


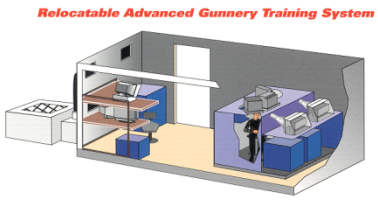

Enduring Themes in Military Training Research

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Formerly US Army Research Institute for the Behavioral and Social Science

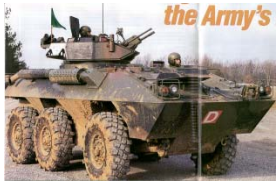
My Background

- PhD in Cognitive Psychology from SUNY at Buffalo.
- Completed degree Summer, 1974
- Joined US Army Research Institute (ARI) in December, 1974
  - Arlington, VA Training Technical Area (74-80)
  - Ft. Knox, KY Armor Training Research (80-84)
  - Ft. Monroe, VA ARI, Liaison to TRADOC (84-89)
  - Orlando Research Unit (89-12) Retired
  - Since retiring - IST but really for the Army's STTC helping to manage the Army's contract with the Institute for Creative Technology at USC

Bottom Line- I've been involved with training research for forty years









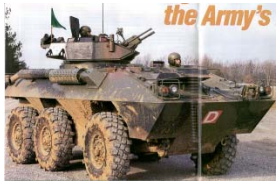
What are Enduring Themes?

Research topics are enduring when:

- The research topic comes up frequently
- Each time the research question is slightly different because of people, policy, equipment, or training method changes
- Some enduring questions are asked frequently but rarely is research performed to address them.
  - Because it's too hard, costly, dangerous, lacks a proponent, or adequate methods are not available.
  - So there is a demand for information that is never fully met.







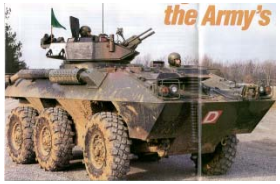


Today's Research Topics

- Researchable
  - Skill Retention Research
  - Rifle Marksmanship
- Often asked about rarely researched
  - Simulator Fidelity
  - Collective Training Effectiveness
- For those in training research these are familiar topics.
- Start with Skill Retention and Simulator Fidelity in some detail and Marksmanship and Training effectiveness as time allows.







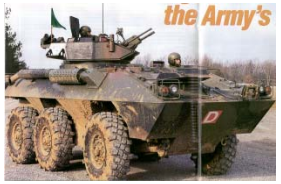


Skill Retention

- In the mid 70s the Army was going through a number of significant changes:
  - A mobilization training model embodied in the Army Training Program ended with the draft and Viet Nam
    - The Army Training Plan – year long training cycle based on training beginning with individuals culminating in battalion and brigade training.
    - A specified amount of time at each echelon and event.
    - Competency was assumed not measured.
  - The All Volunteer Force was to be a smaller professional Army that had to maintain a more constant level of readiness through multi-echelon training.







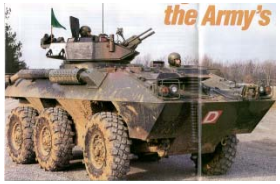


Maintaining a More Consistent State of Readiness

- From a time model the Army went to a competency/performance-based model which identified tasks, conditions and standards for each skill level and echelon.
- The Army wanted to know how often tasks needed to be trained to maintain performance to standard
- Skill Retention research was to provide training frequency guidance







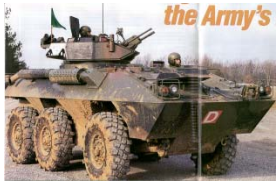


Predicting Skill Retention

- The military has many occupational specialties where after training on a task Soldiers may experience long periods of no practice.
- Skill retention researchers wanted to know after a given period of non-performance what's the probability a Soldier will be able to perform it correctly?
- What factors could predict this performance level?
  - Task characteristics (psychomotor, procedural, etc)
  - Soldier ability (mental category)
  - Time since training (retention interval)
  - How training was conducted (over learning)







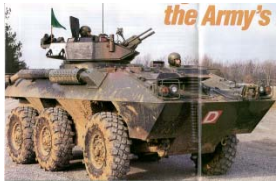


Predicting Skill Retention

- ARI's research program was aimed at gathering enough empirical data to develop a model for predicting retention rates and retraining schedules.
- Data collected on different types of tasks:
  - Type Writing and Maintenance (Psychomotor skills)
  - Chaparral Missile (procedural skills)
  - Basic Training Common Tasks (range of task types)
  - Marksmanship (motor and cognitive task)
  - Infantry/Cannon Crewman/Armor tasks (procedural and motor tasks)
- Effect of training strategies on retention
  - Mastery learning (repetition)
  - Use of feedback
  - Variability of Practice









