5	3.1	6
	12	3	3.5	2.1	4

Table A-8

Descriptive Statistics: Stinger FW Summary Performance

VAR	SCEN	MEAN	SD	N
IDCOR	ALL	.84	.37	57
FIDCOR	3	.43	.51	14
HIDCOR	ALL	.98	.15	43
	1	1.0	0	15
	2	1.0	0	14
	4	.93	.27	14
FENG	3	.50	.52	14
HENG	ALL	.93	.26	43
	1	1.0	0	15
	2	1.0	0	14
	4	.79	.43	14
PKILL	ALL	.65	.48	57
FKILL	3	.29	.47	14
HKILL	ALL	.77	.43	43
	1	.67	.49	15
	2	1.0	0	14
	4	.64	.50	14
ORD	ALL	.98	.15	43
	1	.93	.26	15
	2	1.0	0	14
	4	1.0	0	14
TRACK	ALL	.90	.22	39

Table A-9

Descriptive Statistics: Chaparral FW Summary Performance

VAR	SCEN	MEAN	SD	N
IDCOR	ALL	.73	.45	95
FIDCOR	3	.35	.49	20
HIDCOR	ALL	.83	.38	75
	1	.89	.32	27
	2	.79	.41	24
	4	.79	.41	24
FENG	3	.45	.51	20
HENG	ALL	.56	.50	75
	1	.63	.49	27
	2	.67	.48	24
	4	.38	.49	24
PKILL	ALL	.78	.42	49
FKILL	3	.35	.49	20
HKILL	ALL	.41	.50	75
	1	.44	.51	27
	2	.50	.51	24
	4	.29	.47	24
ORD	ALL	.92	.27	75
	1	.81	.40	27
	2	.95	.20	24
	4	1.0	0	24
TRACK	ALL	.86	.26	31

Table A-10

Descriptive Statistics: Vulcan FW Summary Performance

VAR	SCEN	MEAN	SD	N
IDCOR	ALL	.70	.46	86
FIDCOR	3	.26	.45	23
HIDCOR	ALL	.86	.35	63
	1	.89	.32	18
	2	.79	.41	24
	4	.90	.30	21
FENG	3	.78	.42	23
HENG	ALL	.78	.42	63
	1	.89	.32	18
	2	.67	.48	24
	4	.81	.40	21
PKILL*	ALL	.60(.04)	.49(.26)	67
FKILL	3	.39	.50	23
HKILL	ALL	.49	.50	63
	1	.61	.50	18
	2	.46	.51	24
	4	.43	.51	21
ORD	ALL	1.0	0	63
AVEMISS	ALL	2.2	3.7	86
HITS	ALL	1.2	4.1	86
	1	0.4	1.3	18
	2	2.2	6.5	24
	3	0.9	3.6	20
	4	1.3	1.2	3
BURSTS	ALL	1.6	1.7	86

* Represents Pk from MRADES output versus BT-53

Table A-11

Descriptive Statistics: Stinger RW Summary Performance

VAR	SCEN	TARGET	MEAN	SD	N
IDCOR	ALL	ALL	.68	.47	226
	ALL	1	.70	.46	109
	ALL	2	.70	.46	31
	ALL	3	.64	.49	28
FIDCOR	ALL	ALL	.43	.50	72
	ALL	1	.47	.50	41
	ALL	2	.43	.51	23
	ALL	3	.50	.71	2
	7	--	.36	.50	14
	8	--	.36	.50	14
	9	--	.44	.51	16
	10	--	.57	.51	14
	11	--	.43	.51	14
HIDCOR	ALL	ALL	.79	.41	154
	ALL	1	.84	.37	68
	ALL	2	.81	.40	58
	ALL	3	.65	.49	26
	3	--	.79	.43	14
	4	--	.93	.27	14
	5	--	.79	.43	14
	6	--	.93	.27	14
	7	--	.79	.43	14
	10	--	.36	.36	14
	11	ALL	.64	.49	28
	12	ALL	.79	.42	42
FENG	ALL	ALL	.38	.49	72
	ALL	1	.39	.49	41
	ALL	2	.43	.51	23
	ALL	3	0	0	2
	7	--	.29	.47	14
	8	--	.50	.52	14
	9	--	.31	.48	16
	10	--	.21	.43	14
	11	--	.57	.51	14
HENG	ALL	ALL	.73	.44	154
	ALL	1	.75	.44	68
	ALL	2	.76	.43	58
	ALL	3	.65	.49	26
	3	--	.57	.51	14
	4	--	.36	.36	14
	5	--	.71	.47	14
	6	--	.93	.27	14
	7	--	.79	.43	14
	10	--	.71	.47	14
	11	ALL	.61	.50	28
	12	ALL	.76	.43	42

Table A-11 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
PKILL	ALL	ALL	.86	.35	138
	ALL	1	.91	.29	67
	ALL	2	.83	.38	54
	ALL	3	.76	.44	17
FKILL	ALL	ALL	.33	.47	72
	ALL	1	.37	.49	41
	ALL	2	.35	.49	23
	ALL	3	Ø	Ø	2
	7	--	.29	.47	14
	8	--	.43	.51	14
	9	--	.31	.48	16
	1Ø	--	.21	.43	14
	11	--	.43	.51	14
HKILL	ALL	ALL	.64	.48	154
	ALL	1	.68	.47	68
	ALL	2	.64	.48	58
	ALL	3	.5Ø	.51	26
	3	--	.29	.47	14
	4	--	.86	.36	14
	5	--	.5Ø	.52	14
	6	--	.93	.27	14
	7	--	.71	.47	14
	1Ø	--	.64	.5Ø	14
	11	ALL	.54	.51	28
	12	ALL	.67	.48	42
ORD	ALL	ALL	.74	.44	152
	ALL	1	.54	.5Ø	68
	ALL	2	.84	.37	58
	ALL	3	1.Ø	Ø	26
	3	--	1.Ø	Ø	14
	4	--	1.Ø	Ø	14
	5	--	.71	.47	14
	6	--	.21	.43	14
	7	--	.36	.5Ø	14
	1Ø	--	.86	.36	14
	11	ALL	.82	.39	28
	12	ALL	.79	.42	42
TRACK	ALL	ALL	.98	.11	87

Table A-12

Descriptive Statistics: Chaparral RW Summary Performance

VAR	SCEN	TARGET	MEAN	SD	N
IDCOR	ALL	ALL	.49	.50	379
	ALL	1	.61	.49	188
	ALL	2	.51	.50	122
	ALL	3	.21	.41	39
FIDCOR	ALL	ALL	.32	.47	120
	ALL	1	.38	.49	77
	ALL	2	.24	.44	33
	ALL	3	.33	.58	3
	7	--	.52	.51	23
	8	--	.32	.48	22
	9	--	.22	.42	27
	10	--	.08	.28	24
	11	--	.46	.51	24
HIDCOR	ALL	ALL	.58	.50	259
	ALL	1	.78	.43	111
	ALL	2	.61	.49	89
	ALL	3	.19	.40	36
	3	--	.25	.44	20
	4	--	.71	.46	24
	5	--	.67	.48	24
	6	--	.71	.46	24
	7	--	.78	.42	23
	10	--	.87	.34	24
	11	ALL	.50	.51	48
	12	ALL	.43	.50	72
FENG	ALL	ALL	.25	.43	120
	ALL	1	.30	.46	77
	ALL	2	.21	.42	33
	ALL	3	0	0	3
	7	--	.30	.47	23
	8	--	.27	.46	22
	9	--	.30	.47	27
	10	--	.09	.28	24
	11	--	.29	.46	24
HENG	ALL	ALL	.43	.50	259
	ALL	1	.53	.50	111
	ALL	2	.48	.50	89
	ALL	3	.17	.38	36
	3	--	.35	.49	20
	4	--	.46	.51	24
	5	--	.58	.50	24
	6	--	.46	.51	24
	7	--	.61	.50	23
	10	--	.50	.51	24
	11	ALL	.29	.46	48
	12	ALL	.39	.49	72

