THE EFFECT OF TIME ON TRAINING RETENTION
RATES OF UNITED STATES AIR FORCE
LOADMASTER APPRENTICE STUDENTS

DISSERTATION

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By
Angela F. Canada, B.S., M.S.
Denton, Texas
December, 1998

The purpose of this study was to determine if extended periods of time out of the training environment has an effect on the retention of training. The first chapter presents an overview of the topic of human memory, defines key terms, and identifies questions addressed in the research. The rationale for conducting this study was based on the fact that little research has been done in this area.

The second chapter contains a thorough review of pertinent literature related to human memory, forgetting, retroactive inhibitors, stress and retention of knowledge or training. Due to the lack of research literature concerning a significant source of outside stress on training retention, this is a worthy topic to explore and makes a significant contribution to training literature. It also provides guidance to the Air Force concerning the purposeful introduction of training gaps and stressors into the training continuum.

The last chapter describes the qualitative research methodology used to conduct the study. The primary methodology was a comparison of adjusted mean scores for groups of individuals who either had or had not attended survival school between training courses. The research population consisted of United States Air Force loadmaster apprentice
students. The criterion-referenced tests were validated using classes of students attending the Basic Loadmaster Course at Sheppard Air Force Base, TX. Finally, a reference section identifying the literature used in the preparation of this dissertation is included at the end.

The findings of the study indicated that extensive periods of time out of training do significantly influence the amount of training retained from one loadmaster course to the other. Additionally, there was a significant relationship between the number of days out of training and the posttest scores. The optimum training break between courses appears to be between 10 and 20 days. Training retention is apparently affected by time.
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CHAPTER I

INTRODUCTION

Training costs in the United States represent billions of dollars (Broad & Newstrom, 1992; Foxon, 1993; Industry Report, 1997). An expenditure of this magnitude in other business functions (sales or research and development) would most certainly require an evaluation of the return on investment. Foxon (1993) cites Baldwin and Ford (1988) and Gist, Bavetta and Stevens (1990) in stating that there is little evidence of any actual transfer of training.

The high cost of training personnel is more than enough justification to investigate its value. Why, then, are businesses willing to continue investing money in an area where there is little indication of recovery? The Foundation for the Malcolm Baldrige National Quality Award commissioned a survey of 2500 CEOs of large companies (Harris, 1998). The results indicated that over half of the respondents considered “creating a learning organization” to be a major business trend. This implies that management continues to value training. However, the same report points out that most United States companies are either “fair” or “poor” at producing this learning atmosphere.

Training appears to be valued by workers as much as by the organization.
Schaff (1998), in reporting a study conducted by Training Magazine, Development Dimensions International (DDI) and the Gallup School of Management of Lincoln, NE, relates that nearly 80 percent of participants said they had received some form of training in the last year. More than half of the trainees were pleased with their training and a full 99 percent desired additional training. Perhaps most importantly, 66 percent of the respondents said their training had been helpful in the workplace.

Evidently, training is valued at all levels of the organization. Moreover, this investment represents significant amounts of money (Foxon, 1993). It seems advisable to promote situations that encourage training retention and avoid those which diminish its effectiveness. This would necessitate identifying factors that interfere and reversing their effects. One possible agent is the natural phenomena of forgetting.

It is widely recognized that forgetting occurs over time (Ebbinghaus, 1964; Ekstrand, 1972). Could this cause significant learning loss in trainees in spite of motivation to retain the knowledge? Moreover, if time alone cannot account for a significant loss, are there other factors that can?

The Aircraft Loadmaster Apprentice course conducted at Sheppard Air Force Base is particularly concerned with the answer to those questions. While the students attend an Air Force training installation, they are in a structured environment designed to promote learning. Their housing, food, and spending money are provided for them so as to minimize distractions from learning. (Griffith, 1998). The training itself is provided in a logical procession, one course building upon previous learning. By the time the typical
Air Force member reaches his first duty station, he has had several weeks of uninterrupted, job-specific training. Unlike other career fields, the loadmaster may not accomplish all of his training in a smooth flow fashion. Training availability in weapon-specific and survival schools may be interchanged to minimize time out of training. Although important, survival school covers altogether different knowledge than the weight and balance information provided in loadmaster training. The focus of this proposed study is the break in the cycle of training and the effects of the stress incurred in survival school.

Background

Training for aircraft loadmasters in the United States Air Force occurs in two phases. The Basic Loadmaster (BLM) course consists of 21 academic days for student loadmasters of all airframes: C-130, C-141, C-5, and C-17. BLM is taught at Sheppard Air Force Base, Texas. The follow-on loadmaster training is weapon-system specific and of varying length. C-130 qualification is conducted at Little Rock AFB, Arkansas, while the other courses are located at Altus AFB, Oklahoma.

The qualification standards for aircrew members are high due to the requirements of the job. First, it is imperative that the individual be a volunteer to fly. The stressful nature of the career field would be intolerable if the person were afraid or otherwise unwilling to fly. Furthermore, the person must have graduated high school, or achieved its equivalent. Anyone participating in military service in the United States must complete the Armed
Forces Vocational Aptitude Battery. This series of tests yields several scores including General, Mechanical, and Electrical. Each loadmaster student must achieve a “General” score of at least 55 (USAF, 1998).

In addition to these volunteer and scholastic standards, each aircrew member must pass a rigorous Type III flight physical. The restrictions are very rigid concerning eyesight and other physical standards that could affect the individual’s flying safety. If the prospective student passes the first set of standards, they are then allowed to attend the Enlisted Aircrew Undergraduate course. Therein they attend the altitude chamber where they experience the effects of extreme altitude on the body. They are also screened for attitude, aptitude and motivation for being an aircrew member. The course is very demanding mentally and emotionally.

The typical loadmaster student is an active duty or reserve Air Force member with an occasional National Guard, Navy, Civilian or Foreign National member. Student ages range from 17 into the 50’s with the majority being non-prior-service (NPS) airmen. Prior service students, Senior Airmen (SrA) and above, arrive on station with an assignment to a particular model of aircraft and a base. The assignment of NPS students to an aircraft and duty station is contingent upon the needs of the Air Force but considers the individual’s stated base of preference.

The BLM course provides training concerning entry level weight and balance theories and computations, loadmaster duty familiarization, application of cargo restraint, and supervision of aircraft loading and off-loading activities. Upon completion of BLM,
students proceed to follow-on training in one of several ways, depending on the availability of training quotas. If quotas are available, the students go directly to follow-on training. However, the weapon system classes are small, and it is impossible, under current conditions, to funnel all graduates directly into class. Other students may be held administratively at Sheppard or elsewhere until their training date arrives. Some students must await a class entry date for weeks or months.

In addition to loadmaster training, students must complete aircrew combat survival school which is 17 days long and conducted held at Fairchild AFB, WA. The students are expected to survive for several days on food they can find in the forest. Additionally, they learn and practice evasion techniques designed to prevent being captured. After evasion practice, all students are taken to a mock prisoner of war camp. There they are subjected to treatment designed to determine if they have the mental stamina to endure real prisoner of war situations. Students may or may not have to attend water survival school also. There they are tested to determine if they have the ability to survive if the aircraft ditches in the water. These activities are mentally, physically, and emotionally stressful. Moreover, they contain training and situations which bear no relationship to training at BLM. Many students are routed through survival school while they wait for their follow-on class entry date.
Discussion of Problem

Students graduate the BLM course only if they have achieved 80% mastery of every objective taught in the course. The amount of knowledge they retain upon entry into follow-on training, however, is suspect. The flow of students from the basic loadmaster course to the "qualification" course is not standardized, and there is a perceived additional degradation of training resulting from participation in survival training. However, standardizing the student flow from the BLM course to qualification training would produce additional costs. Does the benefit in decreased training loss outweigh the cost of redirecting student flow?

Purpose of the Study

The purpose of the study is to determine whether training retention levels of Air Force Aircraft Loadmaster students are affected by extended periods of time out of training. Further, it is to determine whether attendance in aircrew survival school results in a significant increase in any such loss.

Research Questions

Three research questions were considered for this study:

1. Do apprentice-level students of the Aircraft Loadmaster training program lose significant knowledge as a result of extended time out of the training environment?

2. Do apprentice-level students of the Aircraft Loadmaster training program lose
significant amounts of knowledge attributable to stress levels resulting from participation in aircrew survival school activities?

3. Is there a way to predict posttest scores from pretest scores or from the number of days out of loadmaster training or from some combination of these?

Definition of Terms

The following definitions are provided to familiarize the reader with terms

Aircrew member - Air Force personnel, officer and enlisted, who control the functions and activities of an aircraft. Includes pilots, loadmaster, flight engineer, navigator, aircraft radar, in-flight refueling operator and others.

Aircraft loadmaster - the aircrew member responsible for the cargo on transport aircraft. Their responsibility includes, but is not limited to, computing the weight and balance condition of the aircraft, placement of the cargo, restraint of the cargo within the aircraft, and supervising the onloading/offloading activities.

Block of instruction - a division of objectives in a course grouping

Control group - the group of participants who are not exposed to the treatment being studied

Course score - the average of the student's block scores for any course of instruction.

Delayed group - the group of participants who do not enter follow-on training until at least the 16th day after graduating BLM but who do not attend survival school in the interim period.
Immediate group - the group of participants who proceed from BLM to follow-on training within 15 days. The control group for this study.

Follow-on training - additional, more in-depth training in a particular area.

Interpolated activity - an activity which occurs after the original learning task but before the retest on the original learning. (Sevenson, 1941)

Mastery - in any given situation, it is defined by Farr (1987) as the standard by which successful learning is measured.

Memory - a intentional recollection of some earlier experience. (Wickelgren, 1977)

Memory trace - any change in the nervous system that is a result of some learning experience. (Wickelgren, 1977)

Non-prior service student - an Air Force member who has not previously been in the military. He comes straight from basic training at Randolph AFB, Texas.

Pretest-posttest control-group design - research design wherein the participants are tested before and after the treatment, but one group receives the treatment and the other does not.

Retroactive inhibition - the interference of later learning with the retention of earlier learning. (Sevenson, 1941) For example, getting the steps for one emergency procedure learned previously confused with the steps of a procedure learned recently.

Smooth-flow - progression from training in one course directly to associated training.

Indicates there is no break in training.

Stress - the human body’s response to outside situations.
Survival school group - the group of participants who attend survival school between graduation from BLM and follow-on training indicating a minimum break of 19 days.

Survival training - a course for all aircrew members (loadmasters, flight engineers, navigators, radio operators, pilots etc.)

