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A Brief History of Aircraft Identification Training

by

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Prefatory Note

The research reported in this paper was conducted by Division No. 5 (Air Defense) of the Human Resources Research Office at Fort Bliss, Texas. The paper presents a selective review of previous and contemporary methods of teaching aircraft recognition. The review does not include an analysis or evaluation of relevant psychological laboratory research concerning shape discrimination.

The review was a part of research activities being conducted under HumRRO Work Unit STAR, Aircraft Recognition Training. The objective of this Work Unit is to identify classroom and self-study methods of teaching aircraft recognition that will provide the recognition skill levels required by operators of Army forward area visually sighted air defense weapons.

A BRIEF HISTORY OF AIRCRAFT IDENTIFICATION TRAINING

Arthur C. Vicory

THE WEFT SYSTEM

Aircraft (A/C) identification[1] training dates back to the World War II period. The subject was systematically pursued first in England in 1940, at the time when an air invasion was imminent and the prompt identification of an aircraft as being friendly or enemy was a matter of vital importance. Gibson (1) has noted that ". . . as a subject of formal instruction, learning to identify objects of this sort was a complete novelty," and he points out that psychological theory at that time could provide no clear guide with regard to procedure. To cope with the problem, special training courses were developed. The methods employed were based on opinion rather than psychological insight into the nature of identification or of how to provide formal training on the skill. Gibson (1) provides a general description of the rationale and development of the first aircraft identification training system.

> As conceived by the British, the study of A/C [identification] included instruction about the nature and characteristics of different military planes over and above simple visual training in identifying them by shape and size. . . . The appearance of planes had to be committed to memory. . . . Since all A/C look more or less alike and many look very much alike, they had to be memorized in considerable detail. A terminology, therefore, arose for the shape-characteristics of planes . . . and there came into use an arbitrary order of memorizing these characteristics by wings, engines, fuselage, and tail. The letters, W, E, F, and T represent this elementary attempt at systemization, and the method of learning came to be known as the "WEFT System." It was primarily an aid to memorization rather than a system of instruction. A student could study alone by this method without the help of an instructor or the use of special training procedures. It had the defect of over-emphasizing those aspects of the shapes of aircraft which could be given names ("swept back," "dihedral," "taper," etc.) to the neglect of other aspects not easily nameable.

[1]The psychological definition of identification (naming response) is used in this review. However, it should be noted that the military employs a different definition. According to military usage, identification is a "friend" or "foe" response, whereas recognition is a "naming" response.

Furthermore, the aspects memorized were frequently not those by which the similar shapes could be discriminated from one another. The learning tended to be verbal in character—a list of characteristics which might or might not arouse an adequate visual image of the actual shape. Much of the learning tended to be wasteful, since the verbal analysis was often arbitrary and unsystematic. Above all, the material available could not be conveniently used to give the students practice in repeated acts of [identification]. pp. 114-115

The last remark in the description by Gibson is a criticism of the limited number of aircraft views used in training. The WEFT System typically used silhouettes of *only* three-plan views (bottom view, head-on view, side view) for the analysis of features training. This type of training did not test the trainee's ability to identify other views of the aircraft that he might encounter in the natural world.

THE RENSHAW SYSTEM

In spite of this and other criticisms, the WEFT System was adopted by the U.S. Navy and Army Air Corps in 1941. The following year Samuel Renshaw of Ohio State University introduced a radically different approach to identification training in general. Dr. Renshaw (2) believed that the individual could make more accurate identifications when trained with short (tachistoscopic) rather than with long exposures of the stimuli. This belief stemmed from Renshaw's notion that brief presentations force the observer to respond to the total form rather than to an aggregate of its component parts.

Basically, the method he proposed involved presenting the aircraft in a brief flash on the screen until the trainee was able to identify it accurately. Then the exposures were gradually reduced to 1/75 or even 1/100 of a second. It was assumed that shorter exposure intervals for the aircraft images during identification training would yield a higher proficiency level. Since almost all observers could be trained to achieve a high level of identification accuracy at the 1/75 of a second exposure, the demonstration was quite impressive and convincing to many of the U.S. Navy and Army Air Corps officials.