Table A-12 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
PKILL	ALL	ALL	.56	.50	135
	ALL	1	.59	.49	79
	ALL	2	.50	.51	48
	ALL	3	.50	.55	6
FKILL	ALL	ALL	.07	.25	120
	ALL	1	.08	.27	77
	ALL	2	.06	.24	33
	ALL	3	0	0	3
	7	--	.17	.39	23
	8	--	0	0	22
	9	--	0	0	27
	10	--	0	0	24
	11	--	.17	.38	24
HKILL	ALL	ALL	.26	.44	259
	ALL	1	.37	.48	111
	ALL	2	.25	.43	89
	ALL	3	.08	.28	36
	3	--	.20	.41	20
	4	--	.29	.46	24
	5	--	.42	.51	24
	6	--	.29	.46	24
	7	--	.39	.50	23
	10	--	.25	.44	24
	11	ALL	.15	.36	48
	12	ALL	.25	.44	72
ORD	ALL	ALL	.85	.35	259
	ALL	1	.72	.45	111
	ALL	2	.93	.25	89
	ALL	3	1.0	0	36
	3	--	1.0	0	20
	4	--	.96	.20	24
	5	--	.58	.50	24
	6	--	.71	.46	24
	7	--	.74	.45	23
	10	--	.83	.38	24
	11	ALL	1.0	0	48
	12	ALL	.86	.35	72
TRACK	ALL	ALL	.92	.18	64

Table A-13

Descriptive Statistics: Vulcan RW Summary Performance

VAR	SCEN	TARGET	MEAN	SD	N
IDCOR	ALL	ALL	.63	.48	402
	ALL	1	.66	.48	193
	ALL	2	.65	.48	162
	ALL	3	.47	.50	47
FIDCOR	ALL	ALL	.48	.50	120
	ALL	1	.51	.50	76
	ALL	2	.42	.50	38
	ALL	3	.50	.55	6
	7	--	.12	.34	24
	8	--	.62	.49	24
	9	--	.12	.34	24
	10	--	.83	.38	24
	11	--	.71	.46	24
HIDCOR	ALL	ALL	.70	.46	282
	ALL	1	.75	.43	117
	ALL	2	.73	.45	124
	ALL	3	.47	.50	41
	3	--	.75	.44	20
	4	--	.58	.51	21
	5	--	.48	.51	25
	6	--	.83	.38	24
	8	--	.92	.28	24
	9	--	.79	.41	24
	10	--	.83	.38	24
	11	ALL	.62	.49	48
	12	ALL	.65	.48	72
FENG	ALL	ALL	.38	.49	120
	ALL	1	.34	.48	76
	ALL	2	.50	.51	38
	ALL	3	.17	.41	6
	7	--	.67	.48	24
	8	--	.08	.28	24
	9	--	.54	.51	24
	10	--	.17	.38	24
	11	--	.46	.51	24
HENG	ALL	ALL	.71	.45	282
	ALL	--	.73	.45	117
	ALL	--	.77	.42	124
	ALL	--	.49	.51	41
	3	--	.80	.41	20
	4	--	.67	.48	21
	5	--	.60	.50	25
	6	--	.83	.38	24
	8	--	1.0	0	24
	9	--	.79	.41	24
	10	ALL	.71	.46	24
	11	ALL	.52	.50	48
	12	ALL	.71	.46	72

Table A-13 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
PKILL*	ALL	ALL	.73(.22)	.46(.41)	247(402)
	ALL	1	.84(.21)	.37(.41)	111(193)
	ALL	2	.63(.24)	.48(.43)	115(162)
	ALL	3	.67(.15)	.48(.36)	21(47)
FKILL	ALL	ALL	.21	.41	120
	ALL	1	.25	.44	76
	ALL	2	.16	.37	38
	ALL	3	0	0	6
	7	--	.54	.51	24
	8	--	0	0	24
	9	--	.38	.49	24
	10	--	.13	.34	24
	11	--	0	0	24
HKILL	ALL	ALL	.55	.50	282
	ALL	1	.63	.48	117
	ALL	2	.54	.50	124
	ALL	3	.34	.48	41
	3	--	.65	.49	20
	4	--	.62	.50	21
	5	--	.48	.51	25
	6	--	.83	.38	24
	8	--	1.0	0	24
	9	--	.50	.51	24
	10	--	0	0	24
	11	ALL	.35	.48	48
	12	ALL	.61	.49	72
ORD	ALL	ALL	.60	.49	282
	ALL	1	.42	.50	117
	ALL	2	.66	.48	124
	ALL	3	.95	.22	41
	3	--	.90	.31	20
	4	--	.48	.51	21
	5	--	.52	.51	25
	6	--	.17	.38	24
	8	--	.04	.20	24
	9	--	.79	.41	24
	10	--	1.0	0	24
	11	ALL	.75	.44	48
	12	ALL	.63	.49	72
AVEMISS	ALL	ALL	.45	.66	402
	ALL	1	.48	.54	193
	ALL	2	.48	.82	162
	ALL	3	.24	.45	47

* Represents Pk from MRADES output versus BT-53 Laser (BT-53 considered more accurate)

Note: HKILL & FKILL based on MRADES calculations

Table A-13 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
HITS	ALL	ALL	7.6	16.0	402
	ALL	1	7.2	15.2	193
	ALL	2	8.8	17.3	162
	ALL	3	5.3	14.3	47
BURSTS	ALL	ALL	1.2	1.3	403
	ALL	1	1.3	1.3	193
	ALL	2	1.3	1.4	163
	ALL	3	0.7	1.2	47

APPENDIX B: SUMMARY STATISTICS FOR FALL, 1989 RTS TESTS

Table B-1

Identification Accuracy

WEAPON	TYPE	TARGET	MODEL	MEAN	SD	N
STNG	FW	---	A7	.37	.52	8
STNG	FW	---	A1Ø	.9Ø	.32	1Ø
STNG	FW	---	F16	.72	.46	18
STNG	FW	---	MiG27	.97	.17	36
STNG	FW	---	SU17	1.Ø	Ø	9
STNG	FW	---	SU25	.82	.4Ø	11
CHAP	FW	---	A7	.67	.58	3
CHAP	FW	---	A1Ø	1.Ø	Ø	3
CHAP	FW	---	F16	.43	.53	7
CHAP	FW	---	MiG27	.85	.38	13
CHAP	FW	---	SU17	.67	.58	3
CHAP	FW	---	SU25	1.Ø	Ø	3
STNG	RW	1	AH1	.43	.53	7
STNG	RW	1	AH64	Ø	Ø	1
STNG	RW	2	AH64	.67	.5Ø	9
STNG	RW	3	AH64	.33	.58	3
STNG	RW	2	CH3	.2Ø	.45	5
STNG	RW	3	CH3	.4Ø	.55	5
STNG	RW	2	UH1	.75	.45	12
STNG	RW	3	UH1	.86	.38	7
STNG	RW	1	Mi8	.88	.33	5Ø
STNG	RW	2	Mi8	1.Ø	Ø	2Ø
STNG	RW	3	Mi8	.75	.5Ø	4
STNG	RW	1	Mi24	.63	.49	38
STNG	RW	2	Mi24	.59	.5Ø	22
STNG	RW	3	Mi24	.83	.41	6
STNG	RW	1	Mi28	.55	.5Ø	1Ø
STNG	RW	2	Mi28	.58	.5Ø	38
STNG	RW	3	Mi28	.32	.48	22

Table B-1 (Continued)

WEAPON	TYPE	TARGET	MODEL	MEAN	SD	N
CHAP	RW	1	AH1	.50	.71	2
CHAP	RW	2	AH64	.43	.53	7
CHAP	RW	2	CH3	1.0	0	1
CHAP	RW	3	CH3	0	0	1
CHAP	RW	2	UH1	.50	.58	4
CHAP	RW	3	UH1	.50	.71	2
CHAP	RW	1	Mi8	.69	.48	16
CHAP	RW	2	Mi8	1.0	0	6
CHAP	RW	3	Mi8	1.0	0	2
CHAP	RW	1	Mi24	.53	.51	17
CHAP	RW	2	Mi24	1.0	0	4
CHAP	RW	3	Mi24	.33	.58	3
CHAP	RW	1	Mi28	.73	.46	15
CHAP	RW	2	Mi28	.67	.49	12
CHAP	RW	3	Mi28	.44	.53	9
VULC	RW	1	AH1	.25	.46	8
VULC	RW	3	AH1	1.0	0	6
VULC	RW	2	AH64	.60	.55	5
VULC	RW	1	CH3	.69	.48	16
VULC	RW	1	UH1	1.0	0	1
VULC	RW	2	UH1	1.0	0	4
VULC	RW	3	UH1	1.0	0	9
VULC	RW	1	Mi8	.92	.28	13
VULC	RW	2	Mi8	.81	.40	27
VULC	RW	3	Mi8	1.0	0	2
VULC	RW	1	Mi24	.95	.23	38
VULC	RW	2	Mi24	1.0	0	8
VULC	RW	3	Mi24	1.0	0	4
VULC	RW	1	Mi28	.55	.51	20
VULC	RW	2	Mi28	1.0	0	8
VULC	RW	3	Mi28	.71	.49	7