Treatment group - those individuals who experienced the treatment being studied.

Weapon-specific training - training acquired about a specific airframe. For example, C-130 loadmaster school provides cargo loading, restraint and emergency procedure information applicable only to C-130 aircraft.

Weight and balance concepts - includes procedures for computing the center of gravity for an aircraft and knowledge of the effects of cargo movement on that balance point.

Limitations

This study is limited to loadmaster students attending the Aircraft Loadmaster Apprentice Course at Sheppard Air Force Base, Texas. These student are not representative of the general population since they must be volunteers to fly. Students may self-eliminate from the flying career field at any time. The students samples are, however, representative of the aircraft loadmaster population.

Delimitations

The stated limitation is also a delimitation. Since the loadmaster population is the only one in question, the study is thereby reduced to that population. Related to this is the
inability to test individuals who either did not meet the qualifications for the career field or chose not to volunteer to fly.

Summary

Students attending Aircraft Loadmaster training at Sheppard Air Force Base graduate having achieved at least the minimum standard of competency for the subject matter. However, when they reach their weapon-specific training some of the knowledge has been lost. It is important to measure the amount of training that is lost and plan future training based on how significant the loss. Will the reduced training loss be worth the cost of rerouting and standardizing the training flow?
CHAPTER II

REVIEW OF LITERATURE

Human Memory

Human memory is an intriguing phenomenon. The same individual who is incapable of remembering what they had for lunch may have vivid recollections of the smell of their grandmother's perfume or the way they felt waiting for their first date. How the magnificent arrangement of cells we call a brain processes every sound, smell and feeling (even if we are not aware of them) is not yet fully understood. There are, however, many theories. In the following discussion, we will explore the literature pertaining to human memory, the circumstances that cause it to fail, and those that facilitate its success.

The first memory studies were accomplished by Hermann Ebbinghaus in 1885 (Ebbinghaus, 1964). He used himself as the subject and memorized lists of nonsense syllables until mastery was demonstrated by reciting the list one time without error. He then took varying amounts of time to rest and then measurement was made of the amount of time required to relearn the list to the same mastery level. Ebbinghaus described learning as the weaving of "invisible threads" which connect ideas to each other, one idea acting as a retrieval cue for another. Think of the process of trying
to remember the whereabouts of a lost article. A person typically attempts to recall the last time they had the object. Where were they and what were they doing? Remembering this kind of information helps the person work back to the memory of where the object was misplaced.

Ebbinghaus’ two basic findings were: (1) much learned material is quickly forgotten, and (2) if the learning is retained for as long as a day, it will probably remain much longer (Ebbinghaus, 1964). This may indicate that learning should be measured for permanence not immediately after the learning episode, but at some time after. The decay seemed to occur very quickly in the first few hours tapering off at the end. He also reported that spreading the practice repetitions out over days increases the likelihood of recalling the information. Reinforcement over time appeared to “fix” the information in the memory.

There were many who followed Ebbinghaus, studying human memory using nonsense syllables or groups of words with no typical association for each other. Bugelski (1956), however, questioned the value of their research. It is possible to make inferences about human memory from these theories. However, research of that type appears to have serious limitations. The variables of interest and motivation to retain the information are not considered at all. Although limited, this basic research was not worthless. It led to the development of other theories.

As reported by Farr, Hirsh determined that there are at least two divisions of memory. The memory that stores facts and the kind that stores skills (Farr, 1987). Facts are abstract
concepts that must be understood by the learner. Deeper understanding by the student promotes more stable recall of the information. The memory of a learned physical skill is more complex. In addition to understanding what must be done, the learner must "teach" the nerves and muscles that accomplish the task. Early in the process, the individual must think about every sequence. Soon, however, the neural pathway does not require conscious thought on the part of the learner. It is possible to perform the task while thinking about something else.

Wickelgren (1977) described three phases of memory development. Acquisition is the learning of the material. Did the individual read the information, hear it, see a movie about it, or discover it through experiment? The second phase is storage, which is how the retention is affected by rehearsal, consolidation, and forgetting. What associations did the person make between the new information and any previously known or new knowledge that would make them remember it? Lastly, retrieval, recognition and recall, is the ability of the person to use the cues and associations to bring the information back into the working memory.

In 1985, Tulving theorized that memory is actually comprised of three interrelated systems. The procedural memory lets the person retain connections between a stimulus and response. Every experience humans have is a stimulus-response of some type. Semantic memory is a type of procedural memory. The semantic system helps the person form "mental models". These determine how well a person comprehends concepts. If the model a person is using does not make any sense to them, they have a harder time
recalling the information. Tulving's third type is episodic memory. It is actually a type of semantic memory that provides for storage of personal experiences. This would be like smells or sounds that cause us to recall something that happened long ago.

In 1997, White discussed the process by which the brain stores information. He described two methods of information coding which the brain uses. When humans have data to learn, they can use rote memorization through repetition. The other learning method would be associating the new information with something already known. Some types of data are more easily stored by rote memorization, for example, multiplication tables. Others are more easily converted by comparing (associating) it with another knowledge. Consider learning to throw a football by comparing it to throwing a baseball.

More than a century after Ebbinghaus, Rosch (1997) described memory as a complexity with many configurations, circuits, and chemical pathways. He also believed that different types of memories (lists, sounds, poetry, smells) use distinct chemical pathways to access the information. If something happens to disrupt that pathway, the memory becomes inaccessible.

A very popular memory theory is that of the memory trace (Farr, 1987). Based on this idea, everything that happens to an individual creates an actual "path" to the information. A trace is the organic residual left when the body registers the event or sensation. A multi-faceted experience can leave a trace that is complex or multi-layered, providing access to the information in a variety of ways. This is a possible explanation for the
reason behind presenting information to students in many different ways. Then they have more than one "route" to recall the information.

Memory processes, including the dynamics of forgetting, reflect an adaptive response to environmental demands (Anderson & Schooler, 1991). Everyday life causes reinforcement of some knowledge while other knowledge is used infrequently. For instance, most of us take history classes throughout our lives. However, we remember relatively little of the learned information. Those individuals who work with historical information everyday find it easier to recall because it is reinforced often. If we consider this in terms of the trace template, the less needed a memory is, the less accessible a trace will be.

The characteristics of a trace have a great impact on its accessibility. Traces which are distinctive and unique are less likely to be confused with another one (Farr, 1987). Information or events that are very similar to one another tend to become entangled in our mind so that recall of either event tends to bring up conflicting information from the other. This indicates that when a person is learning material with similar but different facets, it is advisable to overlearn that information. Indeed, any information learned to a greater extent is more easily accessed (Farr, 1987).

Trace information can also be very situation specific. In other words, the environment of the learner during the acquisition phase may be integrated as part of the trace. If subsequent recall of the trace is not conducted under much the same conditions, it may not be acceptable at all. Due to this, McGeoch (1942) maintained that testing must be
conducted under roughly the same conditions to appropriately measure learning retention. 

Humans store information in two types of trace (Brainerd & Reyna, 1995). The exact form of the input is stored as a verbatim trace. This would be like memorizing a list or a poem. However, when the communication is stored, the senses and meanings that go with it are retained as gist traces. As reported by Brainerd and Reyna, verbatim traces become inaccessible quicker than gist traces. For example, the meaning of a poem will be remembered long after the memorized stanzas are forgotten.

The study of human memory is a relatively new pursuit. It began with Ebbinghaus' study of nonsense syllables and continued with the phases of development of a memory and memory traces. We currently understand much more about how the brain takes a stimulus and stores it for later use. It is a natural progression to begin an investigation into the occurrence of forgetting.

Forgetting

Psychologists have shown repeatedly that there is a relationship between time and forgetting. They have not, however, pinpointed a reason (Ebbinghaus, 1964; Ekstrand, 1972). Brainerd (1995) describes the standard method for the investigation of forgetting as the "Ebbinghaus Retention Paradigm". In this methodology, material is learned in an initial session and then some variable time period elapses. Finally, the subjects are tested
over the learned material. The forgetting rate is described as the slope of the line from performance during the learning phase to that during the recall session.

The mathematical formula used to describe the rate of forgetting depends on the type of memory and material being tested. Wixted and Ebbesen propose that forgetting is best described by functions that involve time raised to a power (1997). They felt that the effect of extraneous variables upon this phenomena of forgetting is important. However, time is the focal point of the computational formulas.

In 1996, Rubin and Wenzel compiled the data sets from many previous studies of forgetting. They were looking for a mathematical formula that most truthfully describes the function of forgetting, but in the process they found two important points. First, although the study of retention is referred to as "forgetting", the measurements are actually of what is remembered. Those items not remembered on one administration can only be assured to be forgotten on that particular occasion. They might be remembered on the next test with different test conditions.

Second, the majority of memory studies use time as the independent variable. However, Rubin & Wenzel (1996) report that Baddeley (1990), McGeogh (1932), and Rubin (1995) have concluded that it is not time itself but things happening within the time that causes the forgetting. Time, however, is the best measurable indication of the amount of interference.
There are three predominant memory theories which attempt to explain the phenomenon of forgetting: decay/disuse, interference, and consolidation. The first of these, disuse, is defined by Deese (1958) as forgetting which is a result of lack of practice. This alludes to the possibility that the trace is still fully functional, just rusty. Some theorists propose that everything learned, seen touched, thought, smelled, etc. is stored forever in the memory (Loftus, 1980). Evidence, however, does not confirm that all memories are permanent and therefore recoverable. Many memories, if they can be accessed at all, are distorted by human perceptions, feelings and emotions.

Most scientists do not affirm the theory of disuse since it attributes an occurrence to something that produced nothing (Ekstrand, 1972). Loftus and Loftus (1980) published a theory that memories are modifiable. The trace can be changed by later experiences that build on it, so the original is probably unrecoverable. They also did not support theories that all memories are recoverable.

Closely linked to disuse is the idea of memory decay. During his early studies, Ebbinghaus developed the "Tables of Forgetting" (1964, p. 69). These tables chart the difference in time requirements between the original learning and the relearning after a rest interval. The tables indicated that the degeneration of learned material is faster soon after the cessation of learning. As time progresses, more learning is lost, but the rate decreases. As a group, scientists (Wixted & Ebbesen, 1997; Chandler, 1995) agree that the probability of a trace failure decreases with time. Moreover, most failures happen soon after learning the material. Jost's Law states that, "If two associations are now of
equal strength but different ages, the older one will lose strength more slowly with the passage of time." (Woodworth & Schlosberg, 1961, p.730)

G. R. Loftus (1985) likened the rates of forgetting to radioactive decay. In this manner, 50% of the material is lost in the first time period. Likewise, 50% of what is remaining is lost in the next. This continues until the amount being lost each time is negligible. Inspecting another type of decay, Jones (1979) contemplated memory traces to determine if different types of information are lost at different rates. In other words, if a subject learned a physical skill and the related cognitive information, would one or the other be forgotten first? His research indicated first that different types of learning do indeed decay at different rates. As an additional result of his research, he affirmed that forgetting can be avoided with repetition or practice. He theorized that this practice prevented outside events from disrupting the trace.

