The sixth meeting of T2TG was held on 24-25 Mar 92, at Phoenix AZ. It was hosted by Armstrong Laboratory Williams AFB. Dr. William Howell, AL/HRD spoke about situational awareness as it relates to aircrew performance.

Mr. Denis Breglia, NTSC, described issues surrounding development and use of virtual environments as training technologies. Dr. Michael Drillings, USARI, discussed findings of ARI sponsored National Research Council reports on value of "non-mainstream" training techniques for US Army training. Training Technology demonstrations at Williams Air Force Base, Armstrong Laboratory included night vision devices, MULTIRAD (simulator) and visual color modeling. During the Steering Committee meeting it was decided that we should encourage our respective laboratories to view T2TG as a mechanism for implementing TAP STEM. Changes in the chairmanships of subgroups will take place next year: the Navy taking over Advanced Technologies, and the Army assuming chairmanship of the Crew, Group and Unit subgroups. In addition, the chair of the Steering Committee will rotate from the Army to the Navy following next year's meeting.
DOD Training Technology Technical Group (T2TG) Minutes

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The next meeting is scheduled for 4-5 May 1993. It will be hosted by the Army Research Institute in Orlando, Florida.

The following pages provide the agenda, subgroup summaries, hardcopies of the viewgraphs, and the list of attendees.

ROBERT J. SEIDEL, Ph.D.
Chief, Automated Instructional Systems,
U.S. Army Research Institute
Chair, T2TG
AGENDA
6th DoD TRAINING TECHNOLOGY TECHNICAL GROUP
24-25 March 1992

TUESDAY, 24 MARCH 1992

0700 - 0800 Registration/Fees

PLENARY SESSION I

0800 - 0810 Commander's Welcome
(Lt Col Lynn Carroll)

0810 Aircrew Training Research Division Overview

0830 Administrative Support Announcements
(Ms Linda Swan)

0845 - 0900 Introduction of Invited Speakers
(Dr Bob Seidel, ARI)

0900 - 0940 Situational Awareness
(Dr William Howell, HR Directorate Armstrong Laboratory)

0940 - 1020 Enhancing Human Performance
(Dr Michael Drillings, ARI)

1020 - 1050 Coffee Break

1050 - 1130 Virtual Environments
(Mr. Denis Breglia, NTSC)

1130 - 1300 LUNCH

SUBGROUP SESSION I

Advanced Training Technology

Introduction and Administrative Issues Subgroup Theme: Simulator, Simulations and "Virtual Reality"

Enhancing Aircrew Training Through Virtual Environment Research (Dr. Richard Thurman, USAF AL/HRAU)

Research on the Use of Virtual Environments in Crisis Management in the Navy (Ms. Janet Dickieson, NPRDC)

Behavioral Requirements for Training in Virtual Environments (Dr Bruce Knerr, USARI)
Crew, Group, Team, and Unit Technology Sub-Group

Opening Remarks

Joint Collective Training R&D Effort
- Dr Frank Moses, ARI
- Dr Eduardo Salas, NTSC
- Discussion (All)

Training Design & Evaluation

Welcome and Administrative Issues

Training Needs and Evaluation Issues
- Identifying Over-and-Under-Trained Tasks (Ms Morales)
- Opportunities to Perform Trained Tasks (Dr Mark Teachout)

Roundtable Discussion (ALL)

1600 Adjourn from Subgroup Location

1700 - 1900 No Host Bar with Heavy Hors d'Oeuvres - Resort's Lounge

Wednesday, 25 March 1992

Subgroup Session II

Advanced Training Technology

Visual Learning in Virtual Environment (Dr J. Psotka, ARI)

Summary and Conclusions of Virtual Reality in Training Research in the Services or "What are the Research Issues in the use of Virtual Reality in Training?"

Roundtable Discussion

Crew, Group and Unit Training

Aircrew Coordination Training R&D
- Dr David Baker, NTSC
- Mr Randall Oser, NTSC
- Major Wes Woodruff, USAF, NTSC
- Discussion (All)

Training Design and Evaluation

Instructional, Planning and Evaluation Issues
- Modeling Skill Acquisition (Dr Sabol)
- Retention of Knowledge Learned in College (Dr Ellis)

Roundtable Discussion (ALL)
0945 - 1000  BREAK

SUBGROUP SESSION III

Advanced Training Technology

Basic Job Skills Job Family Tutor
(Dr Ellen Hall, USAF-AL/HRMJC)
Issues in Designing and Intelligent, NLP-based Tutor for
Foreign Languages (Dr Michelle Sams, USARI)

Summary and Conclusions

Crew, Group and Unit Training

Update of AF ISD Process
- Major Conrad Bills, ASD/YTEE

Team Decision-Making Training (Update)
- Eduardo Salas

Discussion (All)
- Next Meeting
- Topics
- Format
- Product(s)

Training Design and Evaluation

Instructional, Planning and Evaluation Issues
- Instructional Strategies for Logistic Command and
  Control (Captain Hioki)
- Distance Learning (Mr Gettman)

Roundtable Discussion (ALL)

1145 - 1245  LUNCH

1245  Bus departs Conference Center

1300  Arrival Williams Air Force Base, Armstrong Laboratory

1300 - 1500  DEMONSTRATIONS
<table>
<thead>
<tr>
<th>GROUP 1</th>
<th>DEMOS</th>
<th>GROUP 2</th>
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<tr>
<td>1305 - 1325</td>
<td>Night Vision Devices &amp; Training (Bldg 558)</td>
<td>1435 - 1500</td>
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<td>1335 - 1400</td>
<td>MULTIRAD (Bldg 561)</td>
<td>1405 - 1425</td>
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<td>1435 - 1500</td>
<td>Visual Systems Color Modeling (Bldg 558)</td>
<td>1305 - 1325</td>
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<td>1510</td>
<td>Bus departs Williams Air Force Base</td>
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<td>1525</td>
<td>Arrival Conference Center</td>
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<td>1530 - 1630</td>
<td>Wrap-Up</td>
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PLENARY SESSION I

DR. WILLIAM HOWELL

HR Directorate Armstrong Laboratory
SITUATIONAL AWARENESS

AIR FORCE SYSTEMS COMMAND

DR. WILLIAM C. HOWELL

HUMAN RESOURCES DIRECTORATE

ARMSTRONG LABORATORY
OVERVIEW

- Why SA become hot issue
- Why don't have handle on it
- Why could be useful if did
- What the literature tells us
- Theoretical issues
- Measurement issues
- Research issues
- What AF is doing
- SAINT Initiative (NOW)
- AFOSR 6.1 Initiative (FY94)
- Summary
COORDINATED ATTACK ON SA

MAIN FOCI:

PREDICTION DEVELOPMENT

◆ WHAT TRAITS UNDERLIE SA?
◆ SA ACQUISITION?

SA CONCEPTUALIZATION AND INDEXING

◆ WHAT IS SA?
  ◆ BOUNDARIES?
  ◆ FACETS?

PERFORMANCE CRITERION MEASUREMENT

◆ WHAT DOES SA DO FOR YOU?
  ◆ "GLOBAL" SA?
  ◆ FACETS OF SA?

MAIN ISSUES:

TEST DEVELOPMENT, VALIDATION AND CUSTOMIZATION

◆ THEORY DEVEL. AND TEST
  ◆ EXPERIMENTS
  ◆ SME INPUTS
  ◆ MEASUREMENT TECHNIQUES

MAIN ACTIVITIES:

MAIN LINKS:

PREDICTOR-SA CORRELATION

PREDICTOR-PERFORMANCE CORRELATION

SA-PERFORMANCE CORRELATION

ANTICIPATED PRODUCTS:

◆ VALID SELECTION DEVICES
  ◆ FOR SA
  ◆ FOR SA FACETS
  ◆ IN BATTERIES

CONTENT/CONSTRUCT-VALID SA INDEXES

SA TRAINING PRINCIPLES

REQUIREMENTS FOR TRAINING SYSTEMS

OPERATIONAL SYSTEMS REQUIREMENTS
BACKGROUND

DEFINITION OF SA:
"MILITARY OPERATORS' KNOWLEDGE OF IMMEDIATE TACTICAL SITUATION."
--Sarter & Woods, 1991

OPERATIONAL PROBLEM

- INCREASING INFORMATION-PROCESSING DEMANDS (COCKPIT & ELSEWHERE)
- Mishap Attribution (80% of Ops Class A)
- Air Staff Concerns (PAT)
- Fragmentation of Knowledge; Limited Success of Interventions

CONCLUSION: NEED EXISTS, AS DOES POTENTIAL FOR SIGNIFICANT R&D CONTRIBUTION
BACKGROUND (Cont.)

RESEARCH PROBLEM

● HARD TO DEFINE SA PRECISELY
  ●● STRONG, YET DIFFERENT OPINIONS ON MEANING
  ●● EVIDENCE SUGGESTS MULTIFACETED CONSTRUCT
● HARD TO MEASURE RELIABLY
  3 MAIN APPROACHES, EACH LIMITED
    1. EXPLICIT KNOWLEDGE PROBES
    2. IMPLICIT MEASURES
    3. SUBJECTIVE RATINGS
● R&D EFFORTS TEND TO BE FRACTIONATED

CONCLUSION: NEED FOR AN INTEGRATED ATTACK AT SEVERAL LEVELS (BASIC SCIENCE --- APPLICATION)
Table 1
Characteristics of Pilot Situation Awareness

<table>
<thead>
<tr>
<th>Situation</th>
<th>Situation Components</th>
<th>Benefits of Awareness</th>
<th>Mission Categories</th>
<th>External Information Sources</th>
<th>Novice</th>
<th>Expert</th>
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<td>Routine</td>
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<tr>
<td>Spatial orientation</td>
<td>Mid-air collision avoidance</td>
<td>Local navigation, guidance and control</td>
<td>Sensory information from the environment</td>
<td>Expending unnecessary effort</td>
<td>Utilizing non-competing resources</td>
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<td>Environment</td>
<td>Terrain avoidance</td>
<td>Communication outside the cockpit</td>
<td>Cockpit visual and auditory displays</td>
<td>Not perceiving patterns</td>
<td>Multiplexing</td>
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<td>Routine goals</td>
<td>Robust decision making in the face of:</td>
<td>Flight crew resource management</td>
<td>Extra- and Intra-aircraft communication</td>
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<td>Shortening transmissions</td>
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<td>Procedures for attaining goals</td>
<td>Aircraft system status</td>
<td>Cabin management</td>
<td>Recorded flight plans</td>
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<td>Converting interference</td>
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<td>Future 3D navigation aids</td>
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<td>Chunking</td>
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<tr>
<td>Aircraft performance</td>
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<td>Routine management of physical equipment, resources, and systems</td>
<td>Flight management computer</td>
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<td>Crew responsibilities &amp; knowledge</td>
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<td>Routine management of FMC and related crew aiding systems</td>
<td>Flight manuals and checklists</td>
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<td>Bridging activities</td>
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<td>Non-Routine</td>
<td>Special constraints</td>
<td>Improved decision making in the face of:</td>
<td>Macro-planning &amp; navigation</td>
<td>Future route diversion aids</td>
<td>Making last minute plans during high workload</td>
<td>Shedding, delaying, and pre-loading tasks</td>
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<td>Contingency plans</td>
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<td>Go around Weather rerouting</td>
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<tr>
<td>Emergency</td>
<td>Unusual symptoms</td>
<td>Improved fault management</td>
<td>Diagnosis of physical equipment, resources, and systems</td>
<td>Future fault finding aids</td>
<td>Fixating on one or two salient possibilities</td>
<td>Letting go of high workload strategies</td>
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<tr>
<td>Troubleshooting techniques</td>
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<td>Future fault finding aids</td>
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<tr>
<td>Emergency procedures</td>
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Note: The rows are cumulative. In other words, the entries for emergency situations include all the entries for routine and non-routine situations.
THEORETICAL ISSUES

- 1 CONSTRUCT OR MANY? (SARTER & WOODS, OTHERS)

- SPATIAL ORIENTATION
- GEOGRAPHICAL SA
- TACTICAL SA
- IDENTITY (THREATS)
- RESPONSIBILITY
- TEMPORAL
THEORETICAL ISSUES (CONT.)

- PROCESS (ENDSLEY)
  - LEVEL I (PERCEPTION OF SIT ELEMENTS)
  - LEVEL II (INFORMATION INTEGRATION)
  - LEVEL III (PROJECTION OF FUTURE STATES)
- COGNITIVE UNDERPINNINGS? (FRACKER, BBN)
  - RELATION TO COGNITIVE MODELS, CONSTRUCTS
    - TOP-DOWN (KNOWLEDGE, RULE, SKILL DRIVEN)
    - BOTTOM-UP (DATA DRIVEN)
- INDIVIDUAL DIFFERENCES? TRAINABILITY?
MEASUREMENT ISSUES
(FRACKER, SARTER & WOODS)

- KINDS OF MEASURES
  - EXPLICIT (SELF-REPORT)--MEMORY, CONSCIOUS
    - REFLECTIVE
    - IMMEDIATE (SAGAT)
  - SUBJECTIVE (RATING)--DEFINED BY SCALES
  - IMPLICIT (INFERRED)--PERFORMANCE BASED
    - TSD (ENVELOPE SENSITIVITY)
    - EXPERT SYSTEMS (MODEL COMPARISON)
- QUALITY OF MEASURES (PSYCHOMETRIC)
  - FRACKER'S WORK
**Tentative Conclusions**

<table>
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<td>EXPLICIT</td>
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<td>Memory Probes</td>
<td>Variable</td>
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<td>IMPLICIT</td>
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<td>Sensitivity</td>
<td>Moderate</td>
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<td>SUBJECTIVE</td>
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<tr>
<td>HiRes</td>
<td>Uncertain</td>
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RESEARCH STRATEGIES

- MEASURE EXPLICITLY AS F OF SYSTEM MANIPULATION
  - NARROW FOCUS (STATIC, CONSCIOUS CONTENT)

- APPLY PRINCIPLES IN SELECTION, TRAINING ETC. AND
  MEASURE PERFORMANCE (IMPLICIT)
  - IS SA RESPONSIBLE?

- USE EXPERTS TO DEVELOP MODELS OF COMPLEX SCENARIOS
  (e.g. AIR COMBAT); TEST VS PERFORMANCE; REFINE.
  - SITUATION SPECIFIC?

- MULTIPLE MEASURES; CONVERGE ON CONSTRUCTS
  - PRIMARILY SUGGESTION
AL-WIDE CRASH PROGRAM
(1 YEAR)

- "SAINT" TEAM FORMED
- WORKING DEFINITION

"A PILOT'S CONTINUOUS PERCEPTION OF SELF AND A1C
IN RELATION TO THE DYNAMIC ENVIRONMENT OF FLIGHT,
THREATS, AND MISSION, AND THE ABILITY TO FORECAST,
THEN EXECUTE TASKS BASED ON THE PERCEPTION"

- OBJECTIVES

  • DEVELOP MEASURES FOR VISUALLY-GUIDED AIR-AIR COMBAT
  • IDENTIFY PRELIM. SELECTION TOOLS (ASSUMES APTITUDE/SKILL)
  • IDENTIFY PRELIM. TRAINING TOOLS (ASSUMES TRAINABLE SKILL)
3.1.1 Dr Grant McMillan (AL/CFHP). Serves as project leader and responsible for overall execution of the study.

3.1.2 Lt Col Jim Bushman (AL/CCE). Assists Dr McMillan in management and execution of the study.

3.1.3 Maj David Perry (AL/HRMAA). Responsible for development, test, and evaluation of the SAAB. Responsible for overall analyses of the study.

3.1.4 Dr Wayne Waag (AL/HRAT). Responsible for development, test, and evaluation of the SA Rating Scale. Assists in overall study analyses.

3.1.5 Dr Mike Vidulich (AL/CFHIP). Responsible for identification of the cognitive and performance components of SA. Advises on the development of the SAAB and the SA Rating Scale.