Table B-2

Descriptive Statistics: Stinger FW Event Ranges

VAR	SCEN	MEAN	SD	N
RDET	ALL	9.5	3.8	73
	1	11.2	3.3	18
	2	6.9	3.4	9
	3	10.8	3.8	11
	4	7.3	2.6	8
	5	6.9	2.5	9
	6	13.0	3.5	10
	7	7.2	1.5	8
RIFF	ALL	8.5	5.2	73
	1	10.1	4.2	18
	2	8.1	4.1	9
	3	11.0	3.8	11
	4	4.4	6.4	8
	5	6.8	3.0	9
	6	11.3	3.3	10
	7	4.0	7.3	8

Table B-2 (Continued)

VAR	SCEN	MEAN	SD	N
RID*	ALL	3.8(3.4)	2.0(1.4)	55(18)
	1	3.8(3.3)	2.2(0.9)	10(8)
	2	2.5(2.3)	0.8(0)	8(1)
	3	4.8(5.3)	2.3(3.0)	9(2)
	4	3.8(4.3)	1.6(1.6)	6(2)
	5	3.3(2.5)	0.9(0.4)	7(2)
	6	5.5(2.5)	2.5(0.2)	8(2)
	7	2.9(2.7)	0.9(0)	7(1)
RACQ*	ALL	6.3(2.7)	3.0(0.8)	47(4)
	1	7.4(2.0)	2.6(0)	14(1)
	2	5.1	3.4	7
	3	7.5	2.4	7
	4	3.6(2.6)	0.8(0.1)	3(2)
	5	4.1	1.3	6
	6	9.0	3.1	6
	7	3.3(3.8)	0.9(0)	4(1)
RLOCK*	ALL	4.1(3.8)	2.0(2.1)	32(18)
	1	5.9(3.6)	3.2(0.8)	4(3)
	2	2.7(2.7)	0.8(0.6)	4(5)
	3	4.1	1.7	9
	4	5.1(4.9)	1.2(0.6)	2(3)
	5	3.0(2.8)	0.9(1.1)	6(3)
	6	6.6	0.5	3
	7	3.0(5.1)	0.9(4.1)	4(4)
RFIRE*	ALL	4.0(3.6)	1.8(2.1)	22(27)
	1	6.3(3.7)	3.2(1.1)	3(4)
	2	2.6(2.9)	0.8(0.8)	3(6)
	3	4.2(2.3)	1.2(0.5)	6(3)
	4	4.8(5.4)	1.0(0.4)	2(3)
	5	2.8	0.7	3
	6	5.2(2.8)	1.1(1.1)	2(6)
	7	2.6(5.1)	1.0(4.1)	3(5)

* Represents aircraft ranges which were either ingressing or egressing

Table B-3

Descriptive Statistics: Chaparral FW Event Ranges

VAR	SCEN	MEAN	SD	N
RDET	ALL	8.3	3.0	27
	1	9.2	3.3	7
	2	6.6	2.5	4
	3	8.0	2.9	3
	4	10.1	0.4	4
	5	3.5	0.9	3
	6	10.2	0.8	3
	7	8.9	3.7	3
RIFF	ALL	5.2	4.0	26
	1	6.8	3.1	7
	2	1.2	7.2	3
	3	6.7	1.9	3
	4	6.0	2.1	4
	5	2.5	1.2	3
	6	8.6	1.6	3
	7	4.5	1.5	3
RID*	ALL	4.4(1.9)	2.4(0.6)	23(2)
	1	4.7	3.2	7
	2	4.7(1.4)	2.0(0)	3(1)
	3	2.5	0.4	3
	4	6.0	2.2	3
	5	1.8(2.3)	0.4(0)	2(1)
	6	4.9	2.2	3
	7	4.7	1.0	2
RACQ	ALL	2.9	0.8	11
	1	2.2	0.5	2
	2	2.4	0.7	2
	3	3.2	0.5	3
	4	4.6	0	1
	5	2.4	0.5	2
	7	3.3	0	1
RFIRE*	ALL	3.7(2.1)	2.2(0.9)	15(3)
	1	5.0	2.9	4
	2	3.5(1.4)	1.1(0)	3(1)
	3	2.2(1.8)	0.3(0)	2(1)
	4	5.4	4.2	2
	5	1.7(3.1)	0(0)	1(1)
	7	3.0	0.8	3

* Represents aircraft ranges which were either ingressing or egressing

Table B-4

Descriptive Statistics: Stinger RW Event Times

VAR	SCEN	TARGET	MEAN	SD	N
TDET	ALL	1	6.3	5.6	140
	12	1	2.1	1.8	20
	13	1	4.1	1.0	11
	15	1	7.5	2.3	10
	16	1	8.5	3.2	10
	17	1	6.6	3.4	10
	18	1	8.5	2.7	10
	20	1	4.2	1.0	10
	23	1	7.0	4.2	10
	24	1	6.5	1.8	10
	27	1	6.7	2.7	9
	28	1	7.5	2.2	10
	31	1	13.3	16.7	10
	32	1	3.9	1.0	10
	ALL	2	22.4	13.5	113
	4	2	10.4	8.0	8
	5	2	8.3	3.6	9
	6	2	7.0	3.3	10
	7	2	25.9	20.2	8
	18	2	11.4	5.2	10
	20	2	30.6	9.8	10
	23	2	32.3	10.4	10
	24	2	30.0	5.3	10
	27	2	28.9	6.3	8
	28	2	26.8	7.7	10
	31	2	27.0	19.2	10
	32	2	28.9	8.1	10
	ALL	3	35.1	16.3	56
	6	3	24.6	9.3	10
	7	3	36.2	9.6	5
	18	3	7.9	5.9	7
	27	3	38.4	7.9	7
	28	3	43.6	8.3	10
	31	3	37.9	8.8	8
	32	3	52.8	14.6	9

Table B-4 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TIFF	ALL	1	3.9	5.8	113
	12	1	8.8	6.3	14
	13	1	2.4	5.6	7
	15	1	1.3	1.2	8
	16	1	2.0	1.4	7
	17	1	3.8	6.7	8
	18	1	2.3	1.8	7
	20	1	4.1	6.1	9
	23	1	5.3	8.8	10
	24	1	2.0	2.3	10
	27	1	6.4	8.5	9
	28	1	3.3	4.3	7
	31	1	5.0	6.9	8
	32	1	0.6	1.0	9
	ALL	2	5.9	6.4	98
	4	2	11.9	7.0	8
	5	2	1.5	1.9	8
	6	2	8.0	8.8	10
	7	2	8.4	6.3	8
	18	2	5.3	4.5	8
	20	2	5.9	5.5	7
	23	2	3.0	4.2	8
	24	2	3.8	7.7	9
	27	2	2.2	2.3	6
	28	2	6.0	6.5	9
	31	2	5.4	5.8	8
	32	2	8.1	7.0	9
	ALL	3	5.6	6.6	54
	6	3	4.7	5.5	10
	7	3	11.8	10.2	5
	18	3	4.9	6.5	7
	27	3	10.1	7.1	7
	28	3	2.7	4.4	9
	31	3	5.6	7.0	8
	32	3	2.5	2.9	8

Table B-4 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TID	ALL	1	11.0	8.3	136
	12	1	5.3	2.8	20
	13	1	7.4	3.3	10
	15	1	13.0	4.0	10
	16	1	9.4	4.9	9
	17	1	14.8	5.0	10
	18	1	10.6	3.4	9
	20	1	10.4	4.9	10
	23	1	11.8	6.3	10
	24	1	8.4	4.0	10
	27	1	9.9	5.5	9
	28	1	14.4	14.9	9
	31	1	19.1	18.6	10
	32	1	14.8	7.7	10
	ALL	2	8.1	4.8	106
	4	2	5.6	2.4	8
	5	2	6.9	2.6	9
	6	2	7.3	7.7	10
	7	2	7.3	3.0	7
	18	2	7.0	4.2	9
	20	2	9.7	3.6	10
	23	2	8.5	5.9	8
	24	2	11.5	5.4	8
	27	2	7.0	5.5	8
	28	2	8.2	4.3	10
	31	2	7.6	3.0	9
	32	2	10.3	6.0	10
	ALL	3	8.2	4.5	47
	6	3	6.1	3.3	9
	7	3	10.4	6.7	5
	18	3	6.6	2.4	7
	27	3	10.7	6.2	6
	28	3	7.1	4.9	9
	31	3	9.4	3.7	7
	32	3	9.5	1.7	4