This notion of other events causing a trace failure was an idea termed by McGeoch as interference (1942). He proposed this alternative to decay/disuse because it infers a direct cause of forgetting. Interference occurs due to experiences, be they learning or other, which takes place between the original learning and its recall (Ekstrand, 1972). Elaborating using the trace concept, the original trace is overlaid with new information. Some of the new may agree with the old, while the rest is completely disassociated.

White constructed a paper in 1997 discussing the reasons students cannot remember learned information. He discussed the theory of McGeoch (1942) who maintained that there are two general groups of factors in understanding memory and forgetting. First is
the method of material presentation or the context in which it was supplied. Was the material presented in the most memorable way possible? Additionally, McGeoch discussed the importance of the subject's intent to learn. If this person does not want to learn, he will not.

A slightly different view of the interference concept was proposed by Chandler and Gargano (1995). Their focus was retrieval theories, and they concluded that a memory trace may remain unchanged but irretrievable because interference blocks recovery.

As a plausible explanation for the phenomena of forgetting, interference is very popular. Ekstrand (1972) demonstrated that forgetting takes place less during sleep than during time awake. He proposed two possible explanations for this: either there was less chance for interference to occur or more chance for the brain to "consolidate" the material into long-term storage. Consolidation actually refers to how effectively the storage of information takes place. Sleep is believed by some (Rosch, 1997) to be an integral part of the learning process. It is during sleep that the brain organizes and stores the information presented to the individual that day. This is evidenced by people who are sleep-deprived. They exhibit a decreased ability to move information from short-term memory to long-term memory.

The theory of consolidation was first advanced in 1900 by Muller and Pilzecher (Wickelgren, 1977). They believed that memory traces actually become more entrenched immediately after formal practice ceases. Within the theory of consolidation, there are two hypotheses: (1) the independence hypothesis and (2) the conversion hypotheses. In
the independence hypotheses, a stimulus produces two traces, one short-term and one long-term. The short-term doesn't take long to develop, but it disappears quickly. The long-term trace, however, requires much rehearsal but remains stable. In conversion hypothesis, the short-term trace either becomes the long-term or facilitates the transfer of information to it. These long-term traces resist interference. Both Jones (1979) and Loftus (1985) indicate that memories are resistant to interference if the material is overlearned. Additionally, McGeoch and Irion determined that as the meaningfulness of the material increases, forgetting decreases (1952).

It is apparent that theories concerning trace interference are the most widely accepted. It is appropriate to more closely inspect a specific kind of interference, retroactive inhibition.

Retroactive Inhibitors

As defined by Deese (1958), inhibition (negative transfer) is the result when an experimental condition either affects the retention of previously learned material (retroaction) or the learning of new material (proaction). Several researchers have explored in detail this notion that learning, either before or after a particular learning activity can inhibit, or interfere with, its recall (Britt, 1935; Treverton, 1941; Sevenson, 1941). The results of their inquiries indicate some guidelines to be used in the development of training which limit the retroaction.
In 1935, Britt reported that retention is dependent upon the type of activities occurring between learning and recall. These factors of interaction are the similarity of content, meaning, form, environment, and method. They increase the chances and extent of retroactive inhibition. Information that is closely associated but different than some other particular piece of information is prone to inhibition. However, if the presenter is aware of this, he can take actions, such as an effective visual aid, to emphasize the differences. There are interventions to restrict the inhibition effects of the other factors. Research about these factors indicates weaknesses in the disuse theory and supports the idea of inhibition from subsequent activities (Britt, 1935).

Finally, Sister Lahey (1937) studied the effect produced by varying the time spent in the interpolated activity. In Lahey's study, retention decreased and retroactive inhibition increased when the time spent studying something else increased. Most of the effect is produced in the first four minute interruption. However, a steady increase is shown across the spectrum. Lahey found that retroaction is a function of time spent in the interpolation activity. Her study reported a high retroaction rate immediately after original learning.

In contrast to Lahey's theory, Britt found that the degree of learning of original materials is important. Generally, more learning of original activity lessens the chance of retroactive inhibition (Britt, 1935). Semb and Ellis (1992) discussed several variables they felt would affect the long-term knowledge retention of learning. One of these variables was the properties of the retention interval. This is particularly interesting if a stressful recess follows the learning period.
Retroactive inhibition is therefore a source of interference caused by learning itself. Apparently if the learning activities and their sequence with each other are not well-planned a negative learning effect is produced. There are other factors that also negatively impact the permanent storage of information in memory. Stress is a notable example.

Stress

Hans Selye is the pioneer of stress research. His 1946 article, "The General Adaptation Syndrome and the Diseases of Adaptation," brought attention to a worldwide problem. This was a discussion of the human body's physiological response to stress and its potentially harmful effects. The theory states that a human's natural reaction to stress is the “fight or flight” method. In other words, when threatened our heart rate and blood pressure increase. Adrenaline and other hormones are pumped into the bloodstream to help us react to the situation.

There are two possible outcomes for the resolution of this predicament. If the situation that caused this condition was a physical emergency, such as being chased by a saber-tooth tiger, the General Adaptation Syndrome (GAS) action was productive. The increased hormones and heart rate were useful in the appropriate response - running. It is the alternate situation that causes a problem. If, instead of physical danger, the situation involved a presentation before 200 professional peers, the response would be the same: increased heart rate, blood pressure and hormone production. The individual can't run, and fighting would not be appropriate. The heart rate and blood pressure will return to
normal, but the hormones will still be elevated. Selye's contention was that this resulted in elevated incidence of health risks.

It is evident that stress affects the human physiology. What, then, is it? Stress, according to Selye (1980), is "the nonspecific result of any demand upon the body." A stressor can be anything which produces stress. Stress is produced both by bad things and good things. A new job, a promotion and a new baby are all extremely stressful. Neal Miller emphasized in his research that technology has significantly reduced the amount of physical stress experienced by humans (Selye, 1980). However, these same advances increase the psychological pressure.

The important aspect of stress as it relates to this investigation is its affects on the ability to learn and remember information. Rosch writes that damage to the hippocampus resulted in memory loss (1997). The hippocampus naturally atrophies with age, which explains the memory lapses of the elderly. However, other variables have an effect on the hippocampus. Stress causes it to shrink which Rosch attributes to excess amounts of cortisol, one of the hormones released by the body in response to stress.

As reported by Davis, Tedasco and Meier (1989), impaired memory is a consequence when perceived challenges exceed the individual's ability to cope with stress. Neal Miller reported that animals, including humans, can develop physical problems when exposed to a complex, unfamiliar environment (Selye, 1980). This exposure can produce a severe informational overload which puts stress on the individual. A student's academic success is heavily dependent on their memory skills. Any outside variables, such as stress, which
impair the memory will cause problems. It is apparently important to hold sources of stress at a minimum to maximize learning opportunities.

Retention and the Transfer of Training

In nearly every training environment, some measurement of the amount of learning is necessary. Retention tells you now much of the material originally learned is mastered (Deese, 1958). Mastery is typically an arbitrary measure used to distinguish successful from unsuccessful learning (Farr, 1987). A criterion-referenced test may indicate mastery of the objectives at, for example, 80% mastery. Retention is the result of productive learning and can be measured by requiring that the learner reproduce what he has acquired (Farr, 1987).

Retention is affected by many things. The type of material learned is important to the rate of retention. Healy, Clawson, McNamara, Marmie, Schneider, Rickard, Crutcher, King, Ericsson, and Bourne (1993) found that the effect of an extended retention interval was more severe for concrete tasks than for the abstract calculational parts. Also, the more thorough the original learning, the greater the retention (Bugelski, 1956). If the curriculum includes the theory and supporting information instead of just the facts, the learner maintains more retention.

In that same frame of reference, the amount of retention is roughly proportional to the rate of practice (Ebbinghaus, 1885; Kruger, 1929). Overlearning helps retention of original material. Overlearning involves the repeated practice of a skill past the point of
mastery. Building these strong traces is important in assuring the retention of training (Farr, 1987).

In research presented at the annual meeting of the American Educational Research Association, Semb and Ellis discussed previous studies which confirmed that much of what we learn in school is remembered (Cederstorm, 1930; Eurich, 1934; Greene, 1931; Gaskey & Gates, 1985; Johnson, 1930; Kulik, Kulik, & Bangert-Drowns, 1990; Spitzer, 1939). This research appears to contradict Ebbinghaus' work in which he reported that much of learning is lost quickly. It could, however, point to the significance of learning meaningful material. Ebbinghaus' work with nonsense syllables would decay much faster than material that has meaning.

Training is occurring every day in businesses around the world. However, relatively little of that new knowledge makes it into the workplace (Broad & Newstrom, 1992). A productive transfer of training is necessary for an sufficient return on investment for the venture. Healy et al. (1993) posed from their research two important questions which should be asked of a training program. First, they questioned how general the effects of the training are. There is a difference between specific and generalized transfer. Specific transfer is easier to accomplish because the learning environment and the application environment are similar. Generalization requires commitment on the part of learner to finding commonalities between the new skill and the unique situation. Second, they felt that a good training program has effects which last over time.
Foxon (1993) described the transfer as a five stage process: (1) transfer intention, (2) transfer initiation, (3) partial transfer, and transfer maintenance which consists of two parts, (4) conscious use and (5) unconscious use. In her study, Foxon merged data from several previous studies and performed a factor analysis. She grouped the results into four main categories: (1) organizational climate factors, (2) training design factors, (3) individual learner characteristics, and (4) training delivery factors. Organizational climate referred to the perceptions the learner had concerning whether management, supervision and coworkers favored using the new skills. Training design factors are things within the course, for example conflicting content, that inhibit training use. The individual learner characteristics are things about a particular person that make it hard for them to learn or apply the knowledge and skills. Finally, training delivery factors indicating things like inappropriate training methods, media or delivery style.

Baldwin and Ford (Broad & Newstrom, 1992) emphasized that there are two categories of characteristics that particularly affect the transfer of training: work environment (organizational climate) and trainee characteristics. Work environment characteristics are those that provide the learner the opportunity to use knowledge and skills. These include supervisor support and peer approval.