To begin to look at these questions [illegible] data from over 500 Soldiers at Ft. Sill, OK

Retention Prediction Model

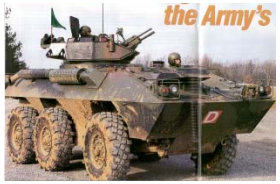
Based on a great deal of data a prediction model was developed in the mid 80s called the Unit Decision Aid (UDA)

- Intended as a tool for Commanders to use in scheduling training
- Consisted of a series of questions about the tasks with weighted responses
- In comparison to training and individual difference data, task data was the largest determiner of retention performance.
- UDA was the best predictor of retention

UDA culminated the first round of skill retention research.







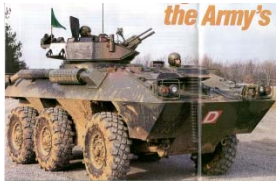


Skill Retention Revisited

- **1990**-Use of Individual Ready Reserve in Desert Storm-What was the extent of "skill decay" in called up IRR Soldiers?
  - Skill decay was evident in written diagnostic and certification tests and weapons qualifications scores.
  - Skills assessed by written tests decay, mostly within the first 6 months since separation; weapon qualification skills decayed mostly after 10 months.
  - A soldier's self-assessment was a strong indicator of skill performance.
  - Skill retention was better in career fields that had more opportunities for soldiers to use their military occupation skills in their civilian jobs.







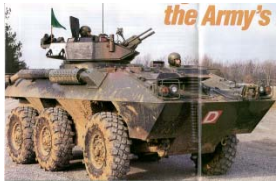


Skill Retention Again-
Digital Skills

- **1995** How well do Soldiers retain the digital skills needed to exploit new Army communication systems like Blue Force Tracker and Force 21 Battle Command Brigade and Below (FBCB2), and Command Post of the Future (CPOF)?
  - Concern that new digital systems were complicated and digital skills would be perishable
  - Frequent software changes require ability to adapt to new processes for the same function
  - Methods needed to predict retention of digital skills and train those skills to be retained longer







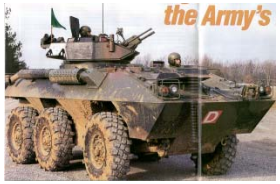


Command and Control Digital Skills

- Skill retention research conducted for FBCB2 and CPOF
  - digital-system interfaces procedural, but hierarchical knowledge of the system is required to effectively navigate digital interfaces and to optimize problem solving
  - FBCB2 in vehicles and lower level command and control centers-relatively straight forward task structure
  - CPOF – higher level headquarters- complex and non-linear system that stresses collaboration







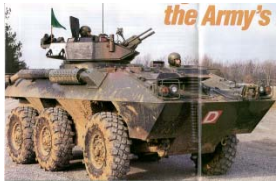


Digital Skill Retention Findings

- Some skill decay after 8 weeks (FBCB2) and 4-6 weeks (CPOF)
- Declines in hands on performance were modest about 10% and restricted to 3 of 13 tasks areas (FBCB2) or 9 of 18 (CPOF). Good retention of knowledge for both.
- Forgetting in both systems was of non-straight forward tasks that lacked internal cueing or screen prompts
- Results indicated areas for future training emphasis







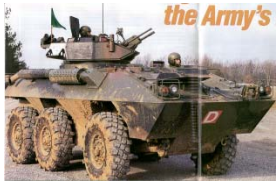


Retention Research Questions Still to be Resolved

- For the most part research has focused on first term Soldiers and tasks they perform infrequently. Most were procedural tasks, few involved decision making or problem solving.
- Little data on more experienced Soldiers or growth of skill over extended periods of performing tasks
- Collective skill retention attempts have been not successful







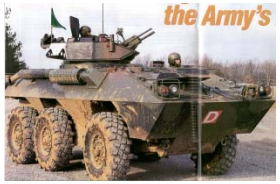


Simulation Fidelity- How much is enough?