Table B-4 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TACQ	ALL	1	6.6	6.5	90
	12	1	4.3	2.3	8
	13	1	7.3	5.5	7
	15	1	5.9	5.1	10
	16	1	5.3	2.1	8
	17	1	6.2	3.4	6
	18	1	7.3	4.5	9
	20	1	5.2	2.7	6
	23	1	3.4	2.1	5
	24	1	8.6	4.5	5
	27	1	9.5	7.2	6
	28	1	6.0	4.9	6
	31	1	12.5	19.9	6
	32	1	5.8	4.3	8
	ALL	2	5.1	3.6	50
	4	2	2.6	1.3	5
	5	2	6.5	2.1	2
	6	2	6.3	4.6	4
	7	2	4.5	1.7	4
	18	2	8.8	6.0	5
	20	2	4.8	3.9	6
	23	2	3.0	2.2	4
	24	2	6.8	2.5	4
	28	2	5.0	2.0	3
	31	2	5.6	4.1	7
	32	2	3.7	2.8	6
	ALL	3	4.9	2.4	22
	6	3	4.7	2.9	3
	7	3	8.0	2.8	2
	18	3	4.0	0	1
	27	3	3.5	1.9	4
	28	3	6.0	4.4	3
	31	3	4.0	1.4	4
	32	3	5.2	1.1	5

Table B-4 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
THAND	ALL	1	5.2	5.3	90
	12	1	4.2	3.3	18
	13	1	7.4	6.6	7
	15	1	5.0	3.8	5
	16	1	3.0	2.8	8
	17	1	2.0	0.8	4
	18	1	1.8	1.3	4
	20	1	6.2	6.1	5
	23	1	8.3	4.0	4
	24	1	6.4	4.7	10
	27	1	9.8	11.0	8
	28	1	3.3	3.9	6
	31	1	6.0	4.6	5
	32	1	2.8	2.1	6
	ALL	2	4.8	4.1	58
	4	2	4.0	2.9	7
	5	2	3.2	3.9	6
	6	2	8.3	6.5	9
	7	2	3.3	1.3	4
	18	2	2.3	2.5	6
	20	2	6.5	3.5	2
	23	2	5.6	3.6	5
	24	2	5.0	1.0	3
	27	2	2.0	0	1
	28	2	4.0	4.2	6
	31	2	5.8	4.0	5
	32	2	4.8	2.5	4
	ALL	3	5.6	4.6	19
	6	3	4.0	2.1	6
	7	3	6.5	3.5	2
	18	3	2.0	0	1
	27	3	3.0	0	1
	28	3	7.8	8.3	4
	31	3	5.0	1.7	3
	32	3	9.0	7.1	2

Table B-4 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TLOCK	ALL	1	8.0	6.8	67
	12	1	6.2	3.2	9
	13	1	7.0	5.3	3
	15	1	8.3	3.3	6
	16	1	5.9	3.9	7
	17	1	10.2	7.7	5
	18	1	6.0	2.6	5
	20	1	7.3	2.2	4
	23	1	14.0	9.9	2
	24	1	7.0	4.2	5
	27	1	11.2	10.8	6
	28	1	6.5	4.4	4
	31	1	14.0	17.0	5
	32	1	5.5	3.5	6
	ALL	2	5.3	2.8	30
	4	2	5.0	2.0	5
	5	2	3.5	0.7	2
	6	2	3.0	0	3
	7	2	5.0	1.4	2
	18	2	3.3	0.6	3
	20	2	5.5	0.7	2
	23	2	9.0	4.2	2
	24	2	3.0	0	1
	28	2	8.3	5.8	3
	31	2	4.3	1.5	3
	32	2	7.0	1.8	4
	ALL	3	7.0	4.8	10
	6	3	3.0	1.4	2
	7	3	5.0	0	1
	18	3	6.0	0	1
	27	3	10.0	8.5	2
	28	3	8.0	0	1
	31	3	4.0	0	1
	32	3	10.5	6.4	2

Table B-4 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TFIRE	ALL	1	9.2	5.0	60
	12	1	8.8	3.5	9
	13	1	8.8	4.3	4
	15	1	9.2	2.2	5
	16	1	8.0	3.6	7
	17	1	8.0	1.7	3
	18	1	7.3	1.9	4
	20	1	8.7	1.5	3
	23	1	17.5	10.6	2
	24	1	9.2	4.4	5
	27	1	13.4	12.0	5
	28	1	9.0	4.8	4
	31	1	9.0	4.6	3
	32	1	7.8	2.9	6
	ALL	2	7.6	2.5	28
	4	2	7.4	3.0	5
	5	2	5.0	0	2
	6	2	5.3	1.2	3
	7	2	7.5	0.7	2
	18	2	6.0	1.0	3
	20	2	9.0	0	2
	23	2	11.5	3.5	2
	28	2	8.0	1.4	2
	31	2	7.0	1.0	3
	32	2	10.0	2.4	4
	ALL	3	8.2	4.1	9
	6	3	5.0	1.4	2
	7	3	8.0	0	1
	18	3	8.0	0	1
	27	3	6.0	0	1
	28	3	10.0	0	1
	31	3	6.0	0	1
	32	3	13.0	7.1	2

Table B-4 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TTOT	ALL	1	14.5	8.1	92
	12	1	8.8	4.2	19
	13	1	14.7	6.3	7
	15	1	17.8	4.4	5
	16	1	13.3	3.6	8
	17	1	17.0	3.2	4
	18	1	12.0	2.4	4
	20	1	15.0	6.1	5
	23	1	18.0	5.4	4
	24	1	14.8	4.9	10
	27	1	19.1	15.3	8
	28	1	19.6	16.7	7
	31	1	15.6	5.1	5
	32	1	14.5	5.6	[illegible]
	ALL	2	11.8	5.8	60
	4	2	8.3	3.7	3
	5	2	10.8	3.5	6
	6	2	15.8	11.2	9
	7	2	10.0	2.2	4
	18	2	8.6	3.6	7
	20	2	16.0	7.1	2
	23	2	12.0	5.1	5
	24	2	14.0	3.0	3
	27	2	12.0	0	1
	28	2	12.5	3.7	6
	31	2	12.0	5.0	5
	32	2	12.8	1.5	4
	ALL	3	11.9	5.0	21
	6	3	10.4	2.3	7
	7	3	11.7	6.8	3
	18	3	12.0	0	1
	27	3	9.0	0	1
	28	3	12.0	6.6	4
	31	3	12.0	5.2	3
	32	3	18.5	9.2	2

Table B-5

Descriptive Statistics: Chaparral RW Event Times

VAR	SCEN	TARGET	MEAN	SD	N
TDET	ALL	1	6.3	4.3	52
	12	1	2.6	1.5	8
	13	1	3.0	1.6	4
	15	1	12.3	6.1	3
	16	1	6.5	2.9	4
	17	1	6.0	2.2	4
	18	1	11.8	6.2	4
	20	1	3.0	0.8	4
	23	1	6.7	1.2	3
	24	1	6.0	2.8	2
	27	1	9.3	5.1	4
	28	1	8.5	2.1	4
	31	1	8.5	3.7	4
	32	1	3.3	0.5	4
	ALL	2	26.5	13.5	42
	4	2	9.3	5.7	4
	5	2	7.7	4.0	3
	6	2	19.3	20.0	3
	7	2	15.5	5.4	4
	18	2	23.3	11.4	4
	20	2	36.0	7.4	4
	23	2	42.3	9.6	3
	24	2	34.0	0	1
	27	2	33.3	7.0	4
	28	2	37.8	12.3	4
	31	2	31.8	5.6	4
	32	2	30.5	3.7	4
	ALL	3	41.9	16.6	18
	6	3	33.7	17.6	3
	7	3	31.0	2.8	2
	18	3	20.0	7.1	2
	27	3	45.0	15.7	3
	28	3	42.5	3.6	2
	31	3	48.0	11.3	2
	32	3	59.0	15.3	4