The Renshaw System or Flash System of Instant Recognition, as it became known, was a definite contrast to the WEFT System, since the former emphasized the *whole-image* concept of training while the latter emphasized the *image-analysis* concept. Gavurin (3) notes the nature of this contrast in his interpretation of criticisms made about the WEFT System by Renshaw:

> Implicit in Renshaw's viewpoint was the conclusion that the WEFT System was ineffective since it encouraged a fractionation of the visually perceived object, thereby creating the possibility that an individual, so trained, would often mistake one plane for another on the basis of responding to only a few of their common characteristics, rather than to the uniqueness of their total form. p. 2

Because of the apparent validity of this criticism, Renshaw was strongly influential in firmly establishing the use of flash recognition. In 1942 the U.S. Navy adopted the Renshaw System of training, and in 1943 the Army Air Corps also accepted a modified version of this system. However, the controversy over the merits and deficiencies of each system continued until official recognition and identification requirements for the combat situation and some experimental evidence were applied. These events occurred as follows:

(1) It was pointed out in a report by Gibson (1) that in the usual combat situation the observer could identify the aircraft long before it got within firing range (less than 1,000 meters). Since the observer had sufficient time to make an identification, accuracy was more important than speed. *From this point of view, Renshaw training was inappropriate.*

(2) Although rapid identification was not required in the field, there still was the question of whether rapid exposure training would improve identification performance under normal field conditions. Gibson (1) conducted an experiment to test the rapid exposure hypothesis. He employed a 3x3 design using 1-second (slow), 1/10-second (intermediate), and 1/50-second (fast) exposures for training and testing. The results showed that statistically higher scores were made on longer test exposures (slow). There were no significant differences between training conditions for slow or intermediate testing conditions, but there was a reliable statistical difference between training conditions for the fast test condition. However, this difference would be pertinent only if it were necessary to identify aircraft in less than a second in the field. It has been noted that this is not an operational requirement. *These findings do not support Renshaw's claim that identification skill improves more with shorter than with longer exposures.*

(3) Another experiment reported by Gibson (1) showed that an emphasis on aircraft features during the early phase of training produced better aircraft identification performance than when the features were not emphasized. This was particularly true for " . . . those [features] which distinguish similar planes from each other." p. 131 *This finding indicated that WEFT training on the aircraft features improves identification.*

Although the evidence appeared in favor of retaining the WEFT and discontinuing the Renshaw System, there was still a belief that the WEFT nomenclature was confusing and relied too much on memorizing details. Also some officials continued to believe that rapid-flash exposure could improve identification skill. Since neither system was entirely acceptable to everyone, some modifications were made, and the two systems were combined. The Navy and Army Air Corps adopted similar versions which consisted of initial training by a WEFT-type verbal description of the aircraft using slides, followed by aircraft identification training using tachistoscopic exposures of several views. The application of this modified WEFT-Renshaw system up to the present time has varied among military schools, training classes, and instructors. This situation has resulted in a nonstandardized training procedure making it difficult to evaluate the effectiveness of the modified system.

THE SARGEANT SYSTEM

Another training system was introduced by the British about 10 years after World War II (circa 1956) as an alternative to the WEFT and Renshaw Systems. It was named the *Sargeant System*, after its originator, Charles Sargeant, who was editor of the *Joint Services Recognition Journal*.

According to Allan (4), a British psychologist, the Sargeant System is fundamentally different in principle from the other two systems. She notes that although the Sargeant System is based on the same theoretical concept of training as the Renshaw System, it does not employ the questionable tachistoscopic training technique to achieve "whole-image" learning. Its resemblance to the WEFT System is indicated by the emphasis it places on learning aircraft features. However, Allan feels that the features are learned only in relation to the whole aircraft. Her description of the Sargeant System is summarized as follows:

> The trainees are given two books of photographs for each group of A/C to be learned. The A/C are grouped according to similarity of design. The first book contains named photographs of different views of each A/C, and a three-plan view inset consisting of silhouettes of the A/C [See Figure 1.] This is the key material for making comparisons with the A/C shown in the second book [See Figure 2.] The second book has 120 to 140 target views of the same A/C. After studying the A/C features in the first book, the trainees attempt to

Photograph and Silhouette Views of Aircraft, Sargeant System

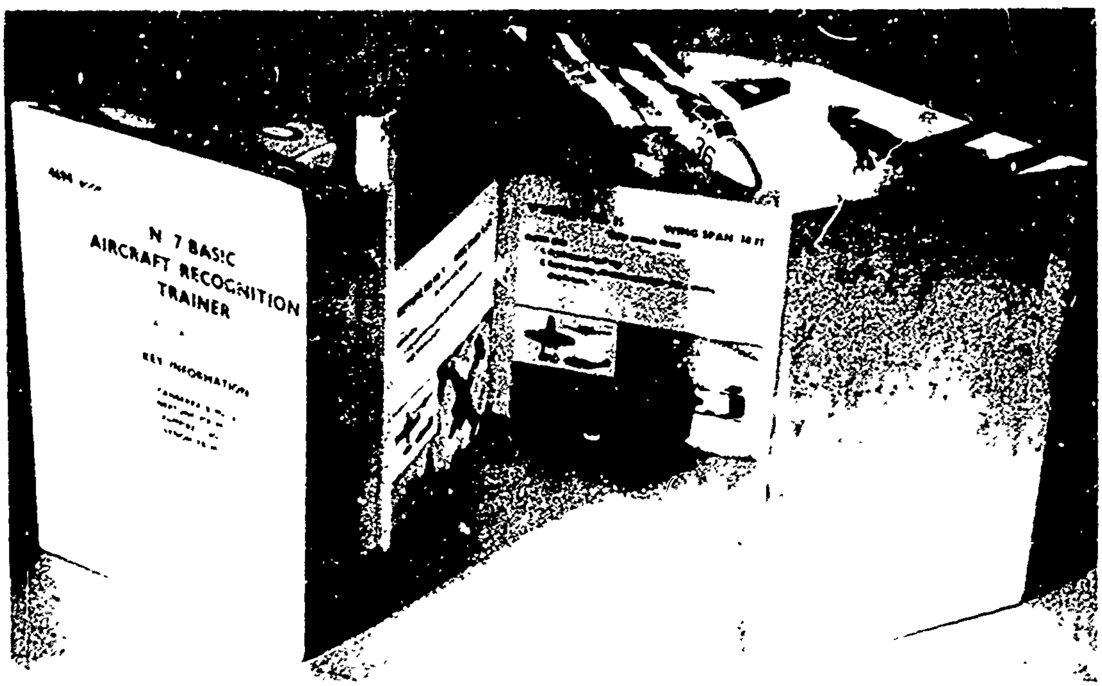

Figure 1

Target Views of Aircraft, Sargeant System

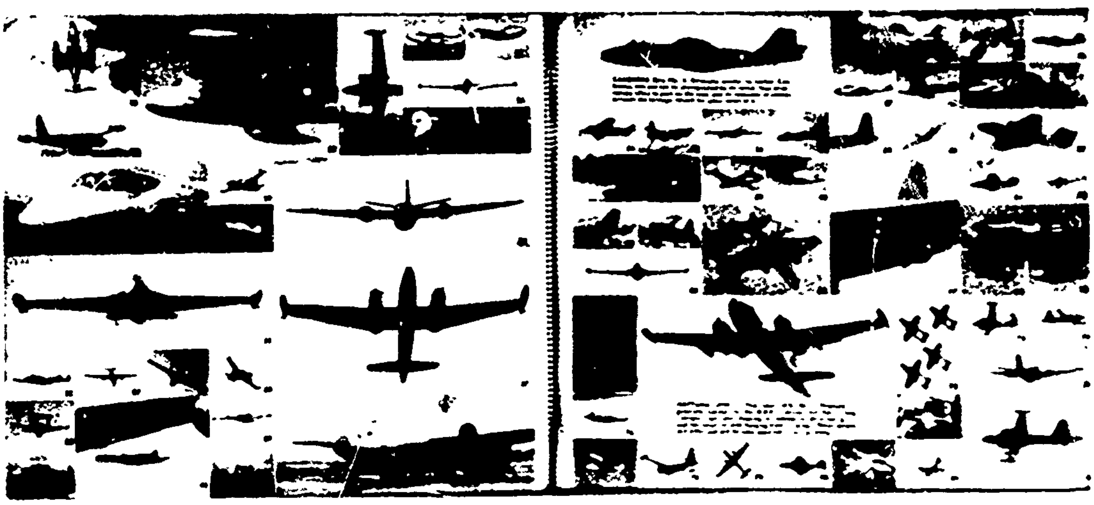

Figure 2

> [identify] each A/C in the second book, by comparing them with those of the first book. This process is continued until each A/C is [identified] correctly. Each trainee works alone at his own rate without formal instruction. pp. 247-248

An experiment that Allan conducted to assess the value of the Sargeant System in comparison with the WEFT System indicated that identification was superior in training by the Sargeant System. A further appraisal was made on rational grounds. Allan speculated that the Sargeant was superior to the Renshaw System, because it employed better training techniques. To support this speculation, Allan points out that Gibson (1) noted a slight advantage of the WEFT over the Renshaw System. This advantage was attributed to training on features. Since the Sargeant System emphasized features, Allan concluded that this system should also be superior to the Renshaw System. However, it should be noted that this may be a weak argument, because there is no instructional control of feature training in the Sargeant System.

A recent set of experiments conducted by Gavurin (3) supports the findings of Allan and Gibson. However, an even more interesting finding was the result of comparing two different procedures for displaying the aircraft. During one condition the aircraft were displayed successively (one at a time), while during another condition they were displayed simultaneously (all at one time). Gavurin found that a subsequent test in which the aircraft were displayed successively showed significantly better identification performance following training by the simultaneous procedure. Typically, the operational identification training session proceeds with a successive rather than a simultaneous presentation. As a result of these findings, Gavurin recommended that the simultaneous procedure be studied for improving current training techniques.