3.1.6 Dr Sam Schiflett (AL/CFTO). Advises on the development of the SAAB and SA Rating Scale.

3.1.7 Maj Glen Larsen (USAFSAM/FP). Consultant to overall study.

3.1.8 Lt Col Tim Kinney (WL/FIP). Joint Cockpit Office representative. Serves as consultant to overall study.
RESEARCH PLAN

- CONCURRENT DEVELOPMENT OF
  - THEORY-DRIVEN (COGNITIVE) SA APTITUDE TEST BATTERY
  - EXPERT-DRIVEN (BEHAVIORAL) CRITERION--BARS
- VALIDATION IN AIR-COMBAT SIMULATOR USING SELECTED SCENARIOS AND PILOTS
Develop Computerized SA Test Battery

Select Test Battery
Task 2

Identify Cognitive & Performance Components
Task 1

Screen Test Battery
Task 3

Assemble Test Battery
Task 4

Identify Behavioral Components
Task 5

Develop SA Rating
Task 6

Develop Performance-Based Metrics
Task 7

Develop Mission Scenarios
Task 8

Administer Test Battery & Conduct Final Analyses
Task 10

SA Test & Validation
Task 9

Develop Behaviorally Anchored SA Rating Scale
- Explore group processes in team performance
- Shared and individual SA
- How do you promote?
- Communication issues
- "Groupware" issues
- Group structure/process issues
- Leadership, training issues
REPORTS OF THE COMMITTEE ON TECHNIQUES FOR THE ENHANCEMENT OF HUMAN PERFORMANCE

U.S. Army Research Institute
Basic Research Office

Michael Drillings
(703) 274-5572; DSN 284-5572
ENHANCING HUMAN PERFORMANCE

- Commissioned by the Army Research Institute
- Performed by the National Research Council
- Major Reports of Phases I & II are:


ENHANCING HUMAN PERFORMANCE

PHASE I OBJECTIVES:

- Evaluate Selected, Non-Mainstream Techniques

- Provide an Authoritative Assessment of These Techniques for Policymakers in R&D

- Consider the Use of the Techniques in Army Training

- Develop Appropriate Criteria for Evaluating Claims

- Recommend Research to Better Understand Performance Enhancement

U.S. Army Research Institute/March 92
ENHANCING HUMAN PERFORMANCE

"EVALUATING HUMAN TECHNOLOGIES..."
HEGGE, TYNER, AND GENSER (1983)

- Effects of Technique
- Evidence for Claims
- Theoretical Support
- Who will be able to use
- Implications for Army Operations
- Army Philosophy
- Cost – Benefit Factors
ENHANCING HUMAN PERFORMANCE

Learning During Sleep

- No Evidence During Verified Sleep
- May be Some Effects During Light Sleep
- May be Relevant to State-Dependent Learning and Retention
- May be Cost-Effective for Additive Training
- Deserves More Research
ENHANCING HUMAN PERFORMANCE

Accelerated Learning

- Systems Approach is Warranted
- No evidence of "Non-Mainstream" effects
- Greater Application Possible in Army

Mental Practice

- Is Effective, But Not in Place of Physical Practice
- Attentional Control & Visual Concentration Training not Proven
- Sybervision™ Not Proven
- Biofeedback Not Proven
ENHANCING HUMAN PERFORMANCE

Altering Mental States

- No Evidence for Hemispheric Effects on Performance
- No Evidence for Hemi-Sync™
- Is There an Optimal Level of Arousal?
- Hypnosis and Meditation Should be Investigated
- No Validated Measures of Hemisphericity
ENHANCING HUMAN PERFORMANCE

Stress Management

- Relaxation Training — Effective
- Biofeedback — Limited Utility
- Cognitive Restructuring — Effective
- Behavioral Skills Training — Effective
- Relevance to Military Situation
- Societal Issues
ENHANCING HUMAN PERFORMANCE

Influence Strategies

- No Evidence for Effect of Neurolinguistic Programming
- Social Psych Literature Could be Basis for Techniques for Training to Influence Soldiers

Group Cohesion

- Lack of Studies Linking Cohesion & Performance
- There may be some Negative Effects
ENHANCING HUMAN PERFORMANCE

Parapsychology

- Evidence does not Justify Optimism
- Remote Viewing and Ganzeld Experiments are Flawed
- Psychokinesis Effects are Extremely Small and the Research is also Flawed
- Recommends a Common Protocol for Experimentation

U.S. Army Research Institute/March 92
ENHANCING HUMAN PERFORMANCE

PHASE II OBJECTIVES:

- Address Broad Theoretical Principles Underlying Training Program

- More Basic Issues of Performance
ENHANCING HUMAN PERFORMANCE

Long-Term Retention & Transfer

- Maximum Performance at End of Training May be Sub-Optimal for Long-Term Performance

- Increased Retention:
  - Increased Original Learning, Varying Learning Conditions, Develop Automaticity, Build in Environmental Cues, Mnemonics, Elaboration, Distributing Practice, Cooperative Learning, Doing, Testing, Part-Task Training

- Increased Transfer:
  - Contextual Interference During Training, Variety in Training, Reducing Feedback

U.S. Army Research Institute/March 92
ENHANCING HUMAN PERFORMANCE

Developing Careers

Myers-Briggs Type Indicator:

- Unsuitied for Self-Assessment
  - Reliability
  - Construct Validity
  - Predicting Validity
  - Discrimination Between Occupations

U.S. Army Research Institute/March 92
ENHANCING HUMAN PERFORMANCE

Subliminal Self-Help

• No Evidence that it is Effective

• No Reason to Believe That it could be

Meditation

• No "Special" Effect

• Epistemological Note

• Other Evidence

U.S. Army Research Institute/March 92
ENHANCING HUMAN PERFORMANCE

Optimizing Individual Performance

- Relaxation, Imagery, Mental Preparation Strategies, Skill Development Strategies, and Coping Produce Small to Moderate Improvements in Motor Performance in Less than Elite Performers.

- Preperformance Routines Seem to be Effective.

- Aerobic Exercise Helps People to Cope Better with Psychosocial Stressors.

- Neuropsychological Advances are Promising.
ENHANCING HUMAN PERFORMANCE

Team Performance

- Research on Group Structure and Functions is Lacking
- Groups Should be Stratified for Military Relevance
- Difficult to Generalize Results from Real Groups
- What is Optimal Division of Training Between Team and Individual Skills?
ENHANCING HUMAN PERFORMANCE

PHASE III OBJECTIVE:

- Look More at Army Training Environment

Candidate Topics:

- Hypnotic Augmentation of Performance
- Situated Learning
- Motivation
- Sensory Transformation
MR. DENIS BREGLIA

Naval Training Systems Center, Code 251
Orlando, Florida
VIRTUAL ENVIRONMENT TRAINING TECHNOLOGY

VETT

Denis R. Breglia
Simulation Imagery Branch
Naval Training Systems Center
A communication medium which facilitates natural, high efficiency interaction between a user and a computer generated environment
VE FEATURES

Efficient

Flexible

Multimodal

Three-dimensional

Interactive
VIRTUAL ENVIRONMENT

PROVIDES:

- MULTIMODALITY
- SENSORY STIMULATION
- DISPLAYS
  - VISUAL
  - AUDIO
  - TACTILE
  - FORCE
  - ?

MEASURES:

- TRAINEE MOVEMENTS
- FORCE
- VOICE
CHALLENGES FACING MILITARY TRAINING

* DECREASING ECONOMIC RESOURCES
* INCREASING COMPLEXITY OF TASKS
* INCREASING COSTS OF INSTRUCTIONAL PERSONNEL
* DECREASING AVAILABILITY OF RANGES
* INCREASING UTILIZATION OF RESERVES
* INCREASING COSTS OF TRAINING TDY
* DECREASING AVAILABILITY OF SCHOOLHOUSES
* INCREASING NEED FOR TEAM TRAINING
* CHANGING ROLE OF MILITARY

NTSC 251 1100 03/92
Anti-Tank Weapon
Precision Gunnery Training System (PGTS)
VETT

POTENTIAL PAYOFFS

- DECREASED TRAINER DEVELOPMENT & AND ACQUISITION COSTS

- DECREASED TRAINER OPERATION & AND MAINTENANCE COSTS

- REDUCED PHYSICAL REQUIREMENTS:
  WEIGHT, SIZE, ENERGY

- DEPLOYABLE, AVAILABLE

- ENHANCED TRAINING
## RELIANCE STRUCTURE FOR VETT

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<td>SPECIFIC TRAINING APPLICATIONS</td>
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<tr>
<td>LAND WARFARE/ROTARY WING TRAINING</td>
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<td>SEA WARFARE TRAINING</td>
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<td>CLASSROOM INSTRUCTION</td>
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<tr>
<td>AIRCREW TRNG EFFECTIVENESS</td>
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<tr>
<td>INTELLIGENT COMPUTER-AIDED INSTRUCTION</td>
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VIRTUAL ENVIRONMENT TRAINING
SIMULATOR VS VE

TRAINING SIMULATOR
HMI SPECIFIC TO EQUIPMENT BEING SIMULATED - 1000'S OF DESIGNS
ENVIRONMENT MODELED TO REAL WORLD PHYSICS

VE TRAINING
ONE OR FEW HMI HARDWARE DESIGNS
ENVIRONMENT DESIGNED FOR LEARNING
VE TRAINING

VS

SIMULATOR TRAINING

USER

HUMAN MACHINE INTERFACE

VE

SIMULATOR

DIS WORLD

NTSC 251 1101 03/92
VETT PROJECT

OBJECTIVE: Improve affordability and effectiveness of training through application of VE.

APPROACH: Develop, demonstrate, and evaluate VE-based training system concepts.
VE TRAINING
APPLICATIONS

CONCEPT APPLIES TO ALL TRAINING

BUT

NOW LIMITED BY TECHNOLOGY SOA
VETT APPROACH

3 PARALLEL EFFORTS

DEVELOP COMPONENT TECHNOLOGIES

DESIGN AND INTEGRATE CANDIDATE TRAINING APPLICATIONS

EVALUATE POTENTIAL COST AND TRAINING EFFECTIVENESS
VE DISPLAYS

VISUAL, AUDITORY & HAPTIC

AND, EVENTUALLY

VESTIBULAR, OLFACTORY & GUSTATORY
VISUAL DISPLAYS

ISSUES

AFFORDABILITY
FULL COLOR

FIELD OF VIEW
COMFORT

RESOLUTION
CONVENIENCE

NTSC 251^1003 03/92
AUDITORY DISPLAYS

ISSUES

3-D CALIBRATION

EFFECTIVE UTILIZATION
HAPTIC DISPLAYS

ISSUES

GROUNDED FORCES

TACTILE ICONS

WHOLE BODY ACCELERATION

NTSC 251 1105 03/92
VE TRANSDUCERS

POSITION
ORIENTATION
FORCE
SPEECH
POSITION AND ORIENTATION
TRANSUDCERS
ISSUES
FREEDOM OF MOVEMENT
ABSOLUTE/RELATIVE
INTERFERENCE
FORCE TRANSDUCERS

ISSUES

INTIMATE WITH FORCE DISPLAY

REACTIVE AND PROACTIVE

NTSC 251.1107 03/92
SPEECH TRANSDUCERS

ISSUES

SPEAKER INDEPENDENT

CONTEXT INDEPENDENT

CONTINUOUS SPEECH
TRAINING ENVIRONMENTS

ISSUES

Multimodal cue substitution and/or enhancement

Departures from the physics of the real world

Visualization of the invisible

Behavior of virtual actors
BEHAVIORAL RESEARCH ISSUES

* PERFORMANCE EFFECTIVENESS  - CAN THE JOB BE DONE IN A VE

* TRAINING EFFECTIVENESS    - IS VETT THE BEST WAY TO TRAIN

* SIDE EFFECTS

* EFFECT OF IMMERSION       - DISORIENTATION, VERTIGO, ETC.

- IS IMMERSION CRITICAL TO TRAINING
VETT COMPLEXITY LEVELS

1. SEATED OPERATOR, CONSOLE, 3-D VISUALIZATION

2. PLATFORM OPERATOR, WORKBENCH

3. SEATED TEAM, NETWORK

4. AREA OPERATOR

5. AREA TEAM
SEATED OPERATOR

VE - 1  MONITOR, BUTTONS, SWITCHES, KNOBS, INSTRUMENT DISPLAYS, KEYBOARD, AUDIO

VE - 2  WRAP AROUND, DYNAMIC, 3-D

VE HARDWARE

DISPLAYS -  HMD, HEADPHONES, GLOVES

TRANSDUCERS -  HEAD, HAND, FINGER P & O
PLATFORM OPERATOR

VE - 1  MANUAL CONTROLS AND DISPLAYS, AUDIO, FORCES

VE - 2  WORKBENCH, HANDTOOLS

VE HARDWARE

DISPLAYS - LEVEL 1 PLUS FORCE

TRANSDUCERS - LEVEL 1 PLUS FORCE
F-14D Aircrew Trainers
SEATED TEAM

VE - 1  AUDIBLE TEAM / INSTRUCTOR

VE - 2  VISIBLE TEAM / INSTRUCTOR

VE HARDWARE

DISPLAYS - LEVEL 2 PLUS PEOPLE

TRANSDUCERS - LEVEL 2 PLUS SPEECH
AREA OPERATOR

VE

STAND, WALK, BEND

VE HARDWARE

DISPLAYS - LEVEL 3 PLUS GROUNDED FORCE

TRANSDUCERS - LEVEL 3 PLUS WHOLE BODY P & O & FORCE
AREA TEAM
VE MULTI - PERSONNEL MANUAL TASKS

VE HARDWARE
DISPLAYS - LEVEL 4 PLUS PEOPLE

TRANSDUCERS - LEVEL 4
Introduction and Administrative Issues Subgroup Theme:
Simulator, Simulations and "Virtual Reality"

Enhancing Aircrew Training Through Virtual Environment Research:
Dr. Richard Thurman

Research on the Use of Virtual Environment in Crisis Management in the Navy:
Ms. Janet Dickieson
(no hard copies available)

Behavioral Requirements for Training in Virtual Environments:
Dr. Bruce Knerr
Virtual Environments

ENHANCING AIRCREW TRAINING

Air Force
Armstrong Lab
Aircrew Training Research Division
Williams AFB
Arizona

Richard Thurman
VIRTUAL REALITY
Spatial awareness consists of a description of each object's 3 coordinates of location, 3 coordinates of orientation and a motion velocity vector.
The air-to-air intercept as a spatial awareness problem.
The Basic Air-to-Air Intercept
The geometry of the air-to-air intercept.
Spatial Instruments Representing the Air Space During the Intercept
BEHAVIORAL REQUIREMENTS FOR TRAINING & REHEARSAL IN VIRTUAL ENVIRONMENTS

Dr. Bruce W. Knerr
Army Research Institute
PM TRADE Field Unit
Orlando, FL
OUR CONTEXT FOR VIRTUAL ENVIRONMENT RESEARCH

TRAINING DEVICES AND SIMULATORS

DISTRIBUTED INTERACTIVE SIMULATION (DIS)

SIMNET -> CCTT

BDS-D

UPAS

SUPERTROOP & I-PORT

SOLDIER INTEGRATED PERFORMANCE ENSEMBLE (SIPE)

SNOWBIRD CONFERENCE

ASB 91 SUMMER STUDY ON ARMY SIMULATION STRATEGY

NTSC VIRTUAL ENVIRONMENT TRAINING TECHNOLOGY (VETT)
THE MEMBERS OF THE STUDY TEAM BELIEVE THAT THE APPROACH WE HAVE CALLED THE ELECTRONIC BATTLEFIELD CAN MAKE MAJOR IMPROVEMENTS IN THE WAY THE ARMY DOES DEVELOPMENT, TESTING AND TRAINING. IT CAN EITHER REDUCE COST OVER TIME, OR IMPROVE PERFORMANCE, OR RESULT IN A COMBINATION OF LESSER AMOUNTS OF BOTH.

RECOMMENDATION: AGGRESSIVELY ADOPT THE ELECTRONIC BATTLEFIELD TECHNOLOGY FOR COLLECTIVE COMBINED ARMS TRAINING.

ARMY SCIENCE BOARD 1991 SUMMER STUDY ON SIMULATION STRATEGY
VIRTUAL ENVIRONMENTS RESEARCH GOALS

IDENTIFY VIRTUAL ENVIRONMENT INTERFACE REQUIREMENTS FOR MISSION PLANNING & REHEARSAL, MISSION-SPECIFIC TRAINING, AND COMBAT PROFICIENCY TRAINING FOR THE DISMOUNTED SOLDIER

EXAMINE FEASIBILITY OF VIRTUAL ENVIRONMENT TECHNOLOGY TO SUPPORT MISSION PLANNING AND POST-MISSION FEEDBACK FOR THE UNIT COMMANDER

DEVELOP SUPPORTING TRAINING TECHNOLOGY

VALIDATION OF TRAINING AND PERFORMANCE TRANSFER METHODOLOGY FOR PERFORMANCE MEASUREMENT AND FEEDBACK

METHODOLOGY FOR TRAINING PROGRAM DEVELOPMENT
BEHAVIORAL REQUIREMENTS FOR TRAINING AND REHEARSAL IN VIRTUAL ENVIRONMENTS

OBJECTIVE: TO IDENTIFY THE BEHAVIORAL REQUIREMENTS FOR NETWORKED INDIVIDUAL SOLDIER PORTAL (I-PORT) INTO NETWORKED SIMULATIONS FOR PURPOSES OF TRAINING AND MISSION PLANNING & REHEARSAL.