Table B-5 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TIFF	ALL	1	4.7	3.1	40
	12	1	4.3	2.9	3
	13	1	1.0	1.4	2
	15	1	2.0	0	2
	16	1	4.3	2.1	4
	17	1	7.0	4.2	2
	18	1	5.3	5.2	4
	20	1	5.0	1.7	3
	23	1	7.0	4.4	3
	24	1	8.0	4.2	2
	27	1	4.3	1.7	4
	28	1	5.0	2.9	4
	31	1	4.3	3.5	3
	32	1	3.5	3.0	4
	ALL	2	6.5	8.9	21
	4	2	3.0	0	2
	5	2	5.0	5.7	2
	6	2	0	0	2
	7	2	37.0	0	1
	18	2	4.0	0	1
	20	2	10.0	5.7	2
	23	2	4.5	3.5	2
	24	2	18.0	0	1
	27	2	3.0	0	1
	28	2	4.5	8.3	4
	31	2	3.5	4.9	2
	32	2	5.0	0	1
	ALL	3	5.3	4.9	8
	7	3	0.5	0.7	2
	18	3	5.5	3.5	2
	28	3	8.0	0	1
	31	3	2.0	0	1
	32	3	10.0	7.1	2

Table B-5 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TID	ALL	1	9.8	4.7	51
	12	1	5.5	3.0	8
	13	1	6.8	3.9	4
	15	1	8.7	1.6	3
	16	1	13.0	6.1	4
	17	1	10.8	5.0	4
	18	1	12.3	2.9	3
	20	1	7.5	2.4	4
	23	1	15.7	7.1	3
	24	1	10.5	6.4	2
	27	1	8.5	4.4	4
	28	1	14.0	2.8	4
	31	1	11.5	3.3	4
	32	1	9.3	4.5	4
	ALL	2	6.8	5.7	34
	4	2	4.0	2.0	3
	5	2	9.3	7.8	3
	6	2	3.0	1.7	3
	7	2	7.8	10.3	4
	18	2	8.0	5.7	2
	20	2	6.5	5.7	4
	23	2	7.0	0	1
	24	2	11.0	0	1
	27	2	5.3	5.8	3
	28	2	9.0	9.6	3
	31	2	8.3	5.0	4
	32	2	5.3	3.1	3
	ALL	3	5.8	5.0	17
	6	3	6.3	5.0	3
	7	3	6.0	1.4	2
	18	3	8.5	7.8	2
	27	3	1.7	1.2	3
	28	3	9.5	12.0	2
	31	3	4.5	2.1	2
	32	3	6.0	4.4	3

Table B-5 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TACQ	ALL	1	5.1	3.3	22
	12	1	3.5	3.5	2
	13	1	2.0	0	1
	15	1	2.5	0.7	2
	16	1	4.5	3.5	2
	17	1	13.0	0	1
	18	1	5.0	0	1
	20	1	5.0	1.7	3
	23	1	10.0	0	1
	27	1	8.0	0	1
	28	1	6.3	2.4	4
	31	1	1.0	0	1
	32	1	4.0	3.5	3
	ALL	2	9.7	11.9	9
	4	2	3.0	0	2
	5	2	5.0	5.7	2
	6	2	1.0	0	1
	7	2	37.0	0	1
	18	2	4.0	0	1
	28	2	14.5	7.8	2
	ALL	3	28.0	28.3	2
	18	3	8.0	0	1
	32	3	48.0	0	1

Table B-5 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
THAND	ALL	1	5.6	5.2	23
	12	1	3.2	1.8	5
	13	1	4.5	3.5	2
	15	1	6.Ø	Ø	1
	16	1	3.Ø	4.2	2
	17	1	13.Ø	Ø	1
	18	1	3.Ø	Ø	1
	2Ø	1	12.Ø	15.6	2
	24	1	11.Ø	Ø	2
	27	1	4.3	3.5	3
	28	1	7.Ø	Ø	1
	31	1	2.Ø	Ø	1
	32	1	3.5	Ø.7	2
	ALL	2	3.3	2.7	17
	4	2	2.3	1.5	3
	5	2	1.Ø	Ø	1
	6	2	2.Ø	1.4	2
	7	2	5.Ø	5.7	2
	18	2	2.5	Ø.7	2
	2Ø	2	5.Ø	Ø	1
	27	2	5.Ø	Ø	1
	28	2	8.Ø	Ø	1
	31	2	3.Ø	3.6	3
	32	2	2.Ø	Ø	1
	ALL	3	7.8	6.1	4
	18	3	5.Ø	Ø	1
	28	3	1Ø.Ø	Ø	1
	31	3	1.Ø	Ø	1
	32	3	15.Ø	Ø	1
TFIRE	ALL	1	9.4	4.2	15
	12	1	7.5	1.3	4
	13	1	9.Ø	3.6	3
	15	1	13.Ø	Ø	1
	16	1	12.Ø	9.9	2
	17	1	7.Ø	Ø	1
	18	1	7.Ø	Ø	1
	2Ø	1	6.Ø	Ø	1
	28	1	17.Ø	Ø	1
	32	1	1Ø.Ø	Ø	1
	ALL	2	3.Ø	2.1	6
	4	2	3.Ø	2.8	2
	5	2	3.Ø	Ø	1
	6	2	6.Ø	Ø	1
	18	2	2.Ø	Ø	1
	28	2	1.Ø	Ø	1
	18	3	11.Ø	Ø	1

Table B-5 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TTOT	ALL	1	13.5	7.2	25
	12	1	9.0	2.3	5
	13	1	8.3	6.4	3
	15	1	16.0	0	1
	16	1	16.5	13.4	2
	17	1	14.5	7.8	2
	18	1	12.0	0	1
	20	1	21.0	12.7	2
	24	1	21.5	6.4	2
	27	1	11.0	6.1	3
	28	1	25.0	0	1
	31	1	14.0	0	1
	32	1	10.0	2.8	2
	ALL	2	8.4	4.7	18
	4	2	6.3	2.1	3
	5	2	4.0	0	1
	6	2	4.5	3.5	2
	7	2	8.5	7.8	2
	18	2	10.5	6.4	2
	20	2	13.0	0	1
	27	2	11.0	8.5	2
	28	2	10.0	0	1
	31	2	9.7	5.8	3
	32	2	8.0	0	1
	ALL	3	12.5	6.6	4
	18	3	19.0	0	1
	28	3	11.0	0	1
	31	3	4.0	0	1
	32	3	16.0	0	1

Table B-6

Descriptive Statistics: Vulcan RW Event Times

VAR	SCEN	TARGET	MEAN	SD	N
TDET	ALL	1	6.5	2.8	95
	9	1	4.1	1.2	8
	10	1	4.1	0.6	8
	11	1	5.0	2.7	8
	12	1	7.9	1.6	8
	13	1	5.6	2.8	8
	14	1	10.0	2.1	8
	18	1	10.6	1.5	8
	19	1	5.9	2.6	8
	21	1	5.8	1.7	4
	22	1	5.8	1.0	6
	25	1	7.0	1.5	6
	26	1	5.8	1.5	6
	29	1	6.5	3.3	6
	30	1	6.0	3.6	4
	ALL	2	23.0	9.4	52
	6	2	11.0	0	1
	18	2	11.4	6.0	7
	19	2	23.0	2.9	4
	21	2	25.7	8.0	7
	22	2	22.4	6.1	5
	25	2	33.0	7.1	5
	26	2	23.5	8.2	8
	29	2	25.7	9.6	7
	30	2	25.4	12.1	8
	ALL	3	37.0	14.4	28
	6	3	26.0	0	1
	18	3	13.3	5.3	4
	25	3	49.2	11.3	6
	26	3	42.2	12.6	5
	29	3	40.0	9.0	6
	30	3	35.0	8.2	6

Table B-6 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TID	ALL	1	6.7	6.4	94
	9	1	9.4	6.0	8
	10	1	5.0	4.8	8
	11	1	6.9	4.2	8
	12	1	4.0	2.0	8
	13	1	4.3	2.6	8
	14	1	14.8	13.4	8
	18	1	9.9	7.2	8
	19	1	5.6	4.0	8
	21	1	4.5	3.9	4
	22	1	4.7	4.2	6
	25	1	5.5	1.3	4
	26	1	6.8	7.6	6
	29	1	5.3	4.8	6
	30	1	3.0	2.4	4
	ALL	2	2.9	2.9	42
	6	2	1.0	0	1
	18	2	1.8	1.3	5
	19	2	4.0	4.8	4
	21	2	4.3	2.8	6
	22	2	1.0	0	2
	25	2	3.8	3.8	5
	26	2	1.9	1.6	7
	29	2	3.0	3.9	5
	30	2	2.7	3.0	7
	ALL	3	3.2	2.9	27
	6	3	1.0	0	1
	18	3	4.0	1.4	4
	25	3	3.8	3.8	6
	26	3	3.8	2.8	5
	29	3	1.0	0	6
	30	3	4.2	4.1	5