Trainee characteristics are those things intrinsic to the learner that increase the probability for retention and use of newly acquired skills and knowledge. Ability and aptitude are important, the person must have the intelligence to grasp what is being taught. The personality characteristics more often play a significant role in transfer. These
include a high need for achievement and an internal locus of control. An individual with these characteristics is driven to succeed so they practice until they get it right. A person with internal locus of control believes they contribute to their own success. Lastly, the person must be motivated to succeed. Foxon (1993) described the difference between the motivation to learn and the motivation to transfer. Motivation to transfer refers to the learners intent to actually use the new skills on the job. It is impacted not only by whether they think they can do the job, but also by whether they can recognize when it should be used and if they think it will improve the job performance. Foxon further indicated that the intent to transfer training is an important motivational indicator. Baldwin, Magjuka and Lohen (1990) add that pre-training motivation increases if training is perceived as mandatory.

Summary

Research in the field of memory and forgetting is prolific. Hermann Ebbinghaus began the journey and today we have traveled far. However, there is much yet to be learned. It apparent that thoughts, action, ideas, and feelings we have had or learned do not exist in a vacuum. On the other hand, there is still mystery surrounding the affects of time, other learning, attitude and circumstances on the retention of those experiences by the human mind.
CHAPTER III

METHODS AND PROCEDURES

This chapter describes the procedures employed in collecting and treating data. The study design was a pre-test post-test control group design using results from Air Force developed and validated measurement instruments. Students of the Aircraft Loadmaster Apprentice Course at Sheppard Air Force Base comprised the population. Test results were compared using Analysis of Covariance procedures between three groups.

Research Design

The study was a pretest- posttest control-group design (Gall, Borg & Gall, 1996), using two experimental groups and one control group. Students are selected to the loadmaster specialty based on a minimum AFVAB "General" score of 55. Additionally, they must pass a rigorous physical and, perhaps most importantly, must volunteer to fly. However, of those who chose to enter the aircrew career field, assignment to an airframe was based on Air Force needs at the time. Assignment to follow-on training, and therefore the particular research group, was randomized in the following manner. When the personnel center at Randolph Air Force Base planned the training for a particular individual, they assigned him/her to school dates which minimize time out of training,
thus saving training dollars. Since all students must eventually attend survival school, it made no difference which person attended in a particular time period. The combination of survival school and follow-on school was based on the most rapid procession through both schools and into the field.

There were two experimental groups and one control group involved in the study. The “Immediate” group proceeded from 3-level training at Sheppard to follow-on loadmaster training within 15 days. The first experimental group, “Delayed”, did not begin training until at least the 16th day but did not receive any interim training. The second experimental group, “Survival School” attended survival school between BLM and follow-on training. This mandated a minimum break of 19 days from loadmaster training.

Ethical Standards

Although this was an official Air Force study and student participation was mandatory, approval of the Human Subjects review board was requested and received. Additionally, the approval of the Commander of the 362 Training Squadron, Sheppard Air Force Base, TX was obtained. This report is available to the Loadmaster Career Field and the United States Air Force to further the body of knowledge available concerning the effects of time and stress on retention of training.

Weighing the benefits of the study against any possible detriment to the student, this design was developed to provide maximum information with as little intrusion into the
training regime as possible. Individual information, including social security numbers, will be used only for matching pre- and posttest data. Final analyses and reporting was conducted using only group data, protecting the individual identities.

Population

The subjects were students who attended the Aircraft Loadmaster Apprentice Course, J3ABR1A231 004, at Sheppard Air Force Base, Texas.

Independent Variable

The independent variable in this experimental investigation was the sequence of follow-on training for the loadmaster students. This variable had three levels adjusted for time spent out of training and survival school attendance. The first level contained the “Immediate” group indicating no break in training. The second level was the “Delayed” group of 16+ days out of training. The third level was the “Survival School” group who attended survival school between BLM and follow-on.

Dependent Variable

The dependent variable for this study was the posttest score taken at the follow-on school.
Statement of Hypotheses

\textbf{Ho}$_1$: There will be no statistically significant difference in the adjusted post-test means between students who experience a time interval between the basic training school and follow-on and students who do not experience a delay in training.

\textbf{Ho}$_2$: There will be no statistically significant difference in the adjusted post-test means between students who attended survival school after the basic training school and prior to follow-on and students who did not experience a delay in training.

\textbf{Ho}$_3$: There will be no statistically significant difference in the adjusted post-test means between students who attended survival school after the basic training school and prior to follow-on and students who did not attend survival school but did experience a break in training.

\textbf{Ho}$_4$: There is no significant relationship between the pretest scores, the number of days out of training, and the posttest score for students who did not attend survival school.

Tests and Testing Procedures

The criterion-referenced tests used to measure training retention were developed by career field experts in the Aircraft Loadmasters Course. Initially, pilots of the tests were run to standardize the procedures for the test administration and improve the test. Then, they were validated in accordance with procedures required by the United States Air Force Instructional Systems Development (ISD) system. Test validation for the Air
Education and Training Command is a process which determines if a test actually measures the training objectives it purports to measure. During the validation process, a test is administered to at least three classes (roughly 36 students). The test results are analyzed after each administration and once again as a merged set of all administrations pointing out ineffective items which need to be revised or deleted. A validated test will meet two criteria: (1) the average score for each test must be within five percentage points and (2) a test item which is consistently missed by 50% or more of the students will be removed unless deemed critical by the subject matter experts. Content validity was further strengthened by two methods. First, a correlation coefficient was run comparing student scores with their course average. Additionally, an updated Occupational Survey Report (OSR), supplied by Armstrong Laboratories, was compared to the skills demonstrated on the test. This report contains data indicating the skills and knowledge which are considered by experts in the field to be critical on the job.

Initial reliability was determined for the tests by administering each test to approximately 50 students, ensuring the test means were within five percentage points by either deleting or revising poor test items. Analyses were run periodically on test scores to ensure that validity and reliability remained stable. Results of the analyses were submitted to Armstrong Labs, Brooks Air Force Base, TX for final validation. The response from Armstrong Labs confirming validity and reliability are contained in the letter found in Appendix C.
Upon confirmation of test validation, course personnel began to administer the tests to students on graduation day from BLM. Each of the two test versions were administered to half the students using random assignment. A list of the students and the version they took at BLM was forwarded to the follow-on schools. As students reached their upgrade training, they were administered the alternate version of the test before they received any further training. The use of alternate versions of the test eliminated the risk of test-retest compromise. Results of the follow-on test were returned by mail to Shpeard AFB for analysis.

Data Analysis

Group identity was determined before data collection began. Excessive time out of training indicated one experimental group, "Delayed". The second experimental group, "Survival School", attended survival school between BLM and follow-on training. The statistical software package, Statistical Package for the Social Sciences (SPSS) version 8.0 for Windows, was used to run an Analysis of Covariance (ANCOVA) on the adjusted posttest mean between groups. Pretest scores were used as a covariate to adjust the dependent measure.

The ANCOVA procedure was chosen for its ability to remove the variance effect for an extraneous variable, called the covariate (Hinkle, Wiersma, Jurs, 1994). Adjusting for the variation in the covariate reduces the amount of error variance found in the procedure. The covariate in this case was the pretest raw score, which was linearly related to the
dependent variable, the posttest scores. This linearity is one of the two assumptions that the data must meet for an ANCOVA to apply. The other assumption is that the regression lines for the pretest must be parallel, demonstrating that there is no interaction between the covariate and the treatment (Hinkle, Wiersma, Jurs, 1994).

A significant finding on the ANCOVA indicated a need for further analysis. The Tukey-Kramer post hoc analysis was used for its ability to determine significant differences between unequal group sizes.

In addition to the ANCOVA, a regression analysis was computed between the actual number of days out of training and the posttest score. A relationship was sought indicating that posttest scores could be predicted from the model variables. The mathematical model used to compute the regression is as follows:

$$\text{Posttest} = f(\text{days out}, \text{days}^2, \text{days}^3 \text{ and pretest})$$

Summary

A pretest-posttest control-group design using locally developed criterion-referenced tests was selected for the study. A significance level of .05 was set. The population included United States Air Force Aircraft Loadmaster students. Each student's basic knowledge of weight and balance information was tested at the conclusion of the basic loadmaster training and the beginning of the follow-on school. An ANCOVA was applied to the data to discern any significant difference in the adjusted mean scores between
groups. A regression analysis was computed between days out of training and posttest scores.
CHAPTER IV

DATA ANALYSIS AND DISCUSSION OF RESULTS

Introduction

The purpose of this study was to determine whether there are differences in the training retention rates of United States Air Force aircraft loadmaster students. This chapter is divided into three sections. The first section provides an overview of the participants in the study. The second contains a description of the data and statistical analysis. The last section evaluates the hypotheses against the supporting analysis.

Student Participation

A total of 72 Air Force loadmaster students were administered the pretest and posttest. However, four of these were rendered invalid due to incomplete data. The final analysis used results from 68 participants, 61 men and 7 women. Table 1 contains demographic data for the study participants. These data illustrate the homogeneity of groups across three variables: (1) age, (2) AFVAB “General” score, and (3) gender ratio.
Table 1

Demographic Data for Aircraft Loadmaster Study Participants

<table>
<thead>
<tr>
<th>Group</th>
<th>AGE</th>
<th>AFVAB GENERAL SCORE</th>
<th>PROPORTION MALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMMEDIATE</td>
<td>22.4</td>
<td>72.6</td>
<td>.88</td>
</tr>
<tr>
<td>DELAYED</td>
<td>23.2</td>
<td>73.1</td>
<td>.94</td>
</tr>
<tr>
<td>SURVIVAL SCHOOL</td>
<td>23.0</td>
<td>73.2</td>
<td>.88</td>
</tr>
<tr>
<td>TOTAL</td>
<td>22.9</td>
<td>73.0</td>
<td>.90</td>
</tr>
</tbody>
</table>

Specifically, the study population ranged in age from 19 to 37 (Mean = 22.9, SD = 4.2). The range for the "General" score on the AFVAB was 55-99 (Mean = 73.0, SD = 11.96). All group members were high school graduates and some had college experience.

Students in the Immediate group (n = 17) ranged in age from 19 to 32 (Mean = 22.4, SD = 3.68). The sample contained 15 men, 2 women. The "General" score on the AFVAB ranged from 55-98 (Mean = 72.6, SD = 11.14). Subjects in the Delayed group (n = 17) ranged in age from 20 to 37 (Mean = 23.2, SD = 5.02). The sample contained 16 men, 1 woman. The "General" score ranged from 57-90 (Mean = 73.1, SD = 10.88).