PROBLEMS: NEED TO TRAIN DISMOUNTED AND LIGHT INFANTRY USING THE COMBINED ARMS TACTICAL TRAINER (CCTT)

NEED FOR MISSION PLANNING, REHEARSAL, AND MISSION-SPECIFIC TRAINING CAPABILITY FOR GROUND SPECIAL OPERATIONS FORCES
COMBAT PROFICIENCY TRAINING

IMPROVE UNIT PROFICIENCY IN A VARIETY OF SITUATIONS

SOLDIERS ARE QUALIFIED IN INDIVIDUAL SKILLS

GENERIC MISSION, TERRAIN, & OPFOR

USUALLY REAL TIME
MISSION PLANNING & REHEARSAL

SUPPORT PLAN DEVELOPMENT & TRYOUT FOR SPECIFIC OPERATION

FAMILIARIZE SOLDIERS WITH THEIR ROLES (CRAWL & WALK)

COGNITIVE EMPHASIS (WHAT, WHEN, & WHERE)

INVOLVES UNIT & INDIVIDUAL TASKS

SOLDIERS ARE QUALIFIED IN INDIVIDUAL SKILLS

SPECIFIC MISSION, TERRAIN, & OPFOR

MAY DIFFER FROM REAL TIME (FASTER OR SLOWER)

FEEDBACK DIRECTED TOWARD IMPROVING THE PLAN
MISSION-SPECIFIC TRAINING

IMPROVE CAPABILITY TO CARRY OUT A PLAN FOR A SPECIFIC OPERATION SUCCESSFULLY

INVOLVES UNIT & INDIVIDUAL TASKS

SOLDIERS ARE QUALIFIED IN INDIVIDUAL SKILLS

SPECIFIC MISSION, TERRAIN, & OPFOR

SOLDIERS PRACTICE THEIR ROLES (RUN)

COGNITIVE & PSYCHOMOTOR (WHAT, WHEN, WHERE, & HOW)

REAL TIME
WHAT IS A VIRTUAL ENVIRONMENT?

A SIMULATED SPACE WITH WHICH THE VIEWER DIRECTLY INTERACTS VIA HEAD-MOUNTED DISPLAYS, SENSOR-EQUIPPED GLOVES, AND SPECIAL EQUIPMENT. IT IS DISTINGUISHED FROM MOST VISUAL SIMULATIONS IN THAT THE 'VEHICLE' IS THE PARTICIPANT'S OWN BODY, RATHER THAN AN AIRCRAFT, TANK, ETC.

A VIRTUAL ENVIRONMENT REQUIRES

3-D REAL-TIME INTERACTIVE GRAPHICS (STEREOSPISIS IF NEEDED)

MULTIPLE SENSES BEYOND GRAPHICS (SOUND, TOUCH...)

DIRECT MANIPULATION OF OBJECTS (E.G., BY A GLOVE)

FREE MOTION OF THE EYEPOINT WITHIN THE SPACE

MULTIPLE INTERACTING, MUTUALLY VISIBLE HUMANS
"Is that you, or am I experiencing Artificial Reality?"
"SATISFACTORY SEX, IN A FORM THAT COULD BE TRANSMITTED LONG-DISTANCE, BY COMPUTER, COULD BE AVAILABLE AS EARLY AS THE YEAR 2050."

JOEL GARREAU
WASHINGTON POST SUNDAY MAGAZINE
DECEMBER 30, 1990
ARI OPTION TO NTSC VETT CONTRACT

OBJECTIVES

EXAMINE VE CAPABILITIES AND TRENDS VIS A VIS INDIVIDUAL COMBAT SIMULATIONS (ICS)

CONSIDER CAPABILITIES OF THREE LEVELS OF ICS TO SUPPORT DISMOUNTED INFANTRY FUNCTIONS

LEVEL 1 (SIMNET/CCTT EQUIVALENT)

MULTI-SCREEN VISUAL DISPLAYS
SPEAKERS FOR BATTLEFIELD SOUNDS
JOYSTICKS & SIMILAR DEVICES
DI ICONS

LEVEL 2 (3–5 YEARS)

LOW RESOLUTION HMD
SENSING OF LIMB & BODY POSITION
MOVEMENT IN PLACE
HEADPHONES FOR LOCALIZED SOUND
LIMITED SPEECH RECOGNITION (SD)
SPECIALIZED CONTROL & SENSING DEVICES
LOW-FIDELITY ARTICULATED DI ICONS

LEVEL 3 (>5 YEARS)

HIGH RESOLUTION HMD
EYE TRACKING
SENSORY STIMULATION OF WHOLE BODY MOVEMENT
ADVANCED SPEECH RECOGNITION (SI)
PROGRAMMABLE GENERAL-PURPOSE CONTROL & SENSING DEVICES
FULLY ANIMATED DI ICONS
ARI OPTION TO NTSC VETT CONTRACT

CONCLUSIONS

ICS IS A LOGICAL PROGRESSION OF DIS CAPABILITIES

THERE ARE POTENTIAL TRAINING & MISSION REHEARSAL
BENEFITS TO BE OBTAINED FROM THE TECHNOLOGY AVAILABLE
NOW

DIFFICULT PROBLEMS

MISSION-SPECIFIC TRAINING
URBAN OR CLOSE-IN OPERATIONS
CONTROL AND MANIPULATION OF WEAPONS AND EQUIPMENT
WHOLE BODY MOVEMENT
MAKING VIRTUAL ENVIRONMENTS A REALITY

ENGINEERING/COMPUTER SCIENCE ISSUES
  VISUAL DISPLAYS
  REAL-TIME IMAGERY CONSTRUCTION
  HEAD & BODY TRACKING
  TACTILE & FORCE SENSING & FEEDBACK
  DATABASE GENERATION

BEHAVIORAL ISSUES
  INTERFACE REQUIREMENTS
  PERFORMANCE MEASUREMENT & FEEDBACK
  PERFORMANCE & TRAINING TRANSFER
  TRAINING STRATEGIES
AN EXAMPLE OF WHAT WE DON'T KNOW

WHAT VISUAL DISPLAY UPDATE RATE IS REQUIRED FOR A PERCEPTION OF CONTINUOUS MOVEMENT?

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>UPDATES/SEC</th>
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<tr>
<td>FLIGHT SIMULATORS</td>
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<td>ENTERTAINMENT INDUSTRY</td>
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<td>THRU SIMULATED BUILDING (UNC)</td>
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</tr>
<tr>
<td>DRIVER SIMULATOR (STI)</td>
<td>20</td>
</tr>
<tr>
<td>PARACHUTE MANEUVER SIMULATOR (STI)</td>
<td>10</td>
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</tbody>
</table>
PRELIMINARY VIRTUAL ENVIRONMENT INTERFACE ISSUES

INPUT (SOLDIER -> COMPUTER) REQUIREMENTS
MOVEMENT TRACKING
  GROSS
  FINE
  HEAD/EYE
  HAND/FINGER
  VOICE RECOGNITION

OUTPUT (COMPUTER -> SOLDIER) REQUIREMENTS
VISUAL DISPLAYS
  BRIGHTNESS
  RESOLUTION
    NEAR OBJECTS
    FAR OBJECTS
  UPDATE RATE
  MOVEMENT RATE & LAG
  HEAD MOVEMENT COMPENSATION
  FIELD OF VIEW
  STEREOSCOPIC VS MONOCULAR DISPLAYS
  COLOR
TERRAIN REPRESENTATION
  AREA
  LEVEL OF DETAIL (GRANULARITY)
FUNCTIONAL VS PHYSICAL FIDELITY
ENVIRONMENT
WEAPONS & EQUIPMENT
TACTILE FEEDBACK
FORCE FEEDBACK
AUDITORY CUES/VOICE SYNTHESIS
  LOCALIZATION
  LIBRARY

HUMAN FACTORS ISSUES
BEHAVIORAL REQUIREMENTS FOR TRAINING AND REHEARSAL IN VIRTUAL ENVIRONMENTS (ILLUSION ENGINEERING, INC)

DEVELOP PRACTICAL USAGE SCENARIOS AND TASKS TO BE PERFORMED FOR

COMBAT PROFICIENCY TRAINING
MISSION PLANNING & REHEARSAL
MISSION-SPECIFIC TRAINING

DEVELOP TAXONOMY OF SIGNIFICANT VIRTUAL ENVIRONMENT INTERFACE CHARACTERISTICS

DETERMINE INTERFACE REQUIREMENTS FOR EACH TYPE OF TASK

SUMMARIZE LITERATURE

IDENTIFY KNOWLEDGE GAPS

DEVELOP RESEARCH PLAN TO FILL GAPS

IDENTIFY REQUIREMENTS & COST FOR RESEARCH TEST BED
VIRTUAL ENVIRONMENTS RESEARCH GOALS

IDENTIFY VIRTUAL ENVIRONMENT INTERFACE REQUIREMENTS FOR MISSION PLANNING & REHEARSAL, MISSION-SPECIFIC TRAINING, AND COMBAT PROFICIENCY TRAINING FOR THE DISMOUNTED SOLDIER

EXAMINE FEASIBILITY OF VIRTUAL ENVIRONMENT TECHNOLOGY TO SUPPORT MISSION PLANNING AND POST-MISSION FEEDBACK FOR THE UNIT COMMANDER

DEVELOP SUPPORTING TRAINING TECHNOLOGY

VALIDATION OF TRAINING AND PERFORMANCE TRANSFER

METHODOLOGY FOR PERFORMANCE MEASUREMENT AND FEEDBACK

METHODOLOGY FOR TRAINING PROGRAM DEVELOPMENT
CREW, GROUP, TEAM, AND UNIT TECHNOLOGY SUB-GROUP

Opening Remarks

Joint Collective Training R&D Effort:
   Dr. Frank Moses, ARI

   Dr. Eduardo Salas, NTSC
   (No hard copies available)
ASSESSMENT OF JOINT TRAINING STRATEGIES FOR INCREASING WARFIGHTING EFFECTIVENESS

Participating Organizations:

ARI
NTSC
ALHR & ASD/XR

Dr. Frank Moses
POC @ ARI
Tel: 274-8293
ASSESSMENT OF JOINT TRAINING STRATEGIES

GOAL

DEVELOP TECHNOLOGIES FOR --

- TRAINING JOINT SERVICE TASKS -- MIXES OF GROUND, ROTARY, FIXED-WING, BEACHHEAD ASSAULT, AND SUPPORTING NAVAL FORCES

- ASSESSING JOINT TRAINING STRATEGIES -- SCHEDULES OF TRAINING EVENTS AND DISTRIBUTION OF RESOURCES

NEED

- INCREASE JOINT TRAINING EFFECTIVENESS THROUGH BEST USE OF DISTRIBUTED INTERACTIVE SIMULATION

2/12/92
R & D OBJECTIVES & APPROACH

- DEVELOP OR ADAPT A TRAINING TESTBED*
- DEVELOP PROTOTYPE METHODS FOR AFTER ACTION REVIEWS (AARs) AND OTHER FEEDBACK TECHNIQUES
- DEMONSTRATE TRAINING PRINCIPLES/PROCEDURES, AARs, AND OTHER TRAINING AND PERFORMANCE FEEDBACK TECHNIQUES
- ANALYTICALLY ESTIMATE THE TRADEOFFS AMONG ALTERNATIVE TRAINING PRINCIPLES/PROCEDURES

* A DATABASE WITH (A) GENERIC WARTIME SCENARIOS REQUIRING JOINT OPERATIONS AND (B) METHODS/TECHNOLOGIES FOR SELECTIVE REPLAY AND MEASUREMENT OF COLLECTIVE TRAINING PERFORMANCE

2/12/92
R & D SCOPE

- ADDRESS MULTI-SERVICE COMBAT TRAINING RE: BATTLE PLANNING, PREPARATION, AND EXECUTION
  - CLOSE AIR SUPPORT, SAFE PASSAGE
  - COMBINED AMPHIBIOUS AND LAND ASSAULT

- FORCE-LEVEL TRAINING
  - BOTH HORIZONTAL AND VERTICAL ORGANIZATIONS
  - COMBINATIONS OF ANY TWO-OR-MORE ECHELONS

2/12/92
COLLECT CRITICAL DATA

• FROM OBSERVATIONS OF TRAINING WITH SIMULATOR NETWORKS
  - - IDENTIFY CRITICAL TASKS FOR COMBAT SCENARIOS
  - - IDENTIFY MEASUREMENT ISSUES AND METHODS

• ANALYZE OBSERVATIONS/DATA IN TERMS OF
  - - PERFORMANCE REVIEW
  - - CROSS-TRAINING
  - - FREQUENCY OF TRAINING
  - - GUIDED PRACTICE
  - - ETC
HOW TO GET THERE

ENHANCED TRAINING STRATEGIES

(FTX .. DEPLEX .. LFX .. CPX ...)

MEASURES
Assessment Data

RESOURCES
Logistics
Spaces
Ranges

SCENARIOS
Objectives
Conditions
Tasks-Functions

R & D

EMERGING TECHNOLOGIES *

* Models, Simulations, Distributed Interactive Simulations/Networks, Virtual Reality, etc.
RELATED INITIATIVES

LOUISIANA MANEUVERS CONCEPT

REALISTIC (LE UNIT) EXERCISES
"ACHIEVE "WARTIME" REALISM"

Commanders Conference
LOUISIANA MANEUVERS
1941

CONCEPT

- GOAL: BATTLEFIELD REALISM; VALIDATE TRAINING,
  ORGANIZATION AND DOCTRINE

- RED/BLUE FIELD ARMY WITH AIR TASK FORCE

- OFFENSIVE MISSION FOR BOTH SIDES

- FREE PLAY, FIRE MARKERS AND UMPIRES

- NO SCRIPTED SCENARIOS AND MANUAL CONTROL MEASURES

- STRESS C2, MANEUVER, MOVEMENT AND LOGISTICS

- UMPIRE MANUAL USED TO RESOLVE ENGAGEMENTS

- FIRST USE OF AFTER ACTION CRITIQUE

LARGE-SCALE MEETING ENGAGEMENTS

★★★★ Commanders Conference
LOUISIANA MANEUVERS
1941

LESSONS LEARNED

- LARGE SCALE EXERCISES ARE EFFECTIVE
  -- TRAINS SR CDR'S & STAFF OFFICERS
  -- COUNTERPRODUCTIVE FOR GROUND TROOPS

- UMPIRE MANUAL VALID MEANS OF RESOLVING COMBAT
  -- REVISION OF SOME TABLES REQUIRED
  -- DIDN'T REFLECT ACTUAL CAPABILITY OF ALL UNITS AND WEAPONS

- FOLLOW ON TRAINING PROGRAM FOCUSED AT SMALL UNIT LEVEL
  -- STANDARDIZED PERFORMANCE MEASURES
  -- CENTRALIZED EVALUATION

- AFTER ACTION CRITIQUE - EFFECTIVE TOOL

★★★★ Commanders Conference
LOUISIANA MANEUVERS
1994

- TNG AUDIENCE
  -- THEATRE ARMY
  -- ARMY GROUP
  -- FIELD ARMY
  -- CORPS
  -- DIVISION (EXERCISE CELL/FIELD LOCATIONS?)

- AREAS OF EMPHASIS:
  -- SR CDR & STAFF OFFICER TNG
  -- JOINT/COMBINED OPERATIONS
  -- CAMPAIGN PLANNING
  -- COMMAND & CONTROL
  -- FORCE PACKAGING
  -- FORCE PROJECTION
  -- LARGE SCALE MANEUVER
  -- LARGE SCALE MOVEMENT
  -- SUSTAINMENT
  -- INTELLIGENCE
  -- REDEPLOYMENT

⭐⭐⭐⭐ Commanders Conference
ALL FORCE TRAINING
SYNTHETIC BATTLEFIELDS ON DEMAND

DARPA
SIMULATION TECHNOLOGY FOR THE SYNTHETIC BATTLEFIELD

[Diagram showing a three-layered approach to simulation technology:
- **LIVE PLAY** (Instrumented Ranges: NTC, Nellis, Fallon, 29 Palms)
- **TACTICAL ENGAGEMENT SIMULATIONS**
- **VIRTUAL** (Networked Simulators)]
SYNTHETIC BATTLEFIELDS ON DEMAND

KOREAN 3D SIMULATION TEST BED

THEATER - SCALE SIMULATION
LINKED LAND, SEA, AIR FIELD EXERCISES AND SIMULATIONS
MULTIPLE SIMULTANEOUS SCALABLE AGGREGATION LEVELS
WORLD-WIDE MANEUVER AREA
MULTIPLE WAR GAMES

NTC 3D SIMULATION TEST BED

OTHER S/W USA 3D SIMULATION TEST BEDS

CENTCOM SIM TEST BED

DSINET
Training Needs and Evaluation Issues

Identifying Over-and-Under Trained Tasks:
Ms. Michele Morales

Opportunities to Perform Trained Tasks
Dr. Mark Teachout
AN INVESTIGATION OF TRAINING EFFICIENCY

MICHELE M. MORALES
ARMSTRONG LABORATORY

MARCH 1992
TRAINING EFFICIENCY RESEARCH OUTLINE

- RESEARCH OBJECTIVES
- 4 PHASES OF PROJECT
  - TRAINING CONTENT IDENTIFICATION
  - TRAINING EMPHASIS IDENTIFICATION
  - MATCHING TECHNIQUE APPLICATION
  - TASK PERFORMANCE LINKED WITH MATCHING TECHNIQUE
- CURRENT RESEARCH
RESEARCH OBJECTIVES

TO DEVELOP METHODOLOGIES TO EXAMINE:

1. TRAINING CONTENT VALIDITY
   • IS TRAINING CONTENT JOB RELEVANT?

2. TRAINING EFFICIENCY
   • ARE TASKS OVER OR UNDERTRAINED?

FOR THE AGE ABR COURSE
STEP 1
IDENTIFICATION OF TRAINING CONTENT DOMAIN

PURPOSE: IDENTIFY TRAINING CONTENT DOMAIN IN TERMS OF OSR TASK STATEMENTS

METHOD: SMEs LINKED OSR TO POI
SMEs LINKED TASKS TO INSTRUCTIONAL AREAS
INSTRUCTORS VERIFIED LINKS

OUTCOME: TRAINING DOMAIN IDENTIFIED AS CONSISTING OF 99 TASKS
STEP 2
IDENTIFICATION OF TRAINING EMPHASIS

PURPOSE: IDENTIFY EMPHASIS INSTRUCTORS PLACE ON EACH TASK TRAINED

METHOD: SURVEYS DEVELOPED FOR THE FIVE INSTRUCTIONAL AREAS

53 INSTRUCTORS SURVEYED
ESTIMATED TOTAL TIME DEVOTED TO EACH TASK

OUTCOME: TIME ESTIMATES FOR THE 99 TASKS TRAINED
STEP 3
APPLICATION OF THE MATCHING TECHNIQUE

PURPOSE: APPLY MATCHING TECHNIQUE TO AGE ABR COURSE

METHOD: COMPARE OSR EMPHASIS RATINGS TO INSTRUCTOR TIME ESTIMATES

RATINGS AND TIME ESTIMATES TRANSFORMED TO Z-SCORES

COMPUTER SOFTWARE DEVELOPED TO DISPLAY RESULTS

OUTCOMES: IDENTIFICATION OF POTENTIALLY OVER OR UNDERTRAINED TASKS
MATCHING TECHNIQUE TO EXAMINE TRAINING EFFICIENCY

TRAINING EMPHASIS FROM OSR RATINGS

POSSIBLE TRAINING DEFICIENCY

TRAINING MATCH

POSSIBLE TRAINING EXCESSES

ACTUAL TRAINING EMPHASIS
FIGURE 1. Examples of Possible Over and Undertrained Tasks.
FIGURE 2. Examples of Tasks that are Training Hits.