Table B-6 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
THAND	ALL	1	3.8	4.4	62
	9	1	4.0	2.0	3
	10	1	5.0	6.4	7
	11	1	1.5	0.7	2
	12	1	3.3	2.7	6
	13	1	3.7	2.5	3
	14	1	2.0	0	1
	18	1	5.8	7.4	6
	19	1	2.5	1.6	6
	21	1	3.7	2.3	3
	22	1	3.0	1.4	5
	25	1	2.8	1.5	5
	26	1	3.7	5.6	6
	29	1	6.0	8.7	5
	30	1	2.0	1.4	4
	ALL	2	3.0	3.2	34
	6	2	2.0	0	1
	18	2	4.3	2.3	3
	21	2	1.9	0.9	7
	22	2	3.4	1.9	5
	25	2	2.0	2.8	2
	26	2	5.0	7.9	5
	29	2	2.7	1.4	6
	30	2	2.2	1.1	5
	ALL	3	5.7	5.7	10
	6	3	1.0	0	1
	29	3	5.6	5.9	5
	30	3	7.0	6.5	4
TFIRE	ALL	1	1.5	2.1	14
	9	1	1.0	0	1
	10	1	1.0	1.4	2
	11	1	7.0	0	1
	12	1	0	0	1
	14	1	0	0	1
	18	1	0	0	2
	19	1	3.0	2.8	2
	21	1	1.0	0	1
	25	1	1.0	0	1
	26	1	0.5	0.7	2
	30	1	2.0	0	1
	ALL	2	1.5	1.7	8
	6	2	0	0	1
	18	2	1.0	0	1
	21	2	1.0	0	2
	26	2	0	0	1
	29	2	3.0	2.8	2
	30	2	3.0	0	1
	29	3	2.0	2.8	2

Table B-6 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
TTOT	ALL	1	8.8	7.3	71
	9	1	7.8	4.9	4
	10	1	10.3	6.9	7
	11	1	8.0	5.7	2
	12	1	6.0	4.0	7
	13	1	6.0	3.6	3
	14	1	24.3	17.8	3
	18	1	12.0	9.7	7
	19	1	7.3	3.4	8
	21	1	6.5	6.5	4
	22	1	6.2	2.6	5
	25	1	5.3	3.4	6
	26	1	10.5	7.6	6
	29	1	12.0	8.5	5
	30	1	5.0	1.6	4
	ALL	2	5.1	3.6	34
	6	2	3.0	0	1
	18	2	4.3	2.5	4
	21	2	5.6	2.7	7
	22	2	3.8	1.6	5
	25	2	7.5	3.5	2
	26	2	8.3	7.9	4
	29	2	5.0	3.5	6
	30	2	3.6	2.1	5
	ALL	3	7.0	6.0	10
	6	3	2.0	0	1
	29	3	6.6	5.9	5
	30	3	8.8	6.8	4

Table B-7

Descriptive Statistics: Stinger FW Summary Performance

VAR	SCEN	MEAN	SD	N
IDCOR	ALL	.82	.39	73
FIDCOR	ALL	.69	.47	36
	1	.72	.46	18
	4	.37	.52	8
	6	.90	.32	10
HIDCOR	ALL	.95	.23	37
	2	1.0	0	9
	3	.82	.40	11
	5	1.0	0	9
	7	1.0	0	8
FENG	ALL	.18	.39	38
	1	.18	.37	19
	4	.22	.44	9
	6	.20	.42	10
HENG	ALL	.39	.50	38
	2	.33	.50	9
	3	.55	.52	11
	5	.30	.48	10
	7	.38	.52	8
PKILL	ALL	.86	.35	22
FKILL	ALL	.16	.37	38
	1	.11	.32	19
	4	.22	.44	9
	6	.20	.42	10
HKILL	ALL	.34	.48	38
	2	.22	.44	9
	3	.55	.52	11
	5	.30	.48	10
	7	.25	.46	8
ORD	ALL	.34	.48	38
	2	.44	.53	9
	3	.27	.47	11
	5	.40	.52	10
	7	.25	.46	8

Table B-8

Descriptive Statistics: Chaparral FW Summary Performance

VAR	SCEN	MEAN	SD	N
IDCOR	ALL	.76	.44	25
FIDCOR	ALL	.62	.51	13
	1	.43	.53	7
	4	.67	.58	3
	6	1.0	0	3
HIDCOR	ALL	.92	.29	12
	2	1.0	0	4
	3	1.0	0	3
	5	.67	.58	3
	7	1.0	0	2
FENG	ALL	.43	.51	14
	1	.57	.53	7
	4	.50	.58	4
	6	0	0	3
HENG	ALL	.64	.50	14
	2	.75	.50	4
	3	.67	.58	3
	5	.33	.58	3
	7	.75	.50	4
PKILL	ALL	.87	.35	15
FKILL	ALL	.29	.47	14
	1	.43	.53	7
	4	.25	.50	4
	6	0	0	3
HKILL	ALL	.64	.50	14
	2	.75	.50	4
	3	.67	.58	3
	5	.33	.58	3
	7	.75	.50	4
ORD	ALL	.71	.47	14
	2	.50	.58	4
	3	1.0	0	3
	5	1.0	0	3
	7	.50	.58	4

Table B-9

Descriptive Statistics: Stinger RW Summary Performance

VAR	SCEN	TARGET	MEAN	SD	N
IDCOR	ALL	ALL	.65	.48	289
	ALL	1	.68	.47	136
	ALL	2	.67	.47	106
	ALL	3	.51	.51	47
FIDCOR	ALL	ALL	.57	.50	49
	ALL	1	.37	.52	8
	ALL	2	.62	.50	26
	ALL	3	.60	.51	15
	7	---	.40	.55	5
	18	ALL	.69	.48	16
	20	---	.70	.48	10
	27	---	.62	.52	8
	28	---	.30	.48	10
HIDCOR	ALL	ALL	.67	.47	240
	ALL	1	.70	.46	128
	ALL	2	.69	.47	80
	ALL	3	.47	.51	32
	4	---	1.0	0	8
	5	---	.67	.50	9
	6	ALL	.79	.42	19
	7	---	.57	.53	7
	12	---	.95	.22	20
	13	---	.60	.52	10
	15	---	.50	.53	10
	16	---	1.0	0	9
	17	---	.50	.53	10
	18	---	1.0	0	9
	20	---	.50	.53	10
	23	ALL	.56	.51	18
	24	ALL	.78	.43	18
	27	ALL	.47	.52	15
	28	ALL	.50	.51	18
	31	ALL	.54	.51	26
	32	ALL	.62	.49	24
FENG	ALL	ALL	.35	.48	57
	ALL	1	.44	.53	9
	ALL	2	.33	.48	27
	ALL	3	.33	.48	21
	7	---	.50	.53	8
	18	ALL	.20	.41	20
	20	---	.20	.42	10
	27	---	.33	.50	9
	28	---	.70	.48	10

Table B-9 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
HENG	ALL	ALL	.58	.49	266
	ALL	1	.67	.47	131
	ALL	2	.60	.49	86
	ALL	3	.31	.47	49
	4	---	.89	.33	9
	5	---	.60	.52	10
	6	ALL	.80	.41	20
	7	---	.50	.53	8
	12	---	.95	.22	20
	13	---	.64	.50	11
	15	---	.50	.53	10
	16	---	.80	.42	10
	17	---	.40	.52	10
	18	---	.90	.32	10
	20	---	.50	.53	10
	23	ALL	.45	.51	20
	24	ALL	.65	.50	20
	27	ALL	.39	.50	18
	28	ALL	.50	.51	20
	31	ALL	.43	.50	30
	32	ALL	.40	.50	30
PKILL	ALL	ALL	.99	.08	175
	ALL	1	.99	.10	92
	ALL	2	1.0	0	61
	ALL	3	1.0	0	22
FKILL	ALL	ALL	.35	.48	57
	ALL	1	.44	.53	9
	ALL	2	.33	.48	27
	ALL	3	.33	.48	21
	7	---	.50	.53	8
	18	ALL	.20	.41	20
	20	---	.20	.42	10
	27	---	.33	.50	9
	28	---	.70	.48	10