Lastly, the Survival School group ranged in age from 19-35 (Mean = 23.0, SD = 4.05).
The sample contained 30 men, 4 women. The “General” score on the AFVAB ranged from 55-99 (Mean = 73.2, SD = 13.13).

Study Data and Statistical Analysis

The dependent variable in this study was the measure of loadmaster knowledge taken at the follow-on school (posttest). The pretest and posttest were equivalent forms, criterion-referenced tests. Their content validity was determined by loadmaster subject matter experts. Additionally the validity and reliability were affirmed by a separate agency, Armstrong Laboratories, Brooks AFB, San Antonio.

The study used a pretest posttest control-group design. The statistical analysis employed was an analysis of covariance (ANCOVA) using the pretest as a covariate. The ANCOVA was chosen for its ability to partition out the variance for an existing variable. In this particular study, the pretest served as the covariate. The SPSS program adjusted the posttest means using a regression analysis and then compared them with a one-way analysis of variance (ANOVA).

Table 2 contains data from preliminary one-way ANOVA comparisons of demographic variables and the Pretest means. They confirm that there was no significant difference between the group means for the variables of age, “General” score, and Pretest score.
Table 2

Summary of ANOVA Comparisons for Demographic Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between Groups</td>
<td>6.294</td>
<td>2</td>
<td>3.417</td>
<td>.176</td>
<td>.839</td>
</tr>
<tr>
<td>AGE</td>
<td>Within Groups</td>
<td>1159.176</td>
<td>65</td>
<td>17.833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1165.471</td>
<td>67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Between Groups</td>
<td>3.353</td>
<td>1</td>
<td>1.676</td>
<td>.011</td>
<td>.989</td>
</tr>
<tr>
<td>“General”</td>
<td>Within Groups</td>
<td>9572.588</td>
<td>*</td>
<td>147.271</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>9575.941</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Between Groups</td>
<td>4.279</td>
<td>2</td>
<td>2.140</td>
<td>.319</td>
<td>.728</td>
</tr>
<tr>
<td>Pretest</td>
<td>Within Groups</td>
<td>436.588</td>
<td>*</td>
<td>6.717</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>440.868</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * indicates same df for all cells

Having demonstrated the similarity of the three groups, it is now possible to compare them on the study data confident that variance is due in large to the treatment.

Table 3 contains the results of a preliminary ANOVA for the dependent variable, Posttest, prior to adjustments for the Pretest. These comparisons indicate a difference between groups on the Posttest means (p< .002).
Table 3

**Summary of ANOVA for Posttest Means**

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>185.191</td>
<td>2</td>
<td>92.596</td>
<td>7.103</td>
<td>.002</td>
</tr>
<tr>
<td>Within Groups</td>
<td>847.324</td>
<td>65</td>
<td>13.036</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1032.515</td>
<td>67</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results of a one-way ANOVA comparing the means days out of training between groups are shown in Table 4. The data indicate a significant difference between group means. A Tukey-Kramer post hoc analysis confirmed significant differences between all groups.

Table 4

**Summary of ANOVA for Mean Days Out of Training**

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>22050.625</td>
<td>2</td>
<td>11025.312</td>
<td>34.350</td>
<td>.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>20541.793</td>
<td>65</td>
<td>320.966</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>42592.418</td>
<td>67</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results of the ANCOVA comparison between groups after controlling for the pretest are presented in Table 5. The data indicate a significant difference in group means ($p < .001$).

Table 5

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP</td>
<td>217.254</td>
<td>2</td>
<td>108.627</td>
<td>10.332</td>
<td>.001</td>
</tr>
<tr>
<td>Error</td>
<td>672.843</td>
<td>64</td>
<td>10.513</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>33027.000</td>
<td>68</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>1032.515</td>
<td>67</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In an effort to fully realize the effects produced by the pretest adjustment, Table 6 displays the group means and standard deviations before and after adjustment.
Table 6

Descriptive Statistics Before and After ANCOVA Adjustment

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Preadjustment</th>
<th>Postadjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td>Immediate</td>
<td>17</td>
<td>24.06</td>
</tr>
<tr>
<td>Delayed</td>
<td>17</td>
<td>22.41</td>
</tr>
<tr>
<td>Survival School</td>
<td>34</td>
<td>20.15</td>
</tr>
</tbody>
</table>

Final comparison of the group means using the Tukey-Kramer post hoc test reaffirm the significance of difference between the Immediate and Survival School groups.

However, the power added by the ANCOVA procedure also revealed a significant difference between the Delayed and Survival School groups ($p < .001$). A post hoc comparison of the Immediate and Delayed group yielded no significant difference.

In addition to the ANCOVA procedure, a multiple linear regression was accomplished in anticipation of demonstrating a relationship between the posttest score and the number of days between BLM and follow-on training. This procedure was limited to the data collected on the Immediate and Delayed groups due to an inability to block for the effects of survival school. In the regression procedure, the number of days out of training, the days out of training squared, the days out of training cubed and the pretest scores were used as variables to create the model. Table 7 displays the model summary for the regression.
Table 7

Model Summary for Multiple Linear Regression

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Square</th>
<th>the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.663</td>
<td>0.440</td>
<td>0.362</td>
<td>2.7101</td>
</tr>
</tbody>
</table>

Table 8 presents the correlation data produced by the four predictor variables (Pretest, Days Out, Days Out², and Days Out³).

Table 8

Correlation Coefficients for Regression Model Variables

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>15.743</td>
<td>4.645</td>
<td>3.389</td>
<td>.002</td>
</tr>
<tr>
<td>PRETEST</td>
<td>.485</td>
<td>.170</td>
<td>.271</td>
<td>2.853</td>
</tr>
<tr>
<td>DAYS OUT</td>
<td>-.511</td>
<td>.193</td>
<td>-.264</td>
<td>2.643</td>
</tr>
<tr>
<td>DAYS²</td>
<td>2.02E-02</td>
<td>.005</td>
<td>.010</td>
<td>2.209</td>
</tr>
<tr>
<td>DAYS³</td>
<td>7.655E-05</td>
<td>.000</td>
<td>-1.962</td>
<td>.060</td>
</tr>
</tbody>
</table>

Note: Dependent Variable: POSTEST

Figure 1 illustrates the best fit line for the data points. It demonstrates is a sharp drop in scores beginning immediately and leveling out at about Day 20.
Analysis of Hypotheses

**H₀₁**: There will be no statistically significant difference in the adjusted post-test means between students who experience a time interval between the basic training school and follow-on and students who do not experience a delay in training.

The first hypothesis predicts that there will be no significant difference between the posttest means between the Immediate and the Delayed groups. Although there is a difference, it does not exceed the critical value at the preset level (p< .05) of 2.83 either before or after the ANCOVA adjustment. Therefore, the null is retained for the first hypothesis statement.

**H₀₂**: There will be no statistically significant difference in the adjusted post-test means between students who attended survival school after the basic training school and prior to follow-on and students who did not experience a delay in training.
This hypothesis compares the means for the Immediate group with that of the Survival School group. This particular comparison did reveal significance (p< .001) both in the one-way ANOVA and after the means were adjusted in the ANCOVA. The F-ratio of 10.513 (adjusted) was converted to a Q statistic of 6.180 which exceeded the critical value of 2.83. This resulted in the null hypothesis being rejected.

**Ho3:** There will be no statistically significant difference in the adjusted post-test means between students who attended survival school after the basic training school and prior to follow-on and students who did not attend survival school but did experience a break in training.

This statement compared the posttest means of the Delayed and Survival School groups. At this point the power of the ANCOVA procedure was revealed. The preliminary ANOVA (before adjustment) detected no significant difference between the two group. Further analysis of the statement under the adjustment of the ANCOVA did realize a difference. The Q statistic of 3.816 exceeded the critical value of 2.83 for 2 and 64 degrees of freedom and justified the rejection of the null.

**Ho4:** There is no significant relationship between the pretest scores, the number of days out of training, and the posttest score for students who did not attend survival school.

This hypotheses prompted an investigation of the relationship between the posttest score and a model comprised of the pretest, days out of training, days out squared and days out cubed. (Posttest = f(pretest, days out, days out2, days out3). The comparison of
the regression model with the posttest scores confirmed significance (p< .002).

Furthermore, as seen in Table 8, each of the independent variables was significant. Therefore, the null hypothesis for the regression analysis was also rejected.

The results of this study give emphasis to the concept that time affects the retention of training. There was significant difference in scores between groups and in days out of training. The groups were very homogeneous which points to the independent variable, time out of training as the probable cause of variance.
CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Introduction

Learning retention and the subsequent transfer of training are important topics in the field of training and development. Weighty investments are made in attempts to provide personnel additional knowledge and skills (Industry Report, 1997). Some amount of learning loss is inevitable since forgetting begins as soon as practice stops (Ebbinghaus, 1964). We may, however, be able to minimize the amount of learning loss if major factors to forgetting can be identified and neutralized.

This study investigated the effects of time and stress as a retroactive inhibitor on the knowledge retention rates of United States Air Force loadmaster students. It consisted of two procedures: an analysis of covariance on the means for three distinct groups of students and a multiple regression to attempt to find the optimum time frame in which to begin follow-on training. Included here is a discussion of the findings of the study, recommendations for loadmaster training, and a discussion of the possible applications to the training field overall. Finally, the need for further research is explored.

Time has long been recognized as an important factor to forgetting (Ebbinghaus, 1964; Ekstrand, 1972). However, there is much evidence to suggest that it is not time alone, but occurrences within that time period that "interfere" with memory retrieval...
(McGeoch, 1942). This study affirms this theory. When comparing the group of students who went directly into the follow-on loadmaster training against the group who experienced only an extended time lapse between training, there was no significant difference found. The Delayed students reported no extraneous events that would interfere with the transfer of training, and the scores confirm this.

In contrast, the group of individuals who were routed through survival school in the interim produced a significantly smaller mean on the posttest than either the group who went directly into training or those who experienced a time lapse. Rosch (1998) theoretically connected stress to learning loss and the findings of this study may support the idea. Something about the experience of survival school inhibits the transfer of BLM training to the follow-on school. It is not possible from the present study to pinpoint the causal factor, but the effect is evident.