TASK 264: ISOLATE ENGINE OR MOTOR MECH. MALF.

Figure 2a: Training hit, high emphasis

TASK 225: REMOVE OR INSTALL CANNON PLUG PARTS

Figure 2b: Training hit, low emphasis
STEP 4
LINKING MATCHING OUTCOMES & PERFORMANCE

PURPOSE: RELATE MATCHING OUTCOMES WITH TASK PERFORMANCE OF AGE AIRMEN

METHOD: DEVELOPMENT OF CONCEPTUAL MODEL
USE OF JPMS HANDS ON PERFORMANCE DATA FOR THE 11 TASKS TRAINED IN ABR COURSE
PERFORMANCE OF 52 OF 286 AIRMEN EXAMINED
WEIGHTED COMPOSITE SCORES ABOVE 5 CONSIDERED "PERFORMED WELL"

OUTCOMES: TASKS FOUND IN ALL SIX CELLS OF MODEL
**FIGURE 4.** Results of Linking Matching Outcomes to Performance.
CURRENT RESEARCH

• GOAL OF TRAINING

• COLLECTION OF KNOWLEDGE AND PERFORMANCE DATA

• STUDY OF VARIABLES THAT INFLUENCE TRAINING
Cluster by equipment
Cluster by function
Rank order by % performing first term
Rank-order by difficulty rating
Rank order by % performing lst 12 mo.
Rank order by ATI
Return to main menu

Use the UP and DOWN ARROWS to highlight an option
Press RETURN to select the highlighted option

Screen 11
Task: 381 Isolate electrical circuitry malfunctions

Press any key to continue

Screen 17
FACTORS AFFECTING THE OPPORTUNITY TO PERFORM TRAINED TASKS
### PART I:
For each task statement listed below, answer the following questions in the appropriate column. When completing these questions, only consider the first twelve months since graduation from Chanute AFB regardless of how long you have been at your present duty station.

1. In the first 12 months since completion of training at Chanute AFB, have you **PERFORMED** this task either with or without supervision? Completely fill in the circle “Y” if you have performed the task or fill in the circle “N” if you have not performed the task.

   For every item that you answer yes, please answer the following two questions:

2. **WHEN** was the **first** time you performed the task? Fill in “Y” if you first performed the task in the first eight months after graduation. Otherwise, fill in the number corresponding to the month in which you first performed the task.

3. **HOW MANY TIMES** have you performed the task **since** graduating from Chanute AFB? Use the boxes to mark your answer. For example, if you have performed “Adjust contactor points” two times in the first twelve months since graduating from Chanute, you would write in the boxes [0 0] [0 0 0 0] [0 0 0 0 0 0]

<table>
<thead>
<tr>
<th>Task Statement</th>
<th>PERFORMED?</th>
<th>WHEN? (MONTH)</th>
<th>HOW MANY TIMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill out AFTO Forms 244</td>
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<td>Measure resistance in electrical circuits</td>
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<td>Adjust engine fuel system components</td>
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<td>Isolate engine, motor, or generator mechanical malfunctions</td>
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<tr>
<td>Perform compression tests</td>
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<td>Perform engine, motor, or generator operational checks</td>
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<td>Remove or install AGE tire, tube, or wheel assemblies</td>
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<tr>
<td>Perform air conditioner visual or service inspections</td>
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<td>Perform hydraulic test stand service inspections</td>
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<td>Inspect vehicles for safety of operation</td>
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161
## % Performing Task by Month
### After 4 Months

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Times Performing Task

After 4 Months

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**OPPORTUNITY TO PERFORM CONSTRUCT**

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<td># Times</td>
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<tr>
<td>Task Type</td>
<td>Difficulty/Criticality</td>
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METHOD

TRAINING COURSE
Aerospace Ground Equipment
18 Weeks
99 Tasks Taught

SAMPLE
180 Recent Graduates
34 Tasks Sampled

DATA COLLECTION
Survey Methodology
Measures gathered 4 months after training
## MEASURES

<table>
<thead>
<tr>
<th>SUPERVISOR</th>
<th>AIRMAN</th>
<th>OTHER</th>
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<tr>
<td>Attitudes Toward Airman Work Flow</td>
<td>Opportunity to Perform Support Self Efficacy</td>
<td>MAJCOM Ability (ASVAB)</td>
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Work Flow

INDIVIDUAL
Self Efficacy
Ability

OPPORTUNITY TO PERFORM
Breadth
Activity Level
Task Type

WORK CONTEXT
Supervisor Attitudes
Support
Work Flow

ORGANIZATION
Functional Area
Hierarchical Block Regression Results
For Breadth

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<th>$R^2$</th>
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<td>.10*</td>
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NOTE: * $p<.05$

<sup>a</sup> Beta for this variable was significant ($P<.05$) at this step
Hierarchical Block Regression Results
For Activity Level

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NOTE: * $p<.05$

$^a$ Beta for this variable was significant ($P<.05$) at this step
Hierarchical Block Regression Results
For Task Type

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NOTE: * $p<.05$

<sup>a</sup> Beta for this variable was significant ($P<.05$) at this step
Findings

- Opportunity to perform is a multidimensional construct

- There are individual differences in opportunities to perform trained tasks

- These differences are predictable
SUBGROUP SESSION II

ADVANCED TRAINING TECHNOLOGY

Visual Learning in Virtual Environment:
Dr. J. Psotka

Summary and Conclusions of Virtual Reality in Training
Research in the Services or "What are the Research
Issues in the use of Virtual Reality in Training?"
Visual Communication in Multi-Media Virtual Realities.

This basic research project in visual communication examines how visual knowledge should be structured to take full advantage of advanced computer environments for training, especially hypertext and virtual reality. A Visual AirCraft Recognition (VACR) Training hypertext has been built and tested. Virtual Reality workstations have been explored and will be used for future experiments. A theory of visual concept learning is under development.

6.1 RESEARCH

Our first experiments examined the interface, architecture, and training strategy issues for combining images and text in multimedia systems. An Army Field Manual (FM 44-30) was completely digitized, and redesigned to take advantage of several powerful hypertext features: search, browsing, "hot" words or buttons, apparent motion, and colored contrasts. A series of experiments determined the training advantages of these features. These results were integrated into a theoretical framework that combined "ecological perception" with "apparent motion" as a basis for visual concept learning. The theory is continuing to be refined and tested in ongoing work.

The hypertext and digitized images are being transferred from our experimental multimedia platform to a state-of-the-art Virtual Reality Platform for research. This work will examine the value of virtual "immersion" into a 3-D environment for memory of spatial orientation, over 2-D spatial interfaces. In addition, the Virtual Reality workstation will allow us to extend our theoretical framework to begin to analyze the comparative strengths of speech communication versus visual communication in the exchange of shared mental models among crew and group members. Interactions between people and simulated crew members will use detailed models of animated agents and faces developed at the Army Center for AI at the University of Pennsylvania.

THEORY

Basic theories about visual communication need to be developed in detail if the rapid progress in computer technologies is to be fully leveraged in future Army training. Recent synthetic reality and hypermedia computer technologies, combined with Artificial Intelligence (AI) knowledge representation techniques, offer unprecedented opportunities for digitizing, displaying, transforming, and transmitting pictures as easily as words and sentences.

POTENTIAL MILITARY RELEVANCE

The Army is increasingly turning to large scale simulator networking for cost effective training of warfighting skills. This research advances several core technologies that will be transferred to 6.2 research in AISTA, PM-TRADE Field Unit, and Ft. Bliss Field Unit. The VACR training hypertext is being transferred to Ft. Bliss currently. Future work will have direct bearing on distributed simulator design for "popped hatch" tank simulators, and effective crew communication and spatial navigation training.

ARI POC: Dr. Joseph Psotka, AV 284-5540; Comm (703) 274-5540.
Visual Concept Training

Basic Research

Research Problem

What are the best

- Technological opportunities for Visual Communication?
- Interfaces to complex visual knowledge spaces?
- Training designs in advanced technology environments?

Research Approach

Hypothesis: Use Ecological Perception to Structure Knowledge

- Digitize a multimedia HyperBook for training
- Conduct experiments to determine principles of training design in multimedia environments
Visual Concept Training
Basic Research

Technological Opportunity

- Visual Communication
  - Hypertext and Multimedia
  - AI and Semantic Networks
  - CyberSpace

Army Relevance

- Training and Command/Control
  - Protect SHORAD Lethality
  - VACR -- Visual AirCraft Recognitior
  - HQDA -- FM 44-30
Visual Concept Training
Basic Research

Expected Outcomes

- Exploration of Technological Possibilities
- Cognitive Theory of Visual Concept Training
- Experiments Verifying Principles of Hypertext Design for Combining Text and Image Media in Training

Research Accomplishments

- FM 44-30 Digitized Hypertext
- Technologies for Comparison and Contrast of Visual
- CyberSpace Interface to AirPlane Pictorial Browser
Table of Contents

1. ARMY OPPORTUNITY AND NEED
   a. US Army Research Institute

2. RESEARCH OBJECTIVES AND APPROACH

3. RESOURCES

4. MILESTONES

5. PRODUCTS AND DEMO

6. Experimental Results

7. Future Directions

8. 6.2 CONNECTIONS
EXAMPLE

- MILLARD FILLMORE
- JOHN ADAMS
- TORNADO
- GEORGE MASON
FIRST EXPERIMENT

FM 44-30 VERSUS HYPERBOOK

Learn names of 20 planes in half an hour

Unpaired t-Test $X_1$: Condition $Y_1$: PostTest

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2 Standard Deviation effect with only 10 Subjects

12.8 / 20  17 / 20  Correct
SECOND EXPERIMENT

FM 44-30 VERSUS HYPERBOOK

TEST NOT JUST ON OUTLINES, BUT ON DIFFERENT PICTURES AND MODELS

RESULTS

- HyperBook still superior on tests
- Much more examination of HyperBook
  - Similar Planes, ContraPict, WEFT
Third EXPERIMENT

FM 44-30 VERSUS HYPERBOOK

TEST AGAINST SIMILAR PLANES
TRANSFER TEST AGAINST NEW PICTURES
TWENTY PLANES IN ONE HOUR

RESULTS

- HyperBook superior on transfer test
- Individual examination of HyperBook
  - Similar Planes, ContraPict, WEFT
- Many more complaints from FM studiers
<table>
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<td>KING AIR U-21</td>
</tr>
<tr>
<td>HAWK</td>
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<tr>
<td>DRAKEN</td>
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<tr>
<td>F-15 EAGLE</td>
</tr>
<tr>
<td>AN-24 COKE, AN-26 CURL</td>
</tr>
<tr>
<td>YAK-36 FORGER</td>
</tr>
<tr>
<td>U-8F SEMINOLE, QUEEN AIR</td>
</tr>
<tr>
<td>TU-26 BACKFIRE</td>
</tr>
<tr>
<td>C-141B STARLIFTER</td>
</tr>
<tr>
<td>HUNTER</td>
</tr>
<tr>
<td>A-6 INTRUDER</td>
</tr>
<tr>
<td>F-4 PHANTOM</td>
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<tr>
<td>MIG-25 FOXBAT</td>
</tr>
<tr>
<td>MIRAGE-III/5</td>
</tr>
<tr>
<td>C-5A GALAXY</td>
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<td>B-1B</td>
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<tr>
<td>An-32 CLINE</td>
</tr>
<tr>
<td>KFIR C-2</td>
</tr>
<tr>
<td>TORNADO</td>
</tr>
</tbody>
</table>

Click on the name of any plane to go to the card with information about that plane.
Similarity Space of Planes

HELICOPTERS SPACE
Third EXPERIMENT

FM 44-30 VERSUS HYPERBOOK

Learn names of 20 planes in an hour

<table>
<thead>
<tr>
<th></th>
<th>PreTest</th>
<th>PostTest</th>
<th>TransferTest</th>
</tr>
</thead>
<tbody>
<tr>
<td>HyperBook</td>
<td>13.8*</td>
<td>55.0*</td>
<td>41.6**</td>
</tr>
<tr>
<td>(N=8)</td>
<td></td>
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<tr>
<td>Book</td>
<td>14.6*</td>
<td>48.2 *</td>
<td>30.0 **</td>
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<td>(N=7)</td>
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</table>

** p.<.05 (sign test)
* not sig.

Percent correct recognition after 1 hour study.
Percent recognition for Book and Hyper Groups on Transfer Test with New Pictures

- Transfer-B
- Transfer-H

Percent Correct vs Plane

Haw Hunt Jagua King An24 A6 c141 Tu26 Kfir U8f c5a F4 Mirag AV Yak drakenf15 An3 MIG 25b1b
Percent Correct Recognition

Rank Ordered Groups

Percent Correct Recognition

Data from "Hyper Group - Subject Measures"
Number of Similar Planes viewed by Both Groups

Number of Views

Plane

```
Number of Similar Planes viewed by Both Groups

30

20

10

0

A AnAn:AVb1c14cdrak15FHeHuJagKfKIIMIrTu2LYak 36

sim-views-H

sim-views-B
```
Number of Looks at Each Plane

Airplanes

Number of Views

Hyper
Book
Transfer Test

Data from "Hyper Group - Subject Measures"

\[ R^2 = 0.677 \]
Number of Contrasts Viewed

Data from "Hyper Group - Subject Measures"
Data from "Hyper Group - Subject Measures"
15 Stepped

All 50

35 Bubble
W.E.F.T. Test Card

Wings
- Location
- Sweep
- Length
- Taper
- Tip Shape

Engine
- Kind
- Location
- Number

Fuselage
- Nose
- Midsection
- Rear

Tail
- Flat Location
- Flat Tip
- Flat Shape
- Flat Slant

Test yourself on any WEFT feature by buttoning that feature and then answering all the questions that come up ...
Aircraft Role

- Attack
- Ground Attack
- Interceptor
- Fighter
- Strike
- Fighter-bomber
- Bomber
- Cargo
- Transport
- Reconnaissance
- Surveillance
- Observation
- Trainer

Click on any button to see all the aircraft that have the selected Role.

Armament

- Cannon
- Gun
  - Gun pods
  - Gun packs
  - Machine gun
  - Mini gun
- Bombs
- Missiles
  - ALCM
  - SRAM
  - ASM
  - ARM
  - SAM
- Rockets

Main Menu
Guided Tour

To get an overview of the different aircraft listed below, click the "Take Tour" button. On the tour, click anywhere to go to the next plane.

<table>
<thead>
<tr>
<th>USA</th>
<th>IRAQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWACS</td>
<td>MIRAGE-F1</td>
</tr>
<tr>
<td>A-6 INTRUDER</td>
<td>Mi-24 HIND</td>
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<tr>
<td>A-10 Thunderbolt II</td>
<td>MiG-23 Flogger B</td>
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<tr>
<td>B-52</td>
<td>MIG-29 Fulcrum</td>
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<tr>
<td>AH-64 APACHE</td>
<td>Su-24 FENCER</td>
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<tr>
<td>F-4 PHANTOM</td>
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<tr>
<td>F-15 Eagle</td>
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<td>F-16 FIGHTING</td>
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<td>FALCON</td>
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<td>F-111</td>
<td></td>
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<tr>
<td>F-117A</td>
<td></td>
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</tbody>
</table>

Take Tour

<table>
<thead>
<tr>
<th>USA</th>
<th>IRAQ</th>
</tr>
</thead>
</table>

Main Menu

A-10 THUNDERBOLT II

Country of Origin. USA.