Table B-9 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
HKILL	ALL	ALL	.58	.49	265
	ALL	1	.66	.48	130
	ALL	2	.60	.49	86
	ALL	3	.31	.47	49
	4	---	.89	.33	9
	5	---	.60	.52	10
	6	ALL	.80	.41	20
	7	---	.50	.53	8
	12	---	.90	.31	20
	13	---	.60	.52	10
	15	---	.50	.53	10
	16	---	.80	.42	10
	17	---	.40	.52	10
	18	---	.90	.32	10
	20	---	.50	.53	10
	23	ALL	.45	.51	20
	24	ALL	.65	.50	20
	27	ALL	.39	.50	18
	28	ALL	.50	.51	20
	31	ALL	.43	.50	30
	32	ALL	.40	.50	30
ORD	ALL	ALL	.74	.44	265
	ALL	1	.68	.47	130
	ALL	2	.71	.46	86
	ALL	3	.96	.20	49
	4	---	.11	.33	9
	5	---	.40	.52	10
	6	ALL	.70	.47	20
	7	---	1.0	0	8
	12	---	.10	.31	20
	13	---	.40	.52	10
	15	---	.90	.32	10
	16	---	1.0	0	10
	17	---	1.0	0	10
	18	---	.20	.42	10
	20	---	.70	.48	10
	23	ALL	1.0	0	20
	24	ALL	.85	.37	20
	27	ALL	.89	.32	18
	28	ALL	.85	.37	20
	31	ALL	.97	.18	30
	32	ALL	.87	.35	30

Table B-10

Descriptive Statistics: Chaparral RW Summary Performance

VAR	SCEN	TARGET	MEAN	SD	N
IDCOR	ALL	ALL	.63	.48	101
	ALL	1	.64	.48	50
	ALL	2	.71	.46	34
	ALL	3	.47	.51	17
FIDCOR	ALL	ALL	.47	.51	17
	ALL	1	.50	.71	2
	ALL	2	.50	.52	12
	ALL	3	.33	.58	3
	7	---	.25	.50	4
	18	ALL	.50	.58	4
	20	---	.50	.58	4
	27	---	.67	.58	3
	28	---	.50	.71	2
HIDCOR	ALL	ALL	.67	.47	84
	ALL	1	.65	.48	48
	ALL	2	.82	.39	22
	ALL	3	.50	.52	14
	4	---	1.0	0	3
	5	---	.67	.58	3
	6	ALL	.67	.52	6
	7	---	0	0	2
	12	---	.75	.46	8
	13	---	.75	.50	4
	15	---	.67	.58	3
	16	---	.75	.50	4
	17	---	.75	.50	4
	18	---	1.0	0	2
	20	---	.75	.50	4
	23	ALL	.25	.50	4
	24	ALL	1.0	0	3
	27	ALL	.57	.53	7
	28	ALL	.57	.53	7
	31	ALL	.60	.52	10
	32	ALL	.70	.48	10
FENG	ALL	ALL	.35	.49	23
	ALL	1	.20	.45	5
	ALL	2	.38	.51	13
	ALL	3	.33	.52	6
	7	---	.50	.58	4
	18	ALL	.29	.49	7
	20	---	.25	.50	4
	27	---	.50	.58	4
	28	---	.25	.50	4

Table B-10 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
HENG	ALL	ALL	.41	.49	97
	ALL	1	.50	.51	48
	ALL	2	.45	.51	29
	ALL	3	.15	.37	20
	4	---	.75	.50	4
	5	---	.33	.58	3
	6	ALL	.33	.52	6
	7	---	0	0	4
	12	---	.63	.52	8
	13	---	.75	.50	4
	15	---	.33	.58	3
	16	---	.50	.58	4
	17	---	.50	.58	4
	18	---	.50	.58	4
	20	---	.50	.58	4
	23	ALL	0	0	6
	24	ALL	.50	.58	4
	27	ALL	.50	.53	8
	28	ALL	.25	.46	8
	31	ALL	.45	.52	11
	32	ALL	.33	.49	12
PKILL	ALL	ALL	1.0	0	48
FKILL	ALL	ALL	.35	.49	23
	ALL	1	.25	.50	4
	ALL	2	.38	.51	13
	ALL	3	.33	.52	6
	7	---	.50	.58	4
	18	ALL	.29	.49	7
	20	---	.25	.50	4
	27	---	.50	.58	4
	28	---	.25	.50	4

Table B-10 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
HKILL	ALL	ALL	.41	.49	97
	ALL	1	.50	.51	48
	ALL	2	.45	.51	29
	ALL	3	.15	.37	20
	4	---	.75	.50	4
	5	---	.33	.58	3
	6	ALL	.33	.52	6
	7	---	0	0	4
	12	---	.63	.52	8
	13	---	.75	.50	4
	15	---	.33	.58	3
	16	---	.50	.58	4
	17	---	.50	.58	4
	18	---	.50	.58	4
	20	---	.50	.58	4
	23	ALL	0	0	6
	24	ALL	.50	.58	4
	27	ALL	.50	.53	8
	28	ALL	.25	.46	8
	31	ALL	.45	.52	11
	32	ALL	.33	.49	12
ORD	ALL	ALL	.79	.49	97
	ALL	1	.67	.48	48
	ALL	2	.83	.38	29
	ALL	3	1.0	0	20
	4	---	.25	.50	4
	5	---	.67	.58	3
	6	ALL	.83	.41	6
	7	---	1.0	0	4
	12	---	.38	.52	8
	13	---	.25	.50	4
	15	---	1.0	0	3
	16	---	.75	.50	4
	17	---	1.0	0	4
	18	---	1.0	0	4
	20	---	.75	.50	4
	23	ALL	1.0	0	6
	24	ALL	.75	.50	4
	27	ALL	.63	.52	8
	28	ALL	1.0	0	8
	31	ALL	1.0	0	11
	32	ALL	.83	.39	12

Table B-11

Descriptive Statistics: Vulcan RW Summary Performance

VAR	SCEN	TARGET	MEAN	SD	N
IDCOR	ALL	ALL	.82	.39	176
	ALL	1	.76	.43	96
	ALL	2	.87	.34	52
	ALL	3	.93	.26	28
FIDCOR	ALL	ALL	.73	.45	49
	ALL	1	.56	.51	25
	ALL	2	.78	.44	9
	ALL	3	1.0	0	15
	11	---	.62	.52	8
	14	---	.75	.46	8
	18	ALL	.50	.52	12
	19	---	1.0	0	5
	25	ALL	.82	.40	11
	26	---	1.0	0	5
HIDCOR	ALL	ALL	.85	.36	127
	ALL	1	.83	.38	71
	ALL	2	.88	.32	43
	ALL	3	.85	.38	13
	6	ALL	1	0	2
	9	---	.62	.52	8
	10	---	1.0	0	8
	12	---	.87	.35	8
	13	---	.37	.52	8
	18	---	.71	.49	7
	19	---	1.0	0	7
	21	ALL	1.0	0	11
	22	ALL	.91	.30	11
	25	---	1.0	0	6
	26	ALL	.93	.27	14
	29	ALL	.89	.32	19
	30	ALL	.78	.43	18
FENG	ALL	ALL	.35	.48	49
	ALL	1	.60	.50	25
	ALL	2	.22	.44	9
	ALL	3	0	0	15
	11	---	.38	.52	8
	14	---	.50	.53	8
	18	ALL	.58	.51	12
	19	---	.20	.45	5
	25	ALL	.18	.40	11
	26	---	0	0	5

Table B-11 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
HENG	ALL	ALL	.80	.40	139
	ALL	1	.84	.37	75
	ALL	2	.86	.35	43
	ALL	3	.52	.51	21
	6	ALL	1	0	2
	9	---	.50	.53	8
	10	---	1.0	0	8
	12	---	.88	.35	8
	13	---	.38	.52	8
	18	---	.71	.49	7
	19	---	1	0	7
	21	ALL	.85	.38	13
	22	ALL	.77	.44	13
	25	---	1.0	0	6
	26	ALL	.86	.36	14
	29	ALL	.95	.23	19
	30	ALL	.64	.49	22
PKILL	ALL	ALL	.37	.49	124
	ALL	1	.30	.46	74
	ALL	2	.51	.51	39
	ALL	3	.36	.50	11
FKILL	ALL	ALL	.02	.14	49
	ALL	1	.04	.20	25
	ALL	2	0	0	9
	ALL	3	0	0	15
	11	---	.13	.35	8
	14	---	0	0	8
	18	ALL	0	0	12
	19	---	0	0	5
	25	ALL	0	0	11
	26	---	0	0	5