- Question has been following me around since I arrived in Orlando 25 years ago. Everybody wants an answer but not much research actually occurs.
- Why does this question continue to be asked
  - Persistent claim that more realism equates to better training transfer to the real equipment.
  - At the same time realism for its own sake is expensive and likely unnecessary- what do you really need to produce an effective simulator at the lowest cost?







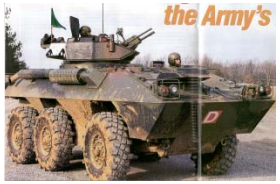


What is Fidelity?

- DoD definition of fidelity-the accuracy of the representation when compared to the real world. [DoD 5000.59-M]
- Fidelity has many components
  - Physical fidelity (how close to the real thing is the simulations physical appearance and environment)
    - Equipment (are all the knobs and dials there and functional)
    - Environmental (are the smells, terrain and buildings proper)
    - Audio visual (level of resolution allows for realistic visuals and audio)
    - Motion(is sense of motion based on the environment perceived by simulator user)
  - Psychological fidelity (how realistically do people react to what they perceive)
  - Functional fidelity
    - How well the simulator replicates the tasks needed to operate the actual equipment)







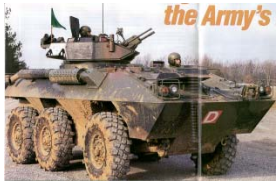


Measuring Fidelity

- Lack of well defined and widely accepted concept of fidelity
  - Most measure are qualitative or subjective
- There are quantitative measures.
  - Those formulas use the actual equipment as a referent.
  - Could be used in writing requirements or specifications
- There is no single Fidelity Scale-way to combine all the aspects of realism in one measure.
- In the end the comparison with the actual equipment, doesn't address whether the simulator has the proper cues to meet its training objectives.







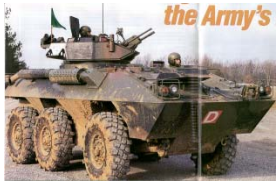


Fidelity and Training

- Psychologists have long been saying that training systems don't necessarily need high fidelity in all aspects of the system.
- Confusion between fidelity and training value. More fidelity more training value? Military always want as much realism as possible.
- Need proper stimuli to illicit the desired response to meet the training objectives
- SIMNET (first networked virtual simulation) used selective fidelity, switches not needed for training were wall paper
- Training analysis should inform simulator design to ensure training objectives are met at the least cost but frequently the analysis to determine what stimuli are needed is not performed.







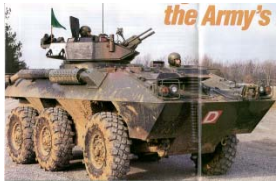


Fidelity and Design of Training Systems

- The state of the art has a lot to do with the simulators design (1980s trees were triangles, now much more lifelike)
- Cost tradeoffs matter but are they performed?
- Very little formative evaluation or summative evaluation.







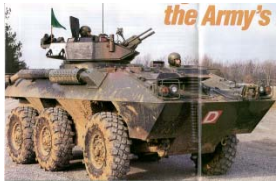


Fidelity and Research

- Often discussed rarely researched
- ARI created a Fidelity Aviation Test Bed at Ft. Rucker in the late 1990s.
  - It was never used for its intended purpose
  - Technology changed too quickly
- For many tasks transfer studies are dangerous
- Quick review of aviation and ground vehicle literature doesn't show many papers on fidelity past mid 2000s







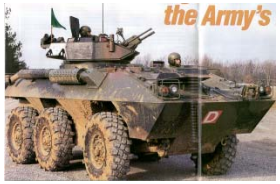


Yet

- I was recently asked by some researchers at a major simulator builder if there is any data that supports the need for simulator motion for ground vehicles
- Medical simulation is booming and fidelity questions are coming from that direction







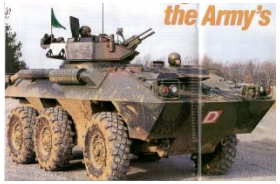


Rifle Marksmanship Training

- Why does this research topic come up so often
  - It's a skill everyone learns
  - Live rounds are expensive in the aggregate
  - Substitution of simulation would be cost effective
  - Services have different training philosophies
    - Marines -Know Distance Ranges
    - Army- Field Fire Ranges with Pop Up targets