Similar Aircraft. None.

Crew. One.

Role. Close air support, ground attack.

Armament. 30-mm cannon, bombs, rockets, HELLFIRE missiles, gun pods.

Dimensions. Length 53 feet, span 58 feet.

Wings. Wings are low mounted on the fuselage, unequally tapered, with blunt curled-under tips. Landing gear pods extend forward of the wings' leading edges.

Engine(s). Two turbofan engines in pods, high on the rear of the body between the wings and the tail section.

Fuselage. Rounded nose, tapered rear, bubble canopy. Protrusion in nose is the 30-mm GAU-8 cannon.

Tail. Two tail fins on tips of flat. Unequally tapered fins extend above and below the tail flat. Rectangular tail flat is low-mounted on fuselage.
Country of Origin: France, West Germany.

Similar Aircraft: Hawk.

Crew: Two
Role: Light attack, advanced trainer.

Armament: Gun pods, bombs, rockets, missiles.

Dimensions: Length 40 feet, span 30 feet.
Wings: High-mounted, swept-back, and tapered with curved tips, slight negative slant.

Engine(s): Two alongside body under the wings, oval shaped air intakes forward of the wings' leading edges. Exhausts at the rear of wings' trailing edges.

Fuselage: Slender, pointed nose and tail. Two-seat bubble cockpit.

Tail: One swept-back and tapered tail fin with squared tip. Swept-back and tapered tail flats mid-mounted on body with negative slant and square tips.
CREW, GROUP AND UNIT TRAINING

Opening Remarks

Aircrew Coordination Training R&D:

Dr. David Baker, NTSC
Mr. Randall Oser, NTSC
Major Wes Woodruff, USAF, NTSC
ORGANIZATIONAL VARIABLES AND AIRCREW COORDINATION: IMPLICATIONS FOR TEAM TRAINING

MARY D ZALESNY
KENT STATE UNIVERSITY

DAVID P. BAKER
CAROLYN PRINCE
EDUARDO SALAS
NAVAL TRAINING SYSTEMS CENTER
BACKGROUND

- HUMAN ERROR IS A LEADING CAUSE OF AVIATION MISHAPS.

- AIRCREW COORINATION TRAINING (ACT) HAS BEEN IDENTIFIED AS AN APPROACH FOR OFFSETTING AIR MISHAPS.

- ORGANIZATIONAL VARIABLES ARE LIKELY TO IMPACT ACT AND CANNOT BE IGNORED.
RESEARCH OBJECTIVES

- GATHER INFORMATION FROM RESERVE AVIATION SQUADRONS RELATED TO:
  - AIRCREW COORDINATION
  - TEAM PERFORMANCE
  - RESOURCE MANAGEMENT

- IDENTIFY CRITICAL ORGANIZATIONAL VARIABLES

- IDENTIFY FUTURE RESEARCH NEEDS
MILITARY RESERVES

- UNIQUE ORGANIZATION TO STUDY FOR SEVERAL REASONS:
  - ORGANIZATIONAL MEMBERS HAVE DUAL ALLIANCES.
  - POSITIONS ARE SHARED BETWEEN RESERVES AND ACTIVES.
  - ACTUAL JOB PERFORMANCE MAY NEVER OCCUR.
METHOD

- INTERVIEWS WERE CONDUCTED WITH PERSONNEL FROM MARINE RESERVE SQUADRONS.

- 1715 QUESTIONNAIRES WERE ADMINISTERED TO A STRATIFIED RANDOM SAMPLE OF ALL RESERVE SQUADRONS.

- COLLECTED 3 PERFORMANCE MEASURES:
  - MCCRES
  - CRP
  - CGI
RESULTS

- 3 ORGANIZATIONAL VARIABLES WERE IDENTIFIED AS CRITICAL:
  - TRAINING
  - LEADERSHIP
  - COORDINATION
TRAINING

- Reserves received significantly less MOS training and OJT prior to joining a squadron.

- The degree of training received was affected by the MAG/SITE/SQUADRON commanders.
LEADERSHIP

- Leadership was strongly related to perceptions of squadron functioning.
- Commanders and their squadrons view the squadron differently.
- Commanders did not feel prepared for the leadership responsibilities of a reserve squadron.
COORDINATION

- COORDINATION WAS VIEWED AS CRITICAL
  - ESPECIALLY FOR OFFICERS.

- COORDINATION MUST OCCUR BETWEEN:
  - TEAM MEMBERS.
  - ACTIVES AND RESERVES IN SIMILAR
    POSITIONS.
  - VARIOUS SQUADRON FUNCTIONS (e.g.,
    OPERATIONS, MAINTENANCE, ETC.).
PERFORMANCE

- % of reservists in the squadron was related to:
  - CRP
  - CGI

- Variables not related included:
  - Drill time spent on inspections
  - Preparation for reserve squadron
  - Degree of coordination required
SUMMARY

The results showed three organizational variables to be critical:

- Training
- Leadership
- Coordination

These variables are likely to have an impact on aircrew coordination and team performance in general.
FUTURE RESEARCH

- IDENTIFY OTHER IMPORTANT ORGANIZATIONAL VARIABLES THAT CAN IMPACT TEAM PERFORMANCE.

- DETERMINE SPECIFIC RELATIONSHIPS BETWEEN ORGANIZATIONAL VARIABLES AND AIRCREW COORDINATION.

- DETERMINE NEW METHODS TO OFFSET ORGANIZATIONAL VARIABLES.

- TEAM TRAINING FOR ACTIVE DUTY AND RESERVES.
AIRCREW COORDINATION TRAINING INTEGRATION

TRAINING TECHNOLOGY TECHNICAL GROUP

MARCH 1992

RANDALL L. OSER

NAVAL TRAINING SYSTEMS CENTER

ORLANDO, FL
AIRCREW COORDINATION TRAINING (ACT) INTEGRATION

- PRESENTATION OVERVIEW
  - ACT AND INTEGRATION
  - INTEGRATION RESEARCH QUESTIONS
  - LEVELS OF INTEGRATION
  - 'SEAMLESS' INTEGRATION OF ACT: V-22
  - RESEARCH REQUIRED
  - CONCLUSIONS
AIRCREW COORDINATION TRAINING INTEGRATION

- RESEARCH QUESTIONS

- WHAT IS THE MOST EFFECTIVE METHOD FOR INTEGRATING SKILL-BASED AIRCREW COORDINATION TRAINING INTO 'STICK AND RUDDER' AIRCREW TRAINING?

- CAN AIRCREW COORDINATION SKILLS BE TRAINED IN PARALLEL WITH 'STICK AND RUDDER' AIRCREW TRAINING?

- WHEN SHOULD AN INTEGRATED APPROACH BE USED OR NOT USED?
AIRCrew coordination training integration

- RESEARCH QUESTIONS (Cont.)
  - HOW SHOULD AN INTEGRATED APPROACH BE EVALUATED?
  - WHEN IS THE MOST APPROPRIATE TIME TO INTRODUCE AND TRAIN AIRCREW COORDINATION SKILLS?
'STAND-ALONE' INTEGRATION

KNOWLEDGE
• Provide Platform
  Specific Information
  (i.e., Modules)

DEMONSTRATION
• Demonstrate
  Effective/Ineffective
  Behaviors

PRACTICE/
  FEEDBACK
• Develop Skills
• Reinforce
  Skills

GROUND
SCHOOL

| AIRCREW
COORDINATION
TRAINING |

| SIM/FLT
TRAINING |
'EMBEDDED' INTEGRATION

**KNOWLEDGE**
- Aircrew Coordination Information (i.e., Modules)
- Mission Specific

**DEMONSTRATION**
- Demonstrate Effective/Ineffective Behaviors
- Synthesize Information to Specific Operational Situations

**PRACTICE/FEEDBACK**
- Develop Skills
- Reinforce Skills

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<tr>
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<th>C</th>
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</table>

**GROUND SCHOOL**

| A | C | T |

**SIM/FLT TRAINING**
'SEAMLESS' INTEGRATION

**KNOWLEDGE**
- Aircrew Coordination Information
- System Specific

**DEMONSTRATION**
- Demonstrate Effective/Ineffective Behaviors
- Synthesize Information to Specific Systems and Operational Situations

**PRACTICE/FEEDBACK**
- Develop Skills
- Reinforce Skills

---

**GROUND SCHOOL**

**PRE-SIM/FLT TRAINING LAB**

**SIM/FLT TRAINING**
AIRCREW COORDINATION TRAINING
V-22 ACT INTEGRATION

• IMPLICATIONS FOR 'SEAMLESS' INTEGRATION
  - GLASS COCKPIT
  - AUTOMATED SYSTEMS
  - TILT-ROTOR FLIGHT PROFILE
  - DEVELOPMENTAL PROGRAM
  - OPERATIONAL TRAINING ENVIRONMENT
AIRCREW COORDINATION TRAINING
V-22 ACT INTEGRATION

- APPLICATION OF 'SEAMLESS' INTEGRATION
  - REVIEW OF RELEVANT LITERATURE
  - CONDUCT NEEDS ANALYSIS
  - IDENTIFICATION OF CRITICAL TASKS REQUIRING COORDINATION
  - DEVELOPMENT OF PROTOTYPE MATERIALS (i.e., INTEGRATED GROUND SCHOOL TRAINING MATERIALS, SIMULATOR EXERCISES)
  - UTILIZATION AND EVALUATION OF TRAINING MATERIALS
Outline of Instruction

After selecting the ILS key, the pilot will be prompted to tune the desired ILS frequency and select the desired ILS front course bearing, final decision height, final approach speed and the intercept track (heading) under the VOR/ILS COURSE, ILS FS/DH and TRACK CDU legend/keys. Pilots should decide on all parameters to be entered prior to selecting the ILS key. When the front course bearing is entered, the heading for a 30° intercept will appear under the REF HEADING legend. The reference heading can be changed by the pilot provided the intercept angle is less than 90°.

When data entry is complete, the TRK mode will be activated and the is ILS armed, causing the TRK legend to update to TRK* and the ILS legend to ILS ARM. The system heading reference will be automatically set to magnetic.

NOTE: Arming the ILS mode will also cause the filters for the localizer and glideslope signals to be initialized. These filters provide smoothed estimates of the variables required for the ILS guidance processing.

a) Localizer Geometry

Once the ILS mode is armed, the aircraft will turn to the entered ground track angle to intercept the ILS localizer angle. Pilots should monitor aircraft performance against expected aircraft performance.

Instructor Activity

1. State that it is important to ensure that the entire crew is aware that an ILS approach will be performed.

2. Stress the importance of pilots anticipating and communicating all legend updates during ILS approaches to ensure the system is functioning properly and to maintain situational awareness.

28. Show transparency V-22-PLTFDS-0020 and direct students to the Student Workbook, 2.11.3.
GROUND OPERATIONS

NOTE: IC at TAKEOFF POSITION

ILS Exercise:

Call waveoff prior to DECISION HEIGHT alert, requiring pilot to quickly assume manual control of the aircraft.

[ ] Perform - Normal Instrument Pretakeoff Checks

FLIGHT OPERATIONS

[ ] Perform - Short Instrument Takeoff

[ ] Perform - Instrument Conversion and Climbout, Flight Director

[ ] Perform - Flight using VOR, TACAN - Airplane Mode/Conversion Mode, Flight Director - Commanded

[ ] Perform - Missed Approach/Wave Off - Flight Director - Commanded

NOTE: IC at TAKEOFF POSITION

[ ] Perform - Normal Instrument Takeoff

[ ] Perform - Instrument Conversion and Climbout

[ ] Perform - Instrument Approach: VOR, Flight Director - Commanded

[ ] Perform - Landings from Instrument Approach - Short Landing

NOTE: IC at Final Instrument Approach Position

[ ] Perform - Instrument Approach: ILS, Flight Director

ILS Approach:

[ ] Pilots announce to crew/ensure crew aware that ILS approach will be conducted

[ ] Prior to selecting ILS key, pilots have decided on all parameters to be entered (i.e., ILS front course bearing, final decision height, final approach speed, and intercept track (heading)).
Pilot not flying:

[ ] Enters and checks data
[ ] Communicates TRK* legend update to TRK* and ILS legend update to ILS ARM
[ ] Pilots monitor aircraft turn to ground track angle
[ ] Pilots note LOC CAPTURE annunciator, TRK* mode update to TRK, and ILS ARM update to ILS*
[ ] Pilots monitor aircraft pitchover/descent to glideslope
[ ] Pilot flying communicates readiness to assume aircraft control
[ ] Pilots note DECISION HEIGHT alert
[ ] Pilot flying announces he is assuming control of the aircraft
[ ] Pilot flying assumes control of the aircraft and announces when he has control of the aircraft

[ ] Perform - Landings from Instrument Approach - Hover Vertical Landing
[ ] Perform - Normal Shutdown

POST FLIGHT OPERATIONS
[ ] Review - Problem areas
[ ] Preview next flight
AIRCREW COORDINATION TRAINING INTEGRATION

• RESEARCH REQUIRED

- LABORATORY STUDIES
- OPERATIONAL/FIELD STUDIES
- SKILL RETENTION
- TRAINING OPTIMIZATION
- PERFORMANCE MEASUREMENT
AIRCREW COORDINATION TRAINING INTEGRATION

• CONCLUSIONS

- IMPLICATIONS OF RESEARCH
- CONSTRAINTS OF THE OPERATIONAL ENVIRONMENT
- INTRODUCTION OF NEW TECHNOLOGIES
- APPLICATION OF INTEGRATED ACT IN MILITARY AND CIVILIAN AVIATION ENVIRONMENTS
TABLE TOP AIRCREW
COORDINATION TRAINING SYSTEM

(T-TACTS)

MAJ WES WOODRUFF
NTSC AIR FORCE LIAISON OFFICER
OVERVIEW

- EQUIPMENT
- SOFTWARE
- SCENARIO DEVELOPMENT
- FUTURE ENHANCEMENTS/PROGRAMS
EQUIPMENT

- IBM 286 OR 386 PC
- MICROSOFT FLIGHT SIMULATOR
  AIRCRAFT AND SCENERY DESIGN
  SCENERY DISKS
  VGA UPGRADE
- FLIGHT CONTROLS
- HEADSETS AND SPLITTER BOXES
SOFTWARE

- INEXPENSIVE
  TOTAL COST $ 130.00
- REAL WORLD
- EASY TO LEARN
  15 MINUTE ORIENTATION
- NOT A FLIGHT TRAINER
SCENARIO DEVELOPMENT

- LOCATIONS IN FS DATA BASE
  USE FLIGHT PUBLICATIONS
  UNFAMILIAR AREA TO SUBJECTS
- 20 MINUTES LONG
- NO EQUIPMENT FAILURES
  NOT MAKING SUBJECTS EXPERTS ON FS
- HIGH DEGREE OF REALISM
  ATC COMM
  AIRCrewMAN, PAX ON BOARD
SCENARIO DEVELOPMENT (cont)

- SCENARIOS
  C-12 TYPE AIRCRAFT
  TRANSPORTING AN ADMIRAL FROM A TO B

- CREW PROBLEMS TO SOLVE
  LOST COMMUNICATION
  PASSENGER HAS HEART ATTACK
FUTURE ENHANCEMENTS/PROGRAMS

EQUIPMENT

- SOUND BOARD
- MORE AND VARIED ATC COMMUNICATIONS
- LARGER TEAMS
- ELIMINATION OF KEYBOARD
- THROTTLE, GEAR AND FLAP HANDLE

PROGRAMS

- T-34     - F-18     - T-44
- A-6      - USMC RESERVES
TRAINING DESIGN AND EVALUATION

Instructional, Planning and Evaluation Issues

Modeling Skill Acquisition:
Dr. Mark Sabol

Retention of Knowledge Learned in College:
Dr. John Ellis
MODELS OF SKILL ACQUISITION

MARK SABOL
ARMY RESEARCH INSTITUTE
ALEXANDRIA, VIRGINIA

PRESENTATION AT T2TG MEETING
PHOENIX, ARIZONA
MARCH 25, 1992
TOPICS TO BE DISCUSSED:

- COMPLETED RESEARCH ON PERCEPTUAL-MOTOR SKILL TRAINING
  - MODELS
  - FINAL ISSUES

- FUTURE RESEARCH
  - COLLECTIVE SKILLS
  - RETRAINING
All errors that occurred ≥5% of the time each stimulus was presented (4-element stimuli, only):

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Response</th>
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<tbody>
<tr>
<td><strong>H</strong></td>
<td><strong>S</strong></td>
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<td><strong>Q</strong></td>
<td><strong>W</strong></td>
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</tbody>
</table>

*PRELIMINARY CONFUSION MATRIX RESULTS - SEP 90*
(Data from 10 subjects at each speed)
THREE-ELEMENT CHARACTERS

PERCENT CORRECT

R_._G_._D_._S_._W_._U_._K_._O___

MORSE CODE CHARACTERS

8 Ss, 400 trials/s
THREE-ELEMENT CHARACTERS

MORSE CODE CHARACTERS

REACTION TIME (ms)