Although the difference between group means for the Immediate and Delayed groups did not prove to be significantly different, the regression analysis did highlight a modest negative correlation between days out of training and posttest scores. It would be an important contribution if the optimal time period could be pinpointed within which to apply the newly learned skills. Minimizing the loss and maximizing the effects of reinforced learning could save countless training dollars. The best fit line indicated an initial sharp drop in the first 10 days after training with the decline leveling out at 20 days. It would appear that the optimal time frame within which to continue training is within the first 10 days after BLM.
The logistics of supplying training to thousands of Air Force personnel every year necessitates some compromise. However, based on the results of this study, it is apparent that training loss is a very real constraint. It is important that every effort is made to smooth-flow the loadmaster training from BLM until they have attained the unconscious maintenance level of training transfer (Foxon, 1993).

This study, although important, has some limitations. The sample was taken from a very specific, although homogeneous, population. Specific inference can only be made back to the loadmaster training program. Additionally, the findings would be more powerful if the size of the sample was larger. However, the findings were significant at p< .002 which was much stronger than the alpha set in the proposal at p< .05.

Further research is indicated as a follow-up to this study, both within the loadmaster community and throughout training and development as a whole. First, does this handicap experienced by individuals who must attend survival school cause them to lag behind the others for the duration of follow-on school? Second, is this learning loss experienced by others in the aircrew field who must interrupt weapon-system training to attend survival school?

More globally, this study raises questions concerning the value of training which has no immediate application. Foxon (1993) maintained that training which was not practiced to the point of unconscious use would eventually become extinct. This research also indicates that the climate the individual works in can significantly inhibit the retention
and transfer of training. Additionally, there would be value in research further exploring
the effects for stress, both personal and workplace, on training retention levels.

The current study does give evidence that time out of training is detrimental to
training retention. Training programs which seek to maximize the return on investment
should seek for optimum times between the end of the training program and the
application of the newly learned skills.
APPENDIX A

Criterion-referenced tests
APPRENTICE AIRCRAFT LOADMASTER COURSE (J3ABR1A231 004)
ASSESSMENT #1
Occupational Survey Study (OSS)# SS07

Privacy Act Statement

In accordance with AFI 37-132, the following information is provided as required by the Privacy Act of 1974.

AUTHORITY: 10 USC 8013, Secretary of the Air Force; power and duties; delegation by Executive Order 9397, 22 November 1943; implemented by AFI 36-2623, Occupational Analysis. AFI 40-402, Using Human Subjects in Research, Development, Test and Evaluation.

ROUTINE USES: The information collected with this end-of-course assessment supports the evaluation of the Apprentice Aircraft Loadmaster Course (J3ABR1A231 004) developed by members of your Major Command and Air Education and Training Command (AETC). The information you are providing will be used for training course evaluation and training research purposes only. Reporting of findings will be at the group, not individual, level; responses and assessment scores from individual participants will not be released.

DISCLOSURE/PARTICIPATION: Completion of this assessment is mandatory. The information provided in this assessment is required for the evaluation of the Aircraft Loadmaster training program. By providing your Social Security Number (SSN) we will be able to match your assessment information with your training record and other job history data, minimizing the amount of background information needed if future data collection activities are necessary. Your SSN will be used for training research purposes only.

PURPOSE: The purpose of this end-of-course assessment is to determine the level of your knowledge of the tasks taught in the Apprentice Aircraft Loadmaster Course. The level of your present task knowledge will be compared to a second assessment of your task knowledge at a later date. This information will be used in our evaluation of the Apprentice Aircraft Loadmaster Course and in training research only. Your score on this assessment will not affect your course grade in any way, and no data will be reported by your name or SSN.

If you have any questions regarding this assessment or the Aircraft Loadmaster study, please E-mail Charles Holt at holtc@cobra.brooks.af.mil, call him at DSN 240-1977 (210-536-1977), or write him at AL/HRCM, Armstrong Laboratory, Human Resources Directorate, 7909 Lindbergh Drive, Brooks AFB, Texas 78235-5352.
APPRENTICE AIRCRAFT LOADMASTER COURSE (J3ABR1A231 004)
ASSESSMENT #1

1. How many moments/10,000 are created by 1260 pounds at station 956?
   a. 120
   b. 120.4
   c. 120.5
   d. 121

2. What is the weight of a vehicle creating 347/10,000 moments placed at station 598?
   a. 1723 lbs
   b. 2075 lbs
   c. 5802 lbs
   d. 5803 lbs

3. What is the CGA of an aircraft weighing 285481 lbs and producing 25899/10,000 moments?
   a. 907
   b. 907.2
   c. 907.3
   d. 908

4. The cargo arm is measured from the
   a. front of the cargo to the CGA.
   b. CG of the cargo to the aircraft balance point.
   c. Nose of the aircraft to the CG of the cargo.
   d. RDL to the center of gravity of the cargo.

5. What is the %MAC for a C-141B with a balance point of 927.9?
   a. 24.9%
   b. 25.0%
   c. 25.9%
   d. 26.0%
6. What is the CGA of a C-141B with of 23.7 %MAC?
   a. 892.0
   b. 921.8
   c. 921.9
   d. 922.0

7. Adding 3800 pounds 80 inches forward of the CG and 3800 pounds 80 inches aft of the CG
   a. decreases the aircraft weight.
   b. does not affect the aircraft CG.
   c. increases the percent of MAC.
   d. does not affect the aircraft weight or moments.

8. Which of the following would decrease the CGA of an aircraft?
   a. Add cargo aft of the CG
   b. Add cargo directly at the CG
   c. Add cargo forward of the CG
   d. Remove cargo forward of the CG

9. How much weight would you have to move 450 inches on an aircraft weighing 263895 pounds in order to achieve a center of gravity change of 5.3 inches?
   a. 3107 lbs
   b. 3108 lbs
   c. 3109 lbs
   d. 3110 lbs

10. What would be the center of gravity change on an aircraft weighing 237469 pounds if a vehicle weighing 6450 is shifted 620 inches?
    a. 16.2 in
    b. 16.4 in
    c. 16.8 in
    d. 16.9 in
11. Smoking is not permitted within how many feet of the aircraft?
   a. 100
   b. 75
   c. 50
   d. 25

12. Which of the following is a safety issue concerning the aircraft engine?
   a. Noise
   b. Length
   c. Weight
   d. Radiation

13. What is the CGFA of the following vehicle?
   OAL 208 ROH 45 FOH 35 FAW 2500 RAW 3300
   a. 71 in
   b. 72 in
   c. 73 in
   d. 74 in

14. What is the CGFE of the following vehicle?
   GW 42500; W1 9764; W3 13587; OAL 326 in; FOH 31 in; ROH 63 in; A1 92 in
   a. 115
   b. 116
   c. 146
   d. 147

15. What is the PSI of a 54" x 72" box weighing 7250 pounds placed on 2 inches of shoring?
   a. 1
   b. 1.6
   c. 1.7
   d. 2
16. What is the PSI of a 720 pound drum, 52" outside diameter, 1/2" rim, on 1 inch shoring?

a. 1.7  
b. 1.8  
c. 2.9  
d. 3.0

17. How much vertical restraint is required for a 9300 pound object?

a. 13,950  
b. 18,600  
c. 25,000  
d. 27,900

18. What is the rated capacity of the MB-1 device?

a. 1,000 lbs  
b. 5,000 lbs  
c. 10,000 lbs  
d. 25,000 lbs

19. Where is the original of the DD form 365-4 kept?

a. Home station  
b. With the aircraft  
c. Departure station  
d. Wing mission control

20. Where are the current total weights and moments for reference #1 of the Form "F" found?

a. DD Form 365-4  
b. DD Form 365-3  
c. DD Form 365-2  
d. DD Form 365-1
21. How many moments/10,000 are gained or lost by moving 7150 pounds from pallet position #2 to pallet position #7?

   a. 320  
   b. 321  
   c. 322  
   d. 323

22. You have a 5400 pound pallet in pallet position #2 and a 9300 pound pallet in pallet position #8. If you shifted the two pallets, how many moments did you gain or lose?

   a. 45  
   b. 162  
   c. 176  
   d. 211

23. Which type of parachute is used in a free drop?

   a. Extraction  
   b. Stabilizer  
   c. Cargo  
   d. None

24. Which type of airdrop uses a release gate which is cut to let the load slide from the aircraft?

   a. Door bundle drop  
   b. Extraction drop  
   c. Personnel drop  
   d. Gravity drop

25. What are the desired load moments (DLM) for a cargo weight of 47,000 and a desired load station of 904?

   a. 51  
   b. 52  
   c. 4248  
   d. 4249
26. How is load station #1 determined when preplanning a load of concentrated cargo?
   a. Add FOH to the load start station
   b. Add load station #1 to the ROH
   c. Add Arm #2 to load station #2
   d. Add Arm #1 to load station #1

27. What is the cable pull when winching a 11500 pound vehicle with pneumatic tires up the ramp of the aircraft with a constant of 0.288?
   a. 2328
   b. 3312
   c. 4337
   d. 4389

28. How much cable pull is exerted when winching a 4800 pound box sliding on dry shoring with a constant of 0.732?
   a. 3512
   b. 3513.2
   c. 3513.6
   d. 3514

29. Which checklists govern the aircraft presflight?
   a. TO 1C-XXX-5CL AND TO 1C-XXX-9CL
   b. TO 1C-XXX-1CL and TO 1C-XXX-9CL
   c. TO 1C-XXX-1CL only
   d. TO 1C-XXX-9CL only

30. What is the first concern of the loadmaster while on/offloading?
   a. Time
   b. Safety
   c. Weather
   d. Passengers
1. How far from the reference line is a 4321 lb object if it creates 153 simplified moments?
   a. 282 in
   b. 283 in
   c. 354 in
   d. 355 in

2. How many moments/10000 are created by 2900 pounds at station 674?
   a. 194
   b. 195
   c. 196
   d. 197

3. How many moments/10000 an aircraft weighing 296,473 and CGA of 923.6?
   a. 320
   b. 321
   c. 27,382
   d. 27,383

4. What is the balance point of an aircraft called?
   a. Centerline
   b. Reference Datum Line
   c. Leading Edge of MAC
   d. Center of Gravity Arm

5. What is the percent of MAC for a C-141B with a CGA of 942.4?
   a. 31%
   b. 31.4%
   c. 31.5%
   d. 32%
6. What is the CGA of a C-141B with a percent of MAC of 16.6?
   a. 903.0
   b. 903.3
   c. 903.7
   d. 903.9

7. How would an aircraft be affected by adding 7500 pounds forward of the CG?
   a. Decrease weight and moment
   b. Increase CGA and %MAC
   c. Decrease CGA and increase %MAC
   d. Increase weight and moment, decrease CGA