Table B-11 (Continued)

VAR	SCEN	TARGET	MEAN	SD	N
HKILL	ALL	ALL	.32	.47	139
	ALL	1	.28	.45	75
	ALL	2	.47	.50	43
	ALL	3	.19	.40	21
	6	ALL	0	0	2
	9	---	.25	.46	8
	10	---	.13	.35	8
	12	---	.50	.53	8
	13	---	0	0	8
	18	---	.43	.53	7
	19	---	0	0	7
	21	ALL	.23	.44	13
	22	ALL	.69	.48	13
	25	---	.50	.55	6
	26	ALL	.43	.51	14
	29	ALL	.53	.51	19
	30	ALL	.18	.39	22
ORD	ALL	ALL	.80	.40	139
	ALL	1	.73	.45	75
	ALL	2	.81	.39	43
	ALL	3	1.00	0	21
	6	ALL	1	0	2
	9	---	.75	.46	8
	10	---	.88	.35	8
	12	---	.50	.53	8
	13	---	1.0	0	8
	18	---	.71	.49	7
	19	---	1.0	0	7
	21	ALL	.92	.28	13
	22	ALL	.62	.51	13
	25	---	.67	.52	6
	26	ALL	.64	.50	14
	29	ALL	.84	.37	19
	30	ALL	.91	.29	22
HITS	ALL	ALL	9.3	17.9	189
	ALL	1	8.0	16.3	101
	ALL	2	14.5	20.7	52
	ALL	3	5.7	16.8	36
BURSTS	ALL	ALL	1.6	1.5	189
	ALL	1	1.7	1.4	101
	ALL	2	1.8	1.6	52
	ALL	3	1.1	1.4	36

APPENDIX C: INDIVIDUAL DIFFERENCES STATISTICS

Table C-1

Descriptive Statistics on Individual Differences

VAR	MEAN	SD	MIN	MAX	N
FVA	16.62	5.09	10	40	136
CS1	5.61	.66	3	7	136
CS2	6.60	.59	5	8	136
CS3	6.43	1.11	2	8	136
CS4	6.02	1.44	0	8	136
CS5	5.54	1.72	0	8	136
CSL	6.10	.52	4	7.5	136
CSH	5.78	1.50	0	8	136
DF	1.01	.54	0	3	136
CF	1.15	.49	0	4	136
RF	1.08	.45	0	3	136
NP	9.43	2.12	3	11	136
FP	-1.63	.88	-4	0	136
FR	11.07	2.04	5	15	136
BI1	3.99	2.20	0	10	136
BI2	3.18	2.11	0	11	136
BIP	4.29	1.87	0	9	136
BIW	6.27	2.28	1	11	136
BIZ	6.24	2.38	1	11	136
BIA	3.58	1.85	0	10.5	136
BIB	5.60	1.87	1.3	9.7	136
GEF	23.62	23.68	0	91	136
SV	33.87	24.94	0	98	136
VP	28.32	26.31	1	92	136
MSA	154.15	73.02	2	299	136
TSA	101.69	22.54	53	163	136
GAMB	72.66	21.62	0	121	136
AGE	25.78	8.01	17	50	135
RANK	3.69	1.92	1	7	136
TSERV	66.12	69.41	0	304	135
TMOS	17.87	29.57	0	204	135
TRANK	21.88	28.26	0	120	135
TAT	8.76	16.56	0	100	136
LFR	1.37	4.70	0	32	136
DET	9.59	28.75	0	180	136
ID	10.56	29.50	0	180	136
HND	5.72	23.13	0	180	136
CMD	7.01	25.17	0	180	136
AFQT	54.73	20.48	9	95	96
EL	104.59	13.73	73	132	96
MM	108.50	12.31	83	136	96
OF	108.70	10.60	84	134	96

Table C-2

Principal Components of Individual Differences

1	2	3	4	5	6
EXPER	FOCUS	IMAGE INT	PERCEPT	MOTOR	PERSONAL
AGE (.91)	RF (-.67)	FP (-.45)	GEF (.79)	MSA (.74)	BI1 (.53)
RANK (.77)	FVA (-.79)	BIP (.80)	VP (.57)	TSA (.75)	GAMB (.75)
TSERV(.94)	CSL (.67)	BIW (.78)	SV (.66)		
TRANK(.80)	CSM (.87)	BIZ (.85)			
NP (-.72)	CSH (.89)	BI1 (.52)			
		BI2 (.75)			
R^2 = .19	R^2 = .34	R^2 = .48	R^2 = .56	R^2 = .62	R^2 = .67

1	2	3
ACTIVE FOCUS	IMAGE INTERP	PASSIVE FOC
RF (-.61)	BIZ (.84)	RF (.50)
FVA (-.84)	BI1 (.74)	NP (.78)
CSL (.73)	BI2 (.83)	FP (.73)
CSH (.90)		
R^2 = .29	R^2 = .53	R^2 = .66

Table C-3

Representative Sampling of Correlations Between Predictors and Performance

TYPE	TARG	WEAP	JOB	PVAR	DVAR	CORR	N	P
FW	1st	VULC	SL	FVA	HIDCOR	-.63	24	****
FW	1st	VULC	SL	CSM	RFIRE	.51	16	*
FW	1st	CHAP	SG	CSM	RFIRE	.42	16	*
FW	1st	VULC	SL	GEF	RID	.48	23	**
FW	1st	VULC	SG	AGE	RDET	-.49	23	**
FW	1st	VULC	SL	TSERV	RDET	-.52	23	**
FW	1st	MIXED	SL	AFQT	RDET	.33	38	*
FW	1st	MIXED	SG	AFQT	RDET	.52	38	****
FW	1st	MIXED	SG	OF	RDET	.42	38	***
RW	1st	VULC	SG	RF	TDET	-.47	13	*
RW	1st	VULC	SG	RF	TDET	-.75	7	**
RW	2nd	CHAP	SL	RF	TDET	-.45	14	*
RW	1st	MIXED	SG	RF	TTOT	.59	18	***
RW	1st	VULC	SG	NP	TDET	-.75	7	**
RW	1st	VULC	SL	FVA	TID	.60	24	****
RW	1st	CHAP	SL	FVA	TID	.60	8	*
RW	1st	VULC	SL	FVA	HIDCOR	-.41	24	*
RW	3rd	CHAP	SL	CSM	HIDCOR	.89	6	***
RW	1st	MIXED	SL	CSH	TTOT	-.52	18	**
RW	1st	VULC	SG	BIZ	TDET	.51	20	**
RW	2nd	CHAP	SG	BIZ	TDET	.50	13	*
RW	1st	VULC	SL	BIZ	FIDCOR	.37	24	*
RW	1st	VULC	SL	BIZ	FIDCOR	.61	12	**
RW	2nd	CHAP	SL	BIZ	HIDCOR	.67	7	*
RW	1st	CHAP	SG	BIZ	HKILL	.59	23	****
RW	1st	VULC	SG	BIZ	HKILL	.53	24	***
RW	1st	VULC	SG	BIZ	HITS	.69	9	**
RW	1st	CHAP	SG	BIZ	ORD	-.66	23	***
RW	1st	CHAP	SL	MSA	TDET	-.42	21	*
RW	1st	CHAP	SG	MSA	TDET	-.60	8	*
RW	3rd	VULC	SG	MSA	TDET	-.54	7	*
RW	1st	VULC	SG	MSA	TDET	-.36	24	*
RW	1st	MIXED	SL	AGE	TDET	.60	22	***
RW	3rd	VULC	SG	AGE	HKILL	.50	23	**
RW	1st	CHAP	SL	AGE	HKILL	.73	8	**
RW	2nd	VULC	SL	TSERV	HIDCOR	.47	11	*
RW	3rd	VULC	SL	TSERV	HKILL	.51	23	**
RW	3rd	VULC	SG	LFR	HKILL	.74	9	**
RW	1st	VULC	SG	LFR	HITS	.53	19	**
RW	1st	MIXED	SG	MM	TDET	-.37	50	***

Pearson corrs: (cases > 11)
* = $p \le .05$
** = $p \le .01$
*** = $p \le .005$
**** = $p \le .001$

Spearman corrs: (cases < 12)
* = $p \le .10$
** = $p \le .05$
*** = $p \le .01$
**** = $p \le .005$