597 552 537 506 492 533 368
FOUR-ELEMENT CHARACTERS

PERCENT CORRECT

MORSE CODE CHARACTERS

70 82 71 68 58 71 82
FOUR-ELEMENT CHARACTERS

PERCENT CORRECT

MORSE CODE CHARACTERS

18 Ss, 240 trials/s

246
FOUR-ELEMENT CHARACTERS

MORSE CODE CHARACTERS

REACTION TIME (ms)
FOUR-ELEMENT CHARACTERS

MORSE CODE CHARACTERS

REACTION TIME (ms)
Stimulation and Decay of Trace Strength Register
Single Presentation

Rest (Noise)

Stimulus Presentation

Rest (Noise)
Stimulation and Decay of Trace Strength Register

Double Presentation

Rest (Noise)

Stimulus Presentation

Strength

Strength

Strength

Strength

Strength

TIME
3-Element Characters with a Final "dah"

Correct RT (msec)

Percent Correct

* Character rank predicted from trace strength model
4-Element Characters with a Final "dit"

Correct RT (msec)

Percent Correct

* Character rank predicted from trace strength model
MODEL DEVELOPMENT

FEATURES OF MODEL:

- attention shifts from previous character recognition to auditory buffer

- **Element Activation**
  - feeds information from sensory store to character recognition system
  - starts once response to previous stimulus is decided upon
  - stops after a fixed period of time (for a given speed, subject)
  - for novices, elements activated serially, earliest first (to avoid further decay)
  - for experts, all elements activated in parallel

- **Character Selection**
  - decides on character identity based upon activated information only
  - initiates response execution

- **Response Execution**
  - autonomous, proceeds without need for attention
  - attention can shift to auditory buffer for activation of next stimulus
Figure 4. Cognitive process model for skilled Morse code copying.
15 Subjects, Last 18 GPM Session

$r = -0.84$

Character Duration

Average RT

0 100 200 300 400 500 600 700

600 550 500 450 400 350 300
PROCESSING SEQUENCE EXAMPLE

ACT | CS | RE

ACT | CS | RE

ACT | CS | RE

ACT | CS | RE

TIME

act = activation time (constant for given speed and subject, internally clocked, starts when previous cs finishes)
cs = character selection time (nearly constant, decreases with practice)
re = response execution time (variable)
STIMULUS SEQUENCE EXAMPLE

ICI = Inter-Character Interval
RESULTANT REACTION TIME SEQUENCE

ICI = Inter-Character Interval
act = activation time (constant, internally clocked, starts when previous cs finishes)
cs  = character selection time (nearly constant)
re  = response execution time (variable)
Figure 1. Mean Reaction Time for Each Group of Subjects at Different Presentation Speeds

Groups of Subjects Based upon Ultimate Success:
- Superior (n=7)
- Average (n=7)
- Attrites (n=7)
Figure 2. Mean Number of Instances of "Copying Behind" by Each Group of Subjects at Different Presentation Speeds

Subject Groups Based upon Ultimate Success:

- ● Superior (n=7)
- ○ Average (n=7)
- ■ Attrites (n=7)
Figure 1. Diagram of the Large Start-Buffer, Upstream Blocking Model for three items.
Figure 3b. Diagram of the Four Stage Model with Simultaneous Buffer Decay.
FUTURE RESEARCH IN SKILL ACQUISITION AND RETENTION

MODELS OF COLLECTIVE SKILL ACQUISITION AND RETENTION (WORK UNDERWAY)

- SYNTHETIC TRAINING ENVIRONMENTS (E.G., SIMNET)
- COGNITIVE TASK ANALYSIS OF CREWS
- GROWTH AND DECAY IN CREW PROFICIENCY

RETRAINING TIME FOR THE INDIVIDUAL READY RESERVE (WORK IN PLANNING)

- TIME TO REGAIN PROFICIENCY AFTER SEPARATION PERIODS OF 9 TO 36 MONTHS
- EMPirical APPROACH THAT REQUIRES "MINI-MOBILIZATION" OF UP TO 1,000 SOLDIERS
- PREVIOUS RESEARCH ON IRR SKILL DECAY WAS UNABLE TO ASSESS RETRAINING DUE TO WAR CONTINGENCIES
RESEARCH QUESTIONS

• How much do we remember of what we learned in secondary and post secondary classroom?

• What variables affect long-term retention for knowledge learned in schools?

• What cognitive structures and processes account for long-term retention?
TYPES OF KNOWLEDGE AND SKILL

- Declaritive

- Procedural

- Conceptual/Contextual/Causal
RESEARCH QUESTIONS - KANSAS STUDIES

- Will PSI students learn and retain more than LFM students?

- Will retention for both groups decline over time?

- If PSI do learn more and retention does decline, will the rate of decline differ for the two groups?

- Will performance on a retention test that is the same as the end-of-course test be better than performance on a different but parallel form of the test?

- Does the amount of forgetting differ for different learning tasks?

- Does proctoring has the same effect as overlearning?
VARIABLES AFFECTING RETENTION

- Original Learning
- Task Requirements
- Overlearning
- Test Conditions
- Retention Interval
- Individual Differences
Data from PE School Study - Late 1970's

<table>
<thead>
<tr>
<th>Test Version</th>
<th>Immediate</th>
<th>4 Weeks Later</th>
<th>6-8 Months Later</th>
<th>Percent Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>89.28</td>
<td>87.61</td>
<td>73.08</td>
<td>18%</td>
</tr>
<tr>
<td>II</td>
<td>87.22</td>
<td>75.28</td>
<td>68.93</td>
<td>21%</td>
</tr>
<tr>
<td>III</td>
<td>89.64</td>
<td>79.53</td>
<td>70.73</td>
<td>21%</td>
</tr>
</tbody>
</table>

N = 83
<table>
<thead>
<tr>
<th>Condition</th>
<th>Percent Correct End of Course</th>
<th>Percent Correct 25 Days Later</th>
<th>Percent Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fact</td>
<td>86%</td>
<td>78%</td>
<td>8%</td>
</tr>
<tr>
<td>Computation</td>
<td>80%</td>
<td>56%</td>
<td>24%</td>
</tr>
<tr>
<td>Gram Analysis</td>
<td>87%</td>
<td>76%</td>
<td>11%</td>
</tr>
<tr>
<td>Gram Classification</td>
<td>85%</td>
<td>74%</td>
<td>11%</td>
</tr>
<tr>
<td>Systematic Analysis</td>
<td>77%</td>
<td>61%</td>
<td>16%</td>
</tr>
</tbody>
</table>
Data from Kansas Study - 1989

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percent Correct End of Course</th>
<th>Percent Correct 3 Months Later</th>
<th>Percent Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSI-S</td>
<td>87%</td>
<td>78%</td>
<td>10%</td>
</tr>
<tr>
<td>PSI-D</td>
<td></td>
<td>73%</td>
<td>16%</td>
</tr>
<tr>
<td>LD-S</td>
<td>76%</td>
<td>68%</td>
<td>10%</td>
</tr>
<tr>
<td>LD-D</td>
<td></td>
<td>62%</td>
<td>17.5%</td>
</tr>
</tbody>
</table>
## Item Category Results from the Kansas Study - 1991

### Gains from Pretest to End of Course

<table>
<thead>
<tr>
<th>Item Category</th>
<th>4-month Group</th>
<th>11-month Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>Recognition</td>
<td>32.1</td>
<td>13.6</td>
</tr>
<tr>
<td>Recall</td>
<td>48.9</td>
<td>21.2</td>
</tr>
<tr>
<td>Comprehension</td>
<td>30.7</td>
<td>20.8</td>
</tr>
<tr>
<td>Mental Skills</td>
<td>31.0</td>
<td>22.1</td>
</tr>
</tbody>
</table>

### Same Form Loss - End-of-Course to End-of-Interval

<table>
<thead>
<tr>
<th>Item Category</th>
<th>4-month Group</th>
<th>11-month Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>Recognition</td>
<td>-13.7</td>
<td>12.7</td>
</tr>
<tr>
<td>Recall</td>
<td>-25.0</td>
<td>20.6</td>
</tr>
<tr>
<td>Comprehension</td>
<td>-12.7</td>
<td>16.6</td>
</tr>
<tr>
<td>Mental Skills</td>
<td>-13.7</td>
<td>18.1</td>
</tr>
</tbody>
</table>

### Different Form Loss - End-of-Course to End-of-Interval

<table>
<thead>
<tr>
<th>Item Category</th>
<th>4-month Group</th>
<th>11-month Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>Recognition</td>
<td>-16.9</td>
<td>14.2</td>
</tr>
<tr>
<td>Recall</td>
<td>-27.9</td>
<td>25.4</td>
</tr>
<tr>
<td>Comprehension</td>
<td>-18.6</td>
<td>18.9</td>
</tr>
<tr>
<td>Mental Skills</td>
<td>-17.9</td>
<td>21.0</td>
</tr>
</tbody>
</table>
SUBGROUP SESSION III

ADVANCED TRAINING TECHNOLOGY

Basic Job Skills Job Family Tutor:
Dr. Ellen Hall

Issues in Designing and Intelligent, NLP-based Tutor for Foreign Languages:
Dr. Michelle Sams
OVERVIEW

History of BJS Program

Research Problem

BJS Goals

Approach

Tutoring Single Jobs vs. Job Families

Job Family Tutor Learning Study

Illustration of JFT Instruction

Payoffs
CHRONICLE OF SIGNIFICANT EVENTS

- CY 88: Successful field test of prototype Avionics Troubleshooting Tutor
- Mar 88: Request from TAC/LG (MGen Vicellio) to AFSC/XT (BGen Stebbins) to accelerate BJS effort
- CY 89: TAC Day briefing to AFSC/CC (Gen Randolph) and TAC/CC (Gen Russ) and staff
- Dec 89: MOU signed by TAC/LG (MGen Logeman) and AFSC/XT (MGen Ferguson) for continued support of BJS R&D
  - included authorizations for two F15 avionics technicians for BJS in-house team
  - allows access to maintenance personnel at F15/16/111 flying units
"We consider this a crucial research project with tremendous payback potential in the aircraft maintenance training area."

MGen Henry Viccelio, Jr TAC/LG

BGGen Charles Stebbins AFSC/XT

March, 1988
- CY 89-90: TAC funded $26.1M FY92 initiative for FSD of F15 and F16 troubleshooting tutors

  - OPR: HSD/YA and XR

- Dec 90: Demo of refined tutor given to CSAF (Gen McPeak) and AFSC/CC (Gen Yates) as part of new CSAF's orientation to AFSC

- Jan 91: TAC Day demo of refined tutor given to TAC/CC (Gen Russ) and AFSC/CC (Gen Yates), Andrews AFB MD
THE PROBLEM

- Becoming competent in technologically complex environment

- Countering the negative effects of machine capabilities

... lost apprenticeship
THE PROBLEM

CURRENT WING STRUCTURE

- Becoming competent in technologically diverse environments

COMPOSITE WING STRUCTURE

- Accommodating new force structure and force downsizing

... Fostering Adaptive Expertise
BASIC JOB SKILLS GOALS:

RESTORED APPRENTICESHIP

TESTING/TRAINING WITH FOCUS ON HIGH-TECH PROBLEM SOLVING

HIGH-TECH COMPETENCE DEFINITIONS AND COMMONALITIES

ADAPTIVE EXPERTISE
APPROACH

- THEORIES OF EXPERT PROBLEM SOLVING
- PROCEDURES BASED ON ADVANCES IN ARTIFICIAL INTELLIGENCE TO SPECIFY HOW EXPERTS SOLVE PROBLEMS
- PROCEDURES BASED ON PRINCIPLES OF APPRENTICESHIP TRAINING TO TURN EXPERT KNOWLEDGE INTO LEARNABLE CONTENT FOR TRAINING

COGNITIVE TASK ANALYSIS TECHNOLOGY

TRAINING DEVELOPMENT TECHNOLOGY
R&D APPROACH

TRAINING DEVELOPMENT TECHNOLOGY

RESEARCH STREAMS

COGNITIVE TASK ANALYSIS

PROTOTYPE TUTORS
BJS TECHNOLOGIES

- Cognitive Task Analysis (CTA) Technology
- Training Development Technology (TDT)
- Prototype Troubleshooting Tutors
  - Single Job Tutors
  - Job Family Tutors
SINGLE JOB TUTOR

- TROUBLESHOOTING SCENARIOS
- COACHING
- TRAINEE EVALUATION

MANUAL TEST STATION ?????

[Diagram of a computer and a cycle of arrows around a head]
EVALUATION RESULTS:
AVIONICS TROUBLESHOOTING TUTOR (SJT)

- 7 LEVELS GROUP
  - CONTROL GROUP
  - EXPERIMENTAL GROUP

PRETEST
IMMEDIATE POSTTEST
DELAYED POSTTEST (5-6 MOS)

56.4 58.9 58.5
53.4 79.0

81.9

PROPOSED JOB FAMILY TUTORS

Original Avionics JFT (F15 AIS)
- Commonalities
  - Knowledge Skills
  - Auto Test Station

Alternative Avionics JFT (F15 Flightline)
- Commonalities
  - Knowledge Skills
  - Indicators & Controls
  - Comm., Nav., & Penetration

Mechanical JFT (F15 TAMS)
- Commonalities
  - Knowledge Skills
  - Crew Chief
  - Jet Engine

Manual Test Station
Electronic Warfare Test Stat
COGNITIVE SKILL COMMONALITIES

Strategic Knowledge

"how-to-decide-what to-do-and-when"

Strategic Decision Factors

System Knowledge

"how-it-works"

Procedural Knowledge

"how-to-do-it"
Six Rivet trainees into EWS job participated
  - Tech School
  - OJT
  - Experience range

Pre-posttest scored by verbal troubleshooting procedure

Six hours of one-on-one tutoring by EWS expert

Effect on performance
  - Four technicians improved
  - Two technicians regressed
AVERAGE PRE- AND POST-TEST SCORES
BETTER LEARNERS VS. POORER LEARNERS

PRE-TEST

POST-TEST

V T T

S C O R E

30

20

50

60

70

80

48.33

63.75

50.79

35.00
SAMPLING OF QUESTIONS

Procedural

"I need to find an easy spot on the Lower 16 card to pick off the signal."

"How do you actually use the general maintenance program?"

Knowledge

System

"I know all the station resources that are being used, but I don't know how."

"Could the RF Counter be called a Microwave Frequency Counter?"

Knowledge

Strategic

"Is there another way to split the path to see if I'm getting the signal, besides measuring off the relays?"

"For practical purposes, is it generally easier to leave the LRU test set up and take a measurement off the MSS to verify the output?"
PERCENTAGE OF QUESTION TYPE BY PROBLEM
(Poorer Learners)

<table>
<thead>
<tr>
<th>Learning Problem</th>
<th>Procedural Knowledge</th>
<th>System Knowledge</th>
<th>Strategic Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem 3</td>
<td>61.5</td>
<td>34.6</td>
<td>3.9</td>
</tr>
<tr>
<td>Problem 4</td>
<td>64.0</td>
<td>32.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Problem 6</td>
<td>65.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PERCENTAGE OF QUESTION TYPE BY PROBLEM
(BETTER LEARNERS)

LEARNING PROBLEM

- Problem 3: 37.2%
  - Procedural Knowledge: 53.5%
  - System Knowledge: 9.3%
  - Strategic Knowledge: 10.9%

- Problem 4: 41.8%
  - Procedural Knowledge: 47.3%
  - System Knowledge: 10.9%
  - Strategic Knowledge: 11.9%

- Problem 5: 66.1%
  - Procedural Knowledge: 22.0%
  - System Knowledge: 11.9%
  - Strategic Knowledge: 11.9%
Figure 6. General Equipment Configuration During LRU Testing
ILLUSTRATION OF JFT INSTRUCTION
FOSTERING ADAPTIVE EXPERTISE

RIVTEK

ELECTRONIC WARFARE TEST STATION

MANUAL TEST STATION

AUTOMATIC TEST STATION

AVIONICS TEST STATION

BEFORE TUTORING

AFTER TUTORING
INTRODUCTION

In RIVTEK you will be challenged to become a better troubleshooter on avionics equipment that is similar, but not identical, to the equipment on which you received your primary AF technical training. You will be presented a series of increasingly difficult troubleshooting scenarios to advance your fault isolation skills on the TEWS Intermediate Test Equipment (TITE). In addition, RIVTEK is equipped to strengthen your troubleshooting and learning skills in general. As a consequence, you can significantly increase your adaptiveness as a technician on multiple avionics systems -- even on systems that are yet to be fielded, e.g., avionics systems on the ATF.
In the course of working through RIVTEK's scenarios, you will be evaluated at various points along the way. Performance indicators will gauge the following: (a) your increasing skill in troubleshooting the TITE station, (b) your growing independence from RIVTEK's coaching, and (c) your general adaptiveness across different avionic systems. Your goal is to take full advantage of RIVTEK's coaching and other explanatory resources to become a skilled, adaptive technician with improved "mental tools" for thinking about and solving hard electronic failures on any piece of equipment. As a final RIVTEK evaluation, you will be presented scenarios on a system that is entirely novel to you.
<table>
<thead>
<tr>
<th>INFORMATION BOX</th>
<th>GENERAL ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Tech Data</td>
<td></td>
</tr>
<tr>
<td>Activate Equipment</td>
<td></td>
</tr>
<tr>
<td>Change Goal</td>
<td></td>
</tr>
<tr>
<td>Show Parallel</td>
<td></td>
</tr>
<tr>
<td>Cancel Current Action</td>
<td></td>
</tr>
<tr>
<td>Quit</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EQUIPMENT ENVIRONMENT</th>
<th>TECH DATA ENVIRONMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Console</td>
<td>A/D Console</td>
</tr>
<tr>
<td>A/D Console</td>
<td>RF Console</td>
</tr>
</tbody>
</table>
The Tactical Electronic Warfare System (TEWS) Intermediate Test Equipment (TITE) is a semi-automatic test station. It is used to test components of the F-15's Electronic Countermeasures (ECM) system. It consists of three sections: (1) the Computer Console which is used to control the test station; (2) the Analog/Digital Console which processes signals below radio frequency; and (3) the Radio Frequency Console which processes RF signals. To ensure the test station is operating correctly it is tested periodically. These tests, called Operational Assurance/ Fault Isolation (OA/FI), test each device in the test station; if one fails, it must be repaired before an ECM component can be tested by the test station.
You are performing the Operational Assurance and Fault Isolation (OA/FI) tests on the Tews Intermediate Test Equipment (TITE) as part of its Weekly Maintenance Inspection. You have installed the proper software and have begun testing. The test station has reported a fail at OA/FI segment P2 T10 S620 D1 M01 and you must troubleshoot the malfunction. Your first goal is to analyze information relevant to the fail. There are two sources of information that will help you do this. The first is the TITE CRT display shown below and the second is the OA/FI Test Summary for the failed test. If you want to know more about the CRT display or see the test summary, select Access Tech Data in the General Action menu.