8. What effect would removing weight directly at the CGA have on the aircraft?
   a. No effect on aircraft CG
   b. Increase weight and moment
   c. Increase percent of MAC and CGA
   d. Decrease percent of MAC, increase CGA

9. How far was a 5400 pound vehicle shifted if it produced a CGC of 8.7 inches on a 278,475 pound aircraft?
   a. 448
   b. 449
   c. 450
   d. 451

10. What is the gross weight of an aircraft if a piece of cargo weighing 3200 pounds is moved 840 inches and produces a change in the CGA of 11.3 inches?
    a. 215,668
    b. 221,429
    c. 237,876
    d. 248,548
11. What is the minimum approach distance for an operating jet engine?
   a. 15 feet
   b. 25 feet
   c. 50 feet
   d. 100 feet

12. Maximum vehicle speed inside an aircraft is
   a. 3 mph
   b. 5 mph
   c. 10 mph
   d. 15 mph

13. What is the CGFE of the following vehicle?
   
   OAL 195  ROH 38  FOH 34  FAW 1800  RAW 2200
   
   a. 62 in
   b. 67 in
   c. 68 in
   d. 72 in

14. What is the CGRL of the following vehicle?

   GW 45218; W1 10,116; W2 19,876; OAL 331 in; FOH 29 in; ROH 57 in; A1 88 in
   
   a. 120
   b. 121
   c. 149
   d. 150

15. What is the contact area of a 40" x 65" box on three 6" x 8" skids placed on 1" shoring?
   a. 144 inches
   b. 240 inches
   c. 2600 inches
   d. 2814 inches
16. What is the PSI of a 837 pound drum, 27" outside diameter, 1/4" rim, on 1-1/2" shoring?
   a. 3.1
   b. 5.4
   c. 23.3
   d. 35.9

17. How much forward restraint is required for a 10800 pound vehicle?
   a. 10,000
   b. 16,200
   c. 21,600
   d. 32,400

18. What is the rated capacity of the CGU/1B device?
   a. 2,500 lbs
   b. 5,000 lbs
   c. 10,000 lbs
   d. 25,000 lbs

19. Where is the original DD form 365-4 filed?
   a. Home station
   b. Departure station
   c. Wing mission control
   d. With the aircraft papers

20. Which of the Form “F” references are used to determine the total aircraft weight?
   a. 9,10, and 11
   b. 1 through 8
   c. 9 and 13
   d. 9 and 23
21. How many moments/10,000 are gained or lost by moving 8000 pounds from pallet position #3 to pallet position #7?
   a. 240
   b. 288
   c. 364
   d. 396

22. You have a 2000 pound pallet in pallet position #3 and a 4000 pound pallet in pallet position #7. If you shift the two pallets, how many moments do you gain or lose?
   a. 72
   b. 162
   c. 186
   d. 837

23. Which type of airdrop uses parachutes to slow the descent of the load?
   a. Free drop
   b. High velocity
   c. Low velocity
   d. None of the above

24. Which airdrop method uses an extraction parachute to overcome the force of the restraint?
   a. Door bundle
   b. Extraction
   c. Personnel
   d. Gravity

25. What would be the desired load station (DLS) for a load weighing 58,000 pounds with a desired load moment (DLM) of 5218/10,000?
   a. 11
   b. 899
   c. 900
   d. 1111
26. How do you determine the load end station when preplanning a concentrated cargo load?
   
a. Add the OAL to the load start station  
b. Add the OAL to the CCGFE of the load  
c. Add the load start station to the CCGFE of the load  
d. Add the load start station to the FOH

27. How much cable pull is exerted when winching a 3900 pound box sliding on dry shoring with a constant of 0.732?
   
a. 1512  
b. 2854  
c. 2855  
d. 3514

28. What is the cable pull when winching a 8100 pound vehicle with pneumatic tires up the ramp of the aircraft with a constant of 0.288?
   
a. 2328  
b. 2332  
c. 2333  
d. 2338

29. Which of the following can be loaded without a checklist?
   
a. Vehicles  
b. Passengers  
c. Palletized cargo  
d. None of the above

30. Which of the following is a safety procedure for cargo offloading?
   
a. Fire truck present  
b. No personnel in the area  
c. No power on the aircraft  
d. Maximum ventilation in cargo area
APPENDIX B

TASK CONFIDENCE QUESTIONNAIRE
APPRENTICE AIRCRAFT LOADMASTER COURSE (J3ABR1A231 004)
TASK CONFIDENCE QUESTIONNAIRE
Occupational Survey Study (OSS)# SS07

Privacy Act Statement

In accordance with AFI 37-132, the following information is provided as required by the Privacy Act of 1974.

AUTHORITY: 10 USC 8013, Secretary of the Air Force; power and duties; delegation by Executive Order 9397, 22 November 1943; implemented by AFI 36-2623, Occupational Analysis. AFI 40-402, Using Human Subjects in Research, Development, Test and Evaluation.

ROUTINE USES: The information collected with this questionnaire supports the evaluation of the Apprentice Aircraft Loadmaster Course (J3ABR1A231 004) developed by members of your Major Command and Air Education and Training Command (AETC). The information you are providing will be used for training course evaluation and training research purposes only. Reporting of findings will be at the group, not individual, level; responses from individual participants will not be released.

DISCLOSURE/PARTICIPATION: Completion of this questionnaire is mandatory. The information provided in this questionnaire is required for the evaluation of the Aircraft Loadmaster training program. By providing your Social Security Number (SSN) we will be able to match your questionnaire information with your training record and other job history data, minimizing the amount of background information we would need to ask if future data collection activities are necessary. Your SSN will be used for training research purposes only.

PURPOSE: The purpose of this questionnaire is to obtain a measure of your confidence in your ability to correctly perform the tasks taught in the Apprentice Aircraft Loadmaster course. This information will be used only for an evaluation of the Apprentice Aircraft Loadmaster course and for training research. No data will be reported by your name or SSN.

If you have questions or comments regarding this questionnaire or this study, E-mail Charles Holt at boltc@cobra.brooks.af.mil, or call him at DSN 240-1977 (210-536-1977), or write him at AL/HRCM, Armstrong Laboratory, Human Resources Directorate, 7909 Lindbergh Drive, Brooks AFB, Texas 78235-5352.

Thank you for participating in this effort.
APPRENTICE AIRCRAFT LOADMASTER COURSE (J3ABR1A231 004)
TASK CONFIDENCE QUESTIONNAIRE

Background Information

1) Name: ______________________  Today’s date: Day ____ Mon ____ Yr ____

2) Social Security Number: _____ / _____ / ____

3) Base where you are currently assigned for training: ____________________________

4) I am (circle one): Active Duty  Guard  Reserve

5) Military pay grade (circle one):
   E-1  E-2  E-3  E-4  E-5
   E-6  E-7  E-8  E-9

6) I am (circle one): Female  Male

7) Date you completed the Basic Loadmaster (BLM) course at Sheppard AFB:
   Day ____ Mon ____ Yr ____

8) List any Military or Survival training you attended since completing BLM course:
   Type of training: ____________________________________________________________
   From: Day ____ Mon ____ Yr ____  To: Day ____ Mon ____ Yr ____
   Type of training: ____________________________________________________________
   From: Day ____ Mon ____ Yr ____  To: Day ____ Mon ____ Yr ____

9) List any leave taken since completing the BLM course:
   Type of leave: ____________________________________________________________
   From: Day ____ Mon ____ Yr ____  To: Day ____ Mon ____ Yr ____
   Type of leave: ____________________________________________________________
   From: Day ____ Mon ____ Yr ____  To: Day ____ Mon ____ Yr ____
APPRENTICE AIRCRAFT LOADMASTER COURSE (J3ABR1A231 004)
TASK CONFIDENCE QUESTIONNAIRE

Instructions

The purpose of this questionnaire is to assess how confident you are in your ability, on the first try, to perform tasks that you were taught in your recent Apprentice Aircraft Loadmaster training at Sheppard AFB.

For each task listed on the following pages, please rate how confident you are that you can perform the task on the first try using the following Task Confidence Scale:

<table>
<thead>
<tr>
<th>Task Confidence Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Not at all confident</td>
</tr>
<tr>
<td>2 = Slightly confident</td>
</tr>
<tr>
<td>3 = Somewhat confident</td>
</tr>
<tr>
<td>4 = Quite confident</td>
</tr>
<tr>
<td>5 = Very confident</td>
</tr>
</tbody>
</table>

Example: If you feel "quite confident" that you can correctly perform the task "Secure ten thousand loose bowling balls using tiedown equipment" on the first try, circle "4," as illustrated in the following example.

<table>
<thead>
<tr>
<th>Task Statement</th>
<th>How confident are you that you can perform each task correctly on the first try?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Secure ten thousand loose bowling balls using tiedown equipment.</td>
<td>Not at all 1  Somewhat 2  Very 5</td>
</tr>
<tr>
<td>2. Calculate ...........etc.</td>
<td>Not at all 1  Somewhat 2  Very 5</td>
</tr>
</tbody>
</table>
## Task Confidence Questionnaire

### Task Confidence Scale

1 = Not at all confident  
2 = Slightly confident  
3 = Somewhat confident  
4 = Quite confident  
5 = Very confident

### Task Statement

<table>
<thead>
<tr>
<th>Task Statement</th>
<th>How confident are you that you can perform each task correctly on the first try?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Locate information in Technical Orders and Standard Publications applicable to loadmaster functions (ref 3.1)</td>
<td>![Confidence Scale](1 2 3 4 5)</td>
</tr>
<tr>
<td>2. Update and post changes to Technical Orders and Standard Publications applicable to loadmaster functions (ref 3.2)</td>
<td>![Confidence Scale](1 2 3 4 5)</td>
</tr>
<tr>
<td>3. Use applicable loadmaster forms (ref 3.3)</td>
<td>![Confidence Scale](1 2 3 4 5)</td>
</tr>
<tr>
<td>4. Compute load distribution (ref 7.2)</td>
<td>![Confidence Scale](1 2 3 4 5)</td>
</tr>
<tr>
<td>5. Record load distribution on DD 365-4 (ref 7.3)</td>
<td>![Confidence Scale](1 2 3 4 5)</td>
</tr>
<tr>
<td>6. Compute PSI and shoring requirements (ref 8.1)</td>
<td>![Confidence Scale](1 2 3 4 5)</td>
</tr>
<tr>
<td>7. Direct loading and offloading of cargo by 463L Forklift Material Handling Vehicle (ref 8.2)</td>
<td>![Confidence Scale](1 2 3 4 5)</td>
</tr>
<tr>
<td>8. Direct loading and offloading of cargo by K-Loader Material Handling Vehicle (ref 8.3)</td>
<td>![Confidence Scale](1 2 3 4 5)</td>
</tr>
<tr>
<td>9. Direct loading and offloading of Self-Propelled Vehicle (ref 8.4)</td>
<td>![Confidence Scale](1 2 3 4 5)</td>
</tr>
</tbody>
</table>
APPRENTICE AIRCRAFT LOADMASTER COURSE (J3ABR1A231 004)  
TASK CONFIDENCE QUESTIONNAIRE