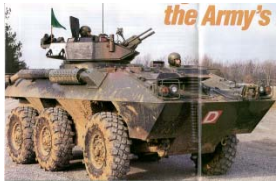


Army Rifle Marksmanship Research Thru the Decades

- 1950s
  - Human Resources Research Organization-TrainFire
    - Increased realism –pop up targets
    - More emphasis on standing and kneeling vs. prone
    - New program increased proficiency, motivation, with decreased training time and cost savings
- 1976-85
  - Army Research Institute (ARI)
    - New Army-wide basic and advanced rifle marksmanship training for individuals and new approach to unit marksmanship based on data from 18,000 Soldiers
    - New targets, manuals, training devices (weaponeer), moving target training







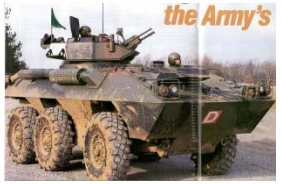


Rifle Marksmanship Research Thru the Decades

- 1990s
  - ARI- Research on rifle marksmanship training systems
    - Multipurpose Arcade Combat Simulator
    - Laser Marksmanship Training System (LMTS)
- 2008-present
  - ARI surveyed 1600 Captains and NCOs from 13 Army branches-identified tasks for diagnostic test before live fire e.g. correct malfunction.
  - Series of experiments on zeroing distance and number of shots needed.
  - Comparison of live fire, dry fire and simulator practice.







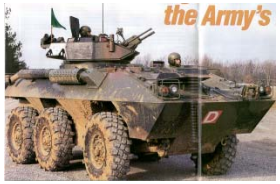


Other Research Performers

- Army Research Institute, Ft. Benning has conducted the most Marksmanship research but there have been many other organizations:
  - Naval Post Graduate School (popular topic for a thesis)
  - UCLA-CRESST for ONR and Marine Corps
  - Army Marksmanship Unit
  - Naval Medical Research Unit-Dayton
  - Army Aeromedical Research Lab-Ft. Rucker
  - DSTO-Salisbury, Australia
  - DRDC-Toronto









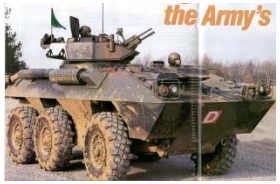
Training Effectiveness Evaluation

Questions that can be asked:

- How well does the training system improve performance on the device?
- How well does that training transfer to performance on the actual equipment?
- How well does the new training method compare with the current approach?
- How well does training performance transfer to performance on the battlefield?







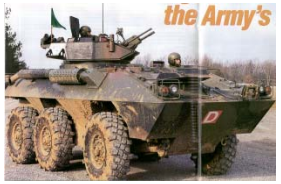


Elements of Training Evaluation

- In 2002 John Boldovici was the first author of a book entitled "Elements of Training Evaluation."
- The book debunked most of the methods used in doing military training effectiveness analyses.
- Boldovici called for an adherence to methods that would result in valid inference.
- The methods Boldovice recommended are those that would be applied in controlled research experiments, including random assignment of Soldiers to groups, increasing power, following the rules for using parametric statistics.
- If you ever are asked to do a training effectiveness evaluation, look at Boldovici's book to see what you should do and then realize what won't work and what risk that involves.









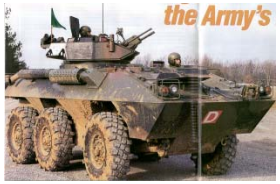
Training Effectiveness Studies

What problems get in the way of doing effectiveness research the right way?

- Large enough sample sizes to have enough power for parametric statistics.
- Being able to safely collect the live data-one use of simulators is to train on tasks too dangerous for the actual equipment
- Finding a funder and sponsor for evaluations that aren't required
- Having valid measures for individual and collective performance for both virtual and live domains







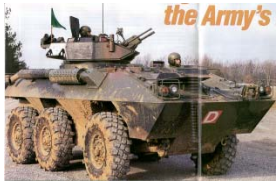


My Experiences

- Even thought there is general recognition training effectiveness studies should be performed , the fact is that for new training systems they are rarely done at fielding and never done once the system is in the field.
- I spent 2 years trying to find an agency to fund a long-term study of the Close Combat Tactical Trainer, the Army's most expensive training system.
  - I failed, partly because it would have cost money 1% of acquisition costs, but mostly because
  - No Army agency had the mission or funding to do post fielding training evaluations.









Enduring Themes

- Some other enduring themes:
  - How to measure and deal with Simulator Sickness
  - Team and Collective Performance Measurement
  - Intelligent tutor research
  - Authoring tools for training
  - Training Management methods
- In a 35 year career you will likely see many of these topics and the ones we reviewed today more than once.