Troubleshooting Goal: Analyze information relevant to the fail.

## General Actions
- Access Tech Data
- Activate Equipment
- Change Goal
- Show Parallel
- Cancel Current Action
- Quit

### Equipment Environment

![Diagram of equipment environment]

### Tech Data Environment

<table>
<thead>
<tr>
<th>P2 T10 S620 D1 M01</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSG 10 620</td>
<td></td>
</tr>
<tr>
<td>H 1 1.99967+37 SEC</td>
<td>1.00000-02 0.00000+00 $15-4 $14-4 $13-4</td>
</tr>
</tbody>
</table>

---

**Operator Action**
1. Use DPO to verify 10 kHz, 2.2 VP-P at both 50 ohm loads on counter/timer.
2. Enter 1 if one signal is missing or 2 if both signals are missing.

---

**Operator Action**
1. Use DPO to verify 10 kHz, 4 VP-P at pulse generator J108.
2. Enter 1 if the signal is missing or 2 if the signal is present.

---

**Operator Instruction**
$15-4$ failed to set. Refer to TO 3307-38-77-28-1-2 for fault isolation instructions.

Station cleared.
### GENERAL ACTIONS

<table>
<thead>
<tr>
<th>Access Tech Data</th>
<th>Activate Equipment</th>
<th>Change Goal</th>
<th>Show Parallel</th>
<th>Cancel Current Action</th>
</tr>
</thead>
</table>

### INFORMATION BOX

The manual test stations consist of a group of three test stations. These test stations are under complete control of the technicians. Each test station is used to test components from one of these functional units: FAA Transponder System and Controls (ATC TS), the Communication, Navigation, and Identification System (CN TS), and their individual control sets. The technician for each test performs the troubleshooting goals.

### TROUBLESHOOTING GOAL:

- **Analysis Information Relevant to the Fail:**

### EQUIPMENT ENVIRONMENT

- **Equipment and Controls Test Station**

- **Antenna Test Station**

- **Communication, Navigation, and Identification Test Station**

### SPECIFICATIONS

- **Computer Console**
- **A/D Console**

---

306
**INFORMATION BOX**

OA/FI tests are also performed on the Manual test stations; however, they are not part of a weekly inspection. In fact, skilled Manual technicians rarely use OA/FI tests because of the limited information they provide. Compared to the TITE OA/FI test summary shown below, the Manual station OA/FI tech data is much more general. For example, the level of detail stops at the CARD level, whereas the TITE OA/FI test summary specifies COMPONENTS (e.g., switches and jacks). To get COMPONENT information, the Manual technician must access schematics.

**TROUBLESHOOTING GOAL:** Analyze information relevant to the failure.

**TECH DATA PARALLEL**

<table>
<thead>
<tr>
<th>Step No</th>
<th>Panel</th>
<th>Action</th>
<th>Normal Indication</th>
<th>Remedy For Abnormal Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1B3</td>
<td>2A2A3 UNF CTRL PHIL</td>
<td>Press to illuminate STIMULUS SEL TEST switch indicator</td>
<td>2A2A1 PREC CTRL 200 MHZ to 310 MHZ</td>
<td>Refer to step F137</td>
</tr>
</tbody>
</table>

---

**TECH DATA ENVIRONMENT**

**GENERAL ACTIONS**

- Access Tech Data
- Activate Equipment
- Change Goal
- Show Parallel
- Cancel Current Action
- Quit

**EQUIPMENT**

Tech Data

---

**OA/FI Fault Isolation tests**

<table>
<thead>
<tr>
<th>Step No</th>
<th>Panel</th>
<th>Action</th>
<th>Normal Indication</th>
<th>Remedy For Abnormal Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>F137</td>
<td>2A2A2 RF/AM VOL</td>
<td>a. Observe RF MILLI-VOLTMETER</td>
<td>Above -5 (-15dBm)</td>
<td>Replace A1A13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Replace A1A13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**TO J307-20-77-00-1-1**

Table 2-15. Coastal Switching Drawer Test Summary

**DEVICE UNDER TEST**

<table>
<thead>
<tr>
<th>Drawer</th>
<th>Setup Data</th>
<th>Drawer</th>
<th>Setup Data</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>D100</td>
<td></td>
<td>D100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MEASUREMENT DEVICE**

- **PCER:** J100
- **ADCOX:** 813-C, 813-4, 810-3, 89-2, 26-1, 87-6, 88-4, 814-6
- **PATH TO CH A INPUT:** ADCOX: 814-C
- **PATH TO CH B INPUT:** TTD: CH A INPUT

**NOTE:** High and low signals follow the same routing, but the low is carried on the shield.
In this section of the tech data display, signal ROUTING information is specified. The signal is being routed from the output of the Pulse Generator (PGEN), which is the STIMULUS device, through relays in the Coaxial Switching Drawer (ADCOAX) (ROUTING device) to both the CHA and CHB inputs of the Counter/Timer (TFD) (MEASUREMENT device). All three drawers are located in the Analog/Digital (A/D) Console of the TITE station.

TROUBLESHOOTING GOAL: Analyze information relevant to the fail.

EQUIPMENT ENVIRONMENT

TECH DATA ENVIRONMENT

---

TO 3307-39-77-20-2-1

Table 3-19. Coaxial Switching Drawer Test Summary

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>BLOCK DATA</th>
<th>SETUP DATA</th>
<th>LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIT10043601950103</td>
<td>5 Vdc output</td>
<td>Counter/Timer</td>
<td>0 to 5V</td>
</tr>
<tr>
<td>Pulse Gen</td>
<td>10 ns ( \pm )</td>
<td>to chA</td>
<td>100 ns</td>
</tr>
<tr>
<td>100 ns Timer</td>
<td>9 Vdc offset</td>
<td>to chB</td>
<td>10 lbs Freq</td>
</tr>
</tbody>
</table>

NOTE: High and low signals follow the same routing, but the low is carried on the shield.
Where can you find the parameters of the Pulse Generator's output signal?

Correct! The parameters of the Pulse Generator's output signal are found in the DEVICE UNDER TEST - SETUP DATA section of the Coaxial Switching Drawer's Test Summary.

TROUBLESHOOTING GOAL: Analyze information relevant to the fall.

TO 3587-35-77-39-1-1

Table 3-19. Coaxial Switching Drawer Test Summary

<table>
<thead>
<tr>
<th>DElVICE UNDER TEST</th>
<th>MEASUREMENT DEVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRAWER 158415841584</td>
<td>DRAWER 158415841584</td>
</tr>
<tr>
<td>TOS 158415841584</td>
<td>TOS 158415841584</td>
</tr>
<tr>
<td>0.5 Vpp output</td>
<td>0.5 Vpp output</td>
</tr>
<tr>
<td>100 ms TR/FP</td>
<td>100 ms TR/FP</td>
</tr>
<tr>
<td>0 Vpp offset</td>
<td>0 Vpp offset</td>
</tr>
<tr>
<td>10 Hz sweep</td>
<td>10 Hz sweep</td>
</tr>
</tbody>
</table>

NOTE: High and low signals follow the same routing, but the low is carried on the shield.
INFORMATION BOX

THIS TROUBLESHOOTING GOAL REQUIRES YOU TO INVESTIGATE THE SIGNAL PATH THROUGH THE ROUTING DEVICE. (DRAWER LEVEL) SINCE YOU HAVE VERIFIED THAT THE INPUTS TO THE MEASUREMENT DEVICE WERE BAD AND THE OUTPUT FROM THE STIMULUS DEVICE WAS GOOD, YOU HAVE ISOLATED THE MALFUNCTION TO THE SIGNAL ROUTING.

TROUBLESHOOTING GOAL: investigate the signal path through the routing device.

EQUIPMENT ENVIRONMENT

REMOTE

PTD's

TECH DATA ENVIRONMENT

Table 2-15. Coaxial Switching Drawer Test Summary

<table>
<thead>
<tr>
<th>DEVICE UNDER TEST</th>
<th>MEASUREMENT DEVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRAWER</td>
<td>DRAWER SETUP DATA</td>
</tr>
<tr>
<td>PTD4/100/300/1300</td>
<td></td>
</tr>
<tr>
<td>Pulse Gen</td>
<td>6 Vdc output</td>
</tr>
<tr>
<td></td>
<td>10 us pr</td>
</tr>
<tr>
<td></td>
<td>100 us TH/TV</td>
</tr>
<tr>
<td></td>
<td>5 Vdc offset</td>
</tr>
<tr>
<td></td>
<td>10 kHz freq</td>
</tr>
<tr>
<td></td>
<td>Counter/ TI from chA</td>
</tr>
<tr>
<td></td>
<td>to chB 0 to 0.01s</td>
</tr>
<tr>
<td></td>
<td>100 us range</td>
</tr>
</tbody>
</table>

NOTE: High and low signals follow the same routing, but the low is carried on the shield.
**INFORMATION BOX**

The UHF Control Panel is a ROUTING and CONTROL device that serves a function similar to that of the Coaxial Switching to route signals to and from the UUT and other station drawers. The Coaxial Switching Drawer is controlled by the station computer. In manual, the technician manually sets the controls on the UHF Control Panel. The UHF Control Panel is also used as a STIMULUS and MEASURING device.

**TROUBLESHOOTING GOAL:** Investigate the signal path through the routing device.

**GENERAL ACTIONS**

- Access Tech Data
- Activate Equipment
- Change Goal
- Show Parallel
- Cancel Current Action
- Quit
- Equipment
- Tech Data

**EQUIPMENT ENVIRONMENT**

- **Manuals**
- **Automatics**

**EQUIPMENT PARALLEL**

- **UHF CONTROL PANEL**
  - Test Point Select Circuits
    - [Circuit Card Assemblies]
  - Stimulus Select Circuits
    - [Coaxial Switches]
Information Box

Troubleshooting Goal: Investigate the signal path through the routing device.

Equipment Engineering

Tests Completed

- Test Results Explained
- Options Remaining
- Preferred Next Test

Tech Data Environment

Table 2-15. Coaxial Switching Deaver Test Summary

<table>
<thead>
<tr>
<th>Device Under Test</th>
<th>Measurement Device</th>
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<tbody>
<tr>
<td>DRAWER</td>
<td>SETUP DATA</td>
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<tr>
<td>P2710381200MB01</td>
<td>Pulse Gen</td>
</tr>
<tr>
<td>5 Vdc output</td>
<td>10 us per</td>
</tr>
<tr>
<td>100 ms TR/FF</td>
<td>100 ms range</td>
</tr>
<tr>
<td>0 Vdc offset</td>
<td></td>
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</table>

NOTE: High and low signals follow the same routing, but the low is carried on the shield.
TROUBLESHOOTING GOAL: Investigate the signal path through the routing device.

19999.9 Kohms

INFORMATION BOX

GENERAL ACTIONS
Access Tech Data
Activate Equipment
Change Goal
Show Parallel
Cancel Current Action
Quit
Troubleshooting Coaching

EQUIPMENT ENVIRONMENT:
- Take Measurement
- Run OAFI
- Swap
- Rerun Original Test

TECH DATA ENVIRONMENT:

T.O. 33D7-38-77-2-3 fig 5-65 (sh3)
Coaxial Swrching Drawer 81A1
POST-PROBLEM ACTIVITIES IN RIVTEK

• Critique of trainee's solution
  • Positive features of solution praised
  • Any violations of standard troubleshooting practices reported
  • General levels of proficiency estimated
    - System Knowledge
    - Procedural Knowledge
    - Strategic Knowledge
  • Adaptiveness level estimated
  • Dependence/independence of coaching: level of appropriateness estimated

• Alternative troubleshooting solutions presented and explained

• Activities to strengthen learning skills associated with adaptive expertise presented/scored
Mental Tools for Thinking
PAYOFFS

- Maintenance savvy captured in tutors
  - Reasons behind decisions made explicit
  - Alternative solutions understood

- Acceleration of complex skill development
  - Restored apprenticeship learning experiences
  - Performance with understanding
  - Enhanced, stable productivity

- Performance adaptiveness
  - Flexibility under novel conditions (e.g., combat)
  - Transfer of skills to new systems, new AF organization structure
  - Reduced training demands/costs
  - Enhanced utilization of personnel
ARMS RESEARCH INSTITUTE (ARI)
FOREIGN LANGUAGE TUTOR

ARI has a program of research on technology applications for language learning. A current project has produced an interactive PC-based tutor to help teach military specific language skills and maintain general language proficiency for students at the intermediate level and above. The current tutor is in German.

INDIVIDUALIZED INSTRUCTION:

The computer program can ask questions (written or orally) and give feedback. It can analyze and understand freely-typed input by the students in the target language using natural language processing. It can diagnose and track errors in grammar and meaning and adapt the lesson automatically to the individual student's progress.

FLEXIBILITY:

The tutor includes an authoring interface which allows instructors to create new lessons. The interface is also an aid to researchers who can use the tutor to define alternative instructional strategies and test them. This interface is comprised of sample templates to be filled in and requires no programming skills.

EXTENDABILITY:

The tutors under development are designed to challenge the student to communicate and learn in the target language. Most of the software in these tutors would require only minimal changes to apply to a range of foreign language (extendability to Arabic has been demonstrated). This is primarily due to two factors: 1) the natural language processor contains reusable language universal components, and 2) the lesson authoring system (a "one-time" development cost) can be used for any language application.

FUTURE DEVELOPMENT:

A new 3-year development program will begin in 1992, with the goal of creating a "second generation" tutor that will immerse the student in the language environment through interactive dialogs utilizing natural language processing, speech recognition systems, and dynamic graphics. Spanish and Arabic are the target languages.

ARI POCs: Dr. Melissa Holland, Team Leader
Dr. Jonathan Kaplan, Dr. Michelle Sams, Dr. Cathie Alderks, Mr. Rich Maisano
(703) 274-5540 AV 284-5540
ARMY RESEARCH INSTITUTE

ADVANCED TECHNOLOGY FOR LANGUAGE LEARNING

TRAINING RESEARCH LAB
ADVANCED LANGUAGE LEARNING TECHNOLOGY TEAM

Dr. Melissa Holland, Team Leader
Dr. Jonathan Kaplan, Dr. Michelle Sams, Dr. Cathie Alderks, Mr. Rich Maisano
(703)274-5540  AV 284-5540
BACKGROUND

ARMY NEED:

** Assist Military Intelligence & Special Forces linguists acquire and maintain language proficiency

* In school, few resources to teach job specific language skills

* In field, constraints exist on training time and resources for language maintenance

ARI's RESPONSE:

** Develop an interactive and adaptive computer tutor

* To provide individualized instruction for MI & SOF linguists

* To provide a vehicle for ARI researchers to investigate how to improve foreign language acquisition and retention
ADVANCED TECHNOLOGY FOR LANGUAGE LEARNING

PROGRAM GOALS:

Increase the preparedness of military linguists by developing "realistic immersion" environments through user-friendly state-of-the-art technology.

Conduct research on second language acquisition and retention with the aim of optimizing the tutor's pedagogical and technological approach.