<table>
<thead>
<tr>
<th>Task Statement</th>
<th>How confident are you that you can perform each task correctly on the first try?</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Comply with safety directives applicable to air transportation of cargo</td>
<td>Not at all</td>
</tr>
<tr>
<td>(ref 8.7)</td>
<td>1</td>
</tr>
<tr>
<td>11. Compute restraint criteria (ref 8.8)</td>
<td>1</td>
</tr>
<tr>
<td>12. Secure cargo using tiedown equipment (ref 8.9)</td>
<td>1</td>
</tr>
<tr>
<td>13. Inspect cargo (ref 8.10)</td>
<td>1</td>
</tr>
<tr>
<td>14. Check cargo documentation (ref 8.12)</td>
<td>1</td>
</tr>
<tr>
<td>15. Apply special safety procedures in handling hazardous materials (ref 9.1)</td>
<td>1</td>
</tr>
<tr>
<td>16. Verify DOT classification / division of hazardous materials (ref 9.2)</td>
<td>1</td>
</tr>
<tr>
<td>17. Determine suitability and segregation/compatibility of hazardous materials to be loaded (ref 9.3)</td>
<td>1</td>
</tr>
<tr>
<td>18. Demonstrate proper safety precautions associated with hazardous material (ref 9.5)</td>
<td>1</td>
</tr>
</tbody>
</table>
MEMORANDUM FOR 362 TRL/CC

FROM: 362 TRS/RML

SUBJECT: Doctoral Dissertation

1. The Aircraft Loadmaster Apprentice Course, J3ABRI1A231 004, underwent a major rewrite in 1996. At that time, squadron commander Lt Col Patrick Cvitanovich ordered a study into the lasting effects of training for the loadmaster students. This was to discover whether students should follow a smooth flow from 3-level school through their qualification as loadmasters.

2. Due to the fact that you, as the current squadron commander, are the owner of this process, I request permission to use the data gathered in the study for my doctoral dissertation.

3. The required Human Subjects approval has been acquired through Armstrong Laboratories, Brooks AFB. Human Subjects release will also be acquired through the University of North Texas. Additionally, this action has been coordinated with Dr. Winston Bennet, project administrator for Armstrong Labs.

4. Please contact me at extension 6-1144 if there are any questions. Thank you for your assistance.

ANGELA F. CANADA, GS-9, DAF
Instructor, Aircraft Loadmaster Course, 362 TRS

1st Ind, 362 TRS/CC

MEMORANDUM FOR 362 TRS/RM
ATTENTION: ANGELA CANADA

Approved/Disapproved

GREGORY L. WALKER
Commander, 362d Training Squadron
APPLICATION FOR APPROVAL OF INVESTIGATION INVOLVING THE USE OF HUMAN SUBJECTS

University of North Texas Institutional Review Board for the Protection of Human Subjects in Research (IRB)

1. **Principle Investigator:** Angela F. Canada

2. **Home Address:** 4606 Lake Park Drive Wichita Falls TX 76302 (940) 761-6043

3. **Faculty Sponsor:** Dr. Michelle Wircenski (940) 565-2431
   
   This is in support of research for Ph.D. dissertation.

4. **Title:** The Effect of Time and Retroactive Inhibitors on the Training Retention Rates of United States Air Force Loadmaster Apprentice Students.

   Project Period: March 20-May 31, 1998

5. **External Support:** External support is not requested for this project.

6. **Agreement by Principle Investigator:** In making this application, I certify that I have read and understand the guidelines and procedures developed by the university for the protection of human subjects, and I fully intend to comply with the letter and spirit of the University's Assurance and policy. I further acknowledge my responsibility to report any significant changes in the protocol, and to obtain written approval for these changes, in accordance with the procedures, prior to making these changes. I understand that I cannot initiate any contact with human subjects before I have received approval and/or complied with all contingencies made in connection with that approval.

   Signature of Principle Investigator ____________________________ Date ________________

7. **Approval by Faculty Sponsor** (Required for all students): I affirm the accuracy of this application and I accept the responsibility for the conduct of this research and supervision of human subjects as required by law.

   Signature of Faculty Sponsor ____________________________ Date ________________
8. **Applicable Documentation:** I have included copies of all pertinent attachments including, but not limited to: Questionnaire/survey instruments, informed consent, letters of approval from cooperating institutions, copy of external support if applicable.

   Yes [X]  No ___

9. **Subjects:** Subjects are Air Force Loadmaster Apprentice trainees. The study will include approximately 130 students from differing racial and ethnic backgrounds.

10. **Study Procedures:** The study design is a pre-test post-test control-group design using two criterion-referenced tests administered at graduation from one course and upon entry into the second. The tests (see Tab 1) were developed by course personnel and validated using Air Force validation procedures. A task confidence questionnaire (see Tab 2) consisting of an 18-item close ended questions was developed by Armstrong Labs. This questionnaire will be concurrently administered. However the data is to be used for future analysis not covered in this study. Test administrators will provide the students with standardized guidelines but will provide no assistance to the participants. It will take each participant approximately one hour to complete both the task confidence questionnaire and test.

11. **Research Consent:** I have gained approval to conduct this research from Lieutenant Colonel Gregory L. Walker, Commander of the 362 Training Squadron, Sheppard Air Force Base, Texas (see Tab 3). This study is an official Air Force approved endeavor and as such student participation is mandatory. However, it will be explained to all subjects that their responses will remain confidential and there will be no retribution effect (see page 1 of Tab 2).

12. **Confidentiality Safeguards:** Participants will not be individually identified in the final report. The tests and questionnaires will be maintained in a secure facility and compiled data will be placed in a secure computer file and will meet Privacy Act of 1974 standards.

13. **Benefits to Subjects:** The intent of this research is to use the data collected to determine if money spent training students in basic loadmaster skills is wasted by interjecting survival school training after the BLM course but before the follow-on training. There are no direct benefits to the individuals participating in the study. Prospective long-term benefits to future students and the Air Force include increased retention of initial skills knowledge and decreased time spent reaccomplishing previously learned information.

14. **Potential Risks:** The potential participant risks associated with this study are minimal and can be overcome with protection of participant data in the final report. These issues were discussed in Paragraph 12. The benefits of the proposed study are outlined in Paragraph 13, and it is my belief and that of the Air Force that subjects can only be helped by this study.
To: Angela Canada  
From: Winston Bennett, Jr. Air Force Research Laboratory, and Charles Holt, Institute for Job and Occupational Analysis  
Subject: Validation Study of Loadmaster Assessment Instruments

This is to provide you with the results of a validity study completed by The Institute for Job and Occupational Analysis (IJOA), under the auspices of the Air Force Research Laboratory (AFRL) at Brooks AFB. This validation study was designed to determine if the two versions of a knowledge assessment instrument designed by Instructors at the Loadmaster Course (HO J3ABR1A231 004-200) at Sheppard AFB, TX, are sufficiently similar to be used interchangeably in a field experiment being conducted at the Loadmaster Course.

Background: Sixty-three Loadmaster Course students participated in the validation study. As students completed the course, they were randomly assigned to complete one of the two assessment instruments. Test sessions were proctored by Loadmaster instructors and scored at the Loadmaster Course using Scantron scoring sheets and software.

Construct Validity: Construct validity was assessed using Pearson Product Moment correlational techniques which compare the scores obtained on both assessment instruments to the students’ corresponding Loadmaster Course final grade (which is based on four Loadmaster Course block tests). To establish criterion-related validity alternative criterion measure would need to be developed and used. This is due to the fact that end of course test in our present analysis is basically a learning criterion measure which shares similar construct assessment properties with our developed assessment measures. Furthermore, course block tests and end-of-course tests have been criticized in published studies as somewhat inadequate criterion measures. This is due to many shortcomings endemic in these measures. Examples include restricted range in scores and pass-fail or binary assessments as opposed to continuous range assessments.

A more appropriate, criterion-related assessment of validity would relate scores on the end-of-course and knowledge assessment measures with task ratings of performance obtained using a performance checklist completed by instructors or field supervisors. This field performance assessment would have been preferable as a source of criterion performance information. Given these caveats, analysis of the data we were provided indicates that both assessment instruments were positively correlated to the students’ course grades as seen in the table, below. In addition the obtained correlations are statistically significant at the 0.01 level (two-tailed) and could reasonably be described as moderately high correlations.
Assessment Instrument 1 (n=39)  Assessment Instrument 2 (n=24)
Mean Score 26.49  Mean Score 26.71
Standard Deviation 2.38  Standard Deviation 2.56
Correlation to course grade 0.519  Correlation to course grade 0.512

The fact that the mean scores and standard deviations for both versions are nearly identical is further evidence that the two versions are basically similar.

Although not an empirical assessment of validity, it is important to establish the apparent relevance of a measure for assessing a content domain. For the present study this apparent relevance was established by having at least two SMEs from the Loadmaster Course, two scientists assigned to AFRL and two scientists employed by IJOA review the instruments and indicate the extent to which the instruments appeared to measure specific Loadmaster course objectives as reflected in the appropriate training documents. In addition, none of the 63 participating students questioned the appropriateness of any of the 60 test items (30 items in each instrument).

In addition, Subject Matter Experts (SMEs), Loadmaster Course instructors, reviewed both assessment instruments for content appropriateness. Their feedback indicated that both instruments appropriately test the knowledge domain with an even distribution of test items across the knowledge objectives of the course. The correlational data also support this assessment.

It should also be noted that an assessment of the reliability of the instruments (e.g. a split-half assessment or a repeated measures study) has not been conducted. Reliability assessments would provide empirical evidence of the “upper bound” of the validity coefficient for the instruments.

We would like to let you know that we would be interested in collaborating with you to publish this work as an AFRL technical paper or report. Of course, you would be the senior author and we would help in completing the work necessary to publish the document. With this in mind, we would like to get a copy of your raw data files and layouts as well as a copy of your final dissertation to use as the basis for such a report.

If further information is required, contact Charles Holt at (210) 349-8525. Wink Bennett can now be contacted at DSN 474-6297.
Bibliography