MAJOR PRODUCTS:

FIRST GENERATION TUTOR
(German, available August 1992)

SECOND GENERATION TUTOR
(Spanish & Arabic, 3 year program starts May 1992)
**LANGUAGE SKILLS**

**COMPREHENSION**  
(Recognition)

**PRODUCTION**  
(Recall)

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<th>WRITING</th>
<th>SPEAKING</th>
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</table>

**Computer-assisted Language Learning**

**WRITING**
- natural language processing
- key word matching
- string matching

**SPEAKING**
- connected speech -> action or discourse results
- speak words/short phrases -> action results
- speak words/short phrases -> pronunciation feedback
- listen -> pronounce -> repeat

**Goal is to communicate.**
OUTSTANDING FEATURES OF TUTOR

* INDIVIDUALIZED INSTRUCTION

Capability provided by natural language processor

Parses full sentences input by students
Analyzes grammatical errors

Capability provided by tutor program

Develops a profile of student's strengths and weaknesses
Adapts lessons to the individual student

* FLEXIBILITY

Authoring system for instructors (requires no programming skills)

Lessons, feedback, hints, lesson progression rules

* EXTENDABILITY

Parser is based on language universal principles with "switches" that change the parameters for different languages
STUDENT

VIEWS/HEARS EXERCISE
- Text
- Graphics (map)
- Audio

REQUESTS ASSISTANCE
- Through Pull-down Menus
  - Dictionary
  - Hints/Explanations/Replay
  - Help
  - Progress

RESPONDS
- Select alternative (T-F, MC)
- Point to map
- Sort
- Fill-in-the-blank
- Type full sentence

LANGUAGE TUTOR

TUTOR PROGRAM
- Presents exercises
- Sends sentences to NLP
- Presents feedback
- Tracks student errors
- Controls lesson progression

INSTRUCTOR/RESEARCHER

CREATES/MODIFIES
- Lessons
- Feedback
- Hints/Explanations
- Lesson Progression

NATURAL LANGUAGE PROCESSOR
- Lexicon
- Grammatical Parser
- Semantic Analyzer
- Fact Checker
SECOND GENERATION ATTRIBUTES

TECHNOLOGIES and DESIGN:

* Utilize relevant technologies (e.g., voice recognition), where possible
* Natural language processing (NLP) integrated with ITS/ICAi
* Based on language universal principles for extendability
* Dynamic graphics and interactive dialogs simulating second language immersion
* Capability to alter feedback mechanisms, track student performance, and diagnose classes of errors
* Easy reconfiguration (by a non-programmer) along selected dimensions for research purposes and lesson alteration
RESEARCH: POSSIBLE ISSUES TO BE EXAMINED

COGNITIVE ASPECTS

** Theoretical framework and cognitive model of foreign language acquisition and retention

* Immersion variables (e.g., overt response to input -> dialog, graphics animation)

* Cognitive demands of task (e.g., production vs. comprehension)

INSTRUCTIONAL APPROACH

* Construction of lessons & tests (e.g., problem solving, multiple-choice)

* Instructional design (e.g., presentation of linguistic rules, response dependent lesson branching)

* Error feedback (e.g., promote discourse & stop only on critical errors, diagnosis & prescription)

FORMAT VARIABLES

* Screen layout, color, graphics

* Input formats

* Speech recognition/production
CREW, GROUP AND UNIT TRAINING

Update of AF ISD Process:
Major Conrad Bills

Team Decision-Making Training (Update)
Dr. Eduardo Salas
(No hard copies available)
INTRODUCTION

GOALS OF BASELINE ANALYSIS

• LOOK AT:

  CURRENT EMERGING INSTRUCTIONAL DESIGN PROCESSES

  ADVANCES IN LEARNING THEORY

  HIGH-TECH TRAINING SYSTEMS

  AUTOMATED ISD TOOLS

• RECOMMEND CHANGES

REVISION OF AIR FORCE ISD
SUMMARY OF APPROACH AND FINDINGS

APPROACH

1. SURVEY THROUGH QUESTIONNAIRE
2. INTERVIEWS
3. OBSERVATION
4. LITERATURE REVIEW

REVISION OF AIR FORCE ISD
SUMMARY OF APPROACH AND FINDINGS

OVERALL RESULTS AND IMPLICATIONS

1. STRENGTHS OF CURRENT AIR FORCE PROCESS
   a. The Process Itself
   b. General Architecture

REVISION OF AIR FORCE ISD
SUMMARY OF APPROACH AND FINDINGS

OVERALL RESULTS AND IMPLICATIONS (Continued)

2. LIMITATIONS OF CURRENT PROCESS

a. Adaptability
b. Follow letter rather than the intent
c. Excessive paperwork
d. Information is too complex
e. Information is outdated
f. Lacks information on affective domain
g. Lacks detail on cognitive domain

REVISION OF AIR FORCE ISD
SUMMARY OF APPROACH AND FINDINGS

OVERALL RESULTS AND IMPLICATIONS (Continued)

3. SUGGESTIONS FOR IMPROVEMENTS

a. Reduce paperwork
b. Provide information in a more comprehensible manner
c. Provide information on affective domain
d. Provide information on cognitive domain

REVISION OF AIR FORCE ISD
DETAILED RESULTS OF THE SURVEY

- TARGET AUDIENCE DESCRIPTION BY APPLICATION

- SUMMARY OF FINDINGS

  - ACQUISITION
  - FLYING/AIRCrew
  - EDUCATION
  - TECHNICAL/MAINTENANCE

REVISION OF AIR FORCE ISD
RECOMMENDATIONS

1. ADAPT SYSTEMS APPROACH

2. ISD IS TOTAL QUALITY PROCESS

3. DEVELOP SEPARATE GUIDELINES
   - ACQUISITION
   - FLYING/AIRCrew
   - TECHNICAL/MAINTENANCE

4. DEVELOP "HOW TO'S"

5. ESTABLISH TECHNOLOGY CLEARING HOUSE AND "WHAT WORKS"

6. ESTABLISH 1-800 CENTRAL FACILITY

---

REVISION OF AIR FORCE ISD
RECOMMENDATIONS

NEEDS:

• ACCESSIBILITY
• FLEXIBILITY
• CURRENCY
• AUTOMATION

REVISION OF AIR FORCE ISD
RECOMMENDATIONS

MODEL FUNCTIONAL REQUIREMENTS

UNIQUE PERFORMANCE REQUIREMENTS

- ACQUISITION: INTERRELATE ENGINEERING AND TRAINING INFORMATION
- FLYING/AIRCrew: INTEGRATE PSYCHOMOTOR, PROCEDURAL, AND COGNITIVE SKILLS IN REAL TIME
- TECHNICAL/MAINTENANCE: DIAGNOSTIC PROBLEM SOLVING

REVOLUTION OF AIR FORCE ISD
TOP-LEVEL TRAINING SYSTEM FUNCTIONS

- ANALYSIS/DESIGN
- DEVELOPMENT
- DELIVERY
- MANAGEMENT/ADMINISTRATION
- SUPPORT
- EVALUATION
- QUALITY ASSURANCE

REVISION OF AIR FORCE ISD
RECOMMENDATIONS

TOTAL QUALITY MANAGEMENT PROCESS

- BELIEFS ABOUT RELATIONSHIP BETWEEN QUALITY AND COSTS
- TO IMPROVE RESULTS, FOCUS ON PROCESS, NOT OUTCOMES

REVISION OF AIR FORCE ISD
RECOMMENDATIONS

- INPUT FROM TOTAL QUALITY MANAGEMENT
  - CUSTOMER
    - KNOWING AND SATISFYING
  - QUALITY
    - DEFINED BY CUSTOMER, ULTIMATE MEASURE OF VALUE
  - CONTINUOUS PROCESS IMPROVEMENT
    - CUSTOMER EXPECTATIONS RISE, FOCUS ON PROCESS
  - PEOPLE
    - TEAMS, COMMON VISION. TO ACHIEVE ORGANIZATION'S OBJECTIVES, COUPLE AUTHORITY WITH RESPONSIBILITY

REVISION OF AIR FORCE ISD
RECOMMENDATIONS

FORMAT:

- AFM 50-2
- AFP 50-68

(3 VOLUMES AND EXECUTIVE SUMMARY)

REVISION OF AIR FORCE ISD
NEXT-PHASE ACTIVITIES

PRODUCTS:

- **AFM 50-2**
- **AFP 50-68**
  - EXECUTIVE SUMMARY
  - VOLUME 1 - ACQUISITION
  - VOLUME 2 - FLYING/AIRCREW
  - VOLUME 3 - TECHNICAL/MAINTENANCE

---

REVISION OF AIR FORCE ISD
PROCESS:

DESIGN/DEVELOP DRAFTS
FORMATIVE EVALUATION
REVISE DRAFTS
PREPARE CAMERA-READY COPY

REVISION OF AIR FORCE ISD
POLICY FLOW

POLICY (AFR 50-XX) → GUIDANCE (AFM 50-2) → HOW TO (AFP 50-68)

ICW DECISION GUIDE OJT
ICW MGT GUIDE PME
ACQUISITION TECHNICAL TRAINING
TOOLS/WAT WORKS FLYING TRAINING
EXECUTIVE SUMMARY ICW SELECTION GUIDE
ICW DEVELOP GUIDE
Training System Functional Model
TRAINING DESIGN AND EVALUATION

Instructional, Planning and Evaluation Issues

Instructional Strategies for Logistic Command and Control:
Captain Reynold Hioki

Distance Learning:
Mr. Dennis Gettman
(No hard copies available)
Training Technology Technical Group (T2TG)

Desktop Training for Logistics Command and Control

Capt Reynold Hioki
AL/HRTC
25 Mar 92

PROBLEM STATEMENT

- Limited training opportunities for required complex, time/risk-critical decision-making.
  - Expense and other limitations of exercises
  - Changing threat environment
  - Personnel changeover
  - Use of battle staff augmentees
  - Inadequate knowledge about effective instructional strategies for complex decision making
  - Lack of validated training outcomes

- Sponsor: HQ USAF/LGXX
- User: HQ AFLC
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<th>OBJECTIVE</th>
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<tbody>
<tr>
<td>Develop instructional strategies for complex decision-making domains</td>
</tr>
<tr>
<td>Develop Desktop Training System for training complex decision-making skills</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>PAYOFFS</th>
<th>PRODUCTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective individualized training for logistic battle staff personnel</td>
<td>Validated instructional strategies</td>
</tr>
<tr>
<td></td>
<td>Desktop Training System prototype</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop instructional strategies for complex decision-making domains designed to instruct:</td>
</tr>
</tbody>
</table>

- concepts/facts
- rules/procedures
- principles/relations

Develop a desktop training system prototype for training of complex decision-making that includes:

- presentation capability
- simulation capability
SYSTEM ARCHITECTURE

PAYOFFS

Provide effective complex decision-making training for individual battle staff personnel:

-- when needed
-- where needed
-- at lower cost
PRODUCTS

Validated instructional strategies
-- literature-based
-- contractor sponsored symposium
-- experimentation

ITS prototype
-- object-based, graphical user interface
-- adaptive to individual student needs
-- presentation and practice capability

SCIENTIFIC METHODOLOGY

Instructional methodology
-- training requirements analysis
-- literature review
-- instructional methodology symposium
-- field evaluation
-- experimentation

ITS prototype
-- instructional methodology
-- rapid-prototyping approach
-- object-based
-- field evaluation
-- experimentation
WRAP-UP

Training Design and Evaluation
Summary - Mark Teachout
(No hard copies available)

CREW, GROUP, UNIT AND TEAM

Dr. Eduardo Salas

ADVANCED TRAINING TECHNOLOGY

Dr. Ray Perez
- Session I was entirely devoted to a discussion of a DMSO proposal submitted by ARI (lead), NTSC, and Armstrong Lab. The discussion was led by Frank Moses. He outlined the objectives of the project and the products. The proposed work is to exploit "SIMNET-like" technology and demonstrated the efficacy of different training strategies. He also showed a videotape recreating the Battle of 73 Easting.

- The topic for Session II was aircrew coordination training (ACT). There was a presentation given by Major Woodruff on a Tabletop Aircrew Coordination trainer. This is a low-fidelity PC based flight simulator that allows crews to practice teamwork skills. It generated lots of interest and discussion. Then, David Baker and Randy Oser from NTSC updated the group on recent advances of the ACT research. They focused their discussion on organizational issues in ACT and integration of ACT to technical skills. Finally, Judith Orasanu (NASA-Ames) gave a summary of current work that they are supporting on aircrew coordination and presented some data on her research.

- The last session was a presentation by Major Bills on the AF ISD work. He updated the group on what has been done and where the work is going.
Summary Advanced Training Technology Subgroup of the T2TG

The Advanced Training Technology subgroup met on the 24 & 25 March 1992. The thirteen attendees for this session represented both bench scientists and users. They represented all the major laboratories in the three services (NRL, ARI, AFHRL, NTSC, NPDRC, ONR). The theme of the five paper presentations of this meeting was research on "Virtual Reality Its Application to Training and Intelligent Tutors." Five papers were presented by Scientists from the service laboratories (ARI, AFHRL, NTSC, NPDRC). The guest discussant for these presentations was Dr. Denis Breglia from NTSC. Each presentation was followed by a discussion led by Dr. Perez, Ms. Dickieson, and Dr. Breglia. The meeting was co-chaired by Dr. Perez and Ms. Dickieson, Ms. Dickieson is the incoming chair.

Dr. Richard Thurman (AFHRL) presented his research on the use of Virtual Reality (VR) technology to enhance pilot tactical skills. He was followed by a presentation by Dr. Bruce Knerr (ARI) on the Army's efforts to generate training requirements for the use of Virtual Reality technology in the Army's future Close Combat Tactical Trainer. Dr. Joseph Psotka (ARI) presented a paper on the use of hyper-media to enhance visual problem-solving in a Virtual Reality environment. Dr. Psotka pointed out the similarities in considerations for VR and Hypertext applications. He was followed by a paper presented by Dr. Ellen Hall (AFHRL) on the Air Force's tutor for the family of skills. This paper in turn was followed by Dr. Wisher (ARI) who described his research on cognitive modeling of the acquisition of morse code. Dr. Michelle Sams (ARI) presented the work they are doing on a Foreign Language Tutor. The objective of Dr. Hall and Dr. Sams' projects is to design, develop, and implement intelligent tutors.

The paper presentations and questions were followed by a discussion and suggestions of future topics for Advanced Training Technologies Subgroup meetings.

A summary of conclusions of the VR research and comments made by the group follow.

- Little or no instructional design theory exists to go along with and guide the use of VR technology.

- Hardware/software hasn't reach sufficient level of maturity for commercial or military applications.

  - Commercial applications will produce the largest technical gains in the development of VR.

  - No economies of scales exists for VR.

- More research is needed to answer the following questions and issues.
- To what degree do we need this technology (what current training problem will it solve)?

- We need a better understanding of spatial orientation before we can effectively design and use VR technology.

- We need better theories and definitions of visual metaphors for capturing data.

  o Government needs to be more proactive in helping industry define its needs.

In general, advances in training technology, including the work on the design of Intelligent tutors, need to address the requirement for personnel to perform increasingly complex and difficult tasks and possess a wide range of skills.

Topics for next meeting:

  o Distance Learning/Distance Education

  o Virtual Environments

  o Applied Technologies

It was suggested that we invite DMSO to attend and have personnel from Disney World brief on their applications of VR. Everyone agreed that we should always have included in our sessions, various projects to be briefed that are beyond the conceptual stage and can report data.

In sum, the meeting was very successful as measured by the entusiasms of the participants and their representativeness. At least one bench scientist from each of the services labs was in attendance.

Ray S. Perez
Jan Dickieson
Co-Chairpersons Advanced Training Technologies Subgroup
## ADVANCE TRAINING TECHNOLOGIES ATTENDEES

<table>
<thead>
<tr>
<th>Name</th>
<th>Agency/Symbol</th>
<th>Phone</th>
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</thead>
<tbody>
<tr>
<td>Ray Perez</td>
<td>ARI, PERI-IIB</td>
<td>C (703) 274-8694</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DSN 284-8694</td>
</tr>
<tr>
<td>Jan Dickieson</td>
<td>NPRDC, 132</td>
<td>C (619) 553-9270</td>
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<td>AV 553-9270</td>
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<tr>
<td>Major Jim Mika</td>
<td>TPDC</td>
<td>C (407) 281-3683</td>
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<td>John E. Buckley</td>
<td>TRADOC-DCST</td>
<td>AV 680-5535</td>
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<tr>
<td>Wes Regian</td>
<td>AL/HRTI</td>
<td>AV 240-2034</td>
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<td>Jim Fleming</td>
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<td>Richard Thurman</td>
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<td>Michelle Sams</td>
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<td>Meryl Baker</td>
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<td>Joe Psotka</td>
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<tr>
<td>Bruce Knerr</td>
<td>ARI-PM TRADE Field Unit</td>
<td>C (407) 380-4378</td>
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<tr>
<td>Denis Breglia</td>
<td>NTSC-CODE 251</td>
<td>C (407) 380-8159</td>
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<tr>
<td>Carl Driskell</td>
<td>US Army STRICOM (Formerly PM TRADE)</td>
<td>C (407) 380-4348</td>
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<td>BILLS, CONRAD G. MAJ</td>
<td>ASD/YTEE, Wright-Patterson AFB, OH</td>
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<td>BREGLIA, DENIS MR.</td>
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<td>DRILLINGS, MICHAEL DR.</td>
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<td>DRISKELL, CARL MR.</td>
<td>PM-TRADE, Orlando, FL</td>
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