A HumRRO METHOD

Another recent study conducted by the Human Resources Research Office under Work Unit STAR, Aircraft Recognition Training, for the Army at Fort Bliss, Texas was designed to develop concepts of identification training that would be suitable for personnel manning all forward area air defense weapons. The objectives of the STAR project were to develop a program that would train observers to a 95% level of accuracy on aircraft identification performance, and to compare the efficiency of this program with the modified WEFT-Renshaw program that had been adopted by the Army. The primary differences between the WEFT-Renshaw and the STAR programs are that the latter places greater emphasis on learning aircraft features that are relevant to identification requirements of the real world, displays the aircraft by the simultaneous as well as by the successive procedure, and exercises greater control on the subjects' training and progress throughout the program. These differences may best be illustrated by a brief description of the STAR program (Whitmore *et al.*, 5), which was administered to Army trainees at Fort Bliss.

STAR training consisted of the following activities: (1) goal setting, (2) aircraft familiarization, (3) supplementary training, (4) paired comparisons, (5) identification practice and review, (6) achievement testing, and (7) remedial training. Activities 1, 2, and 3, respectively, consisted of measuring the subjects' pretraining proficiency on identification, familiarizing subjects with the nomenclature of features, and providing subjects with printed silhouettes of three-plan views which could be used as supplementary training throughout the program. Prior to training, 16 aircraft were sorted into four sets according to overall similarity by an independent group of judges. These sets of aircraft were introduced into training according to controlled procedures. Training consisted of sixteen 50-minute sessions, which progressed from Activity 4 through 7 during each session. The procedure was as follows:

Each of the activities was conducted with the first set of aircraft for as many sessions as was necessary for the class to achieve an average of 80% correct identification (Activity 6). Then, the next set of aircraft was introduced until the same criterion was reached. This procedure was continued for all sets of aircraft until a final average criterion of 95% was achieved over all. The higher final criterion was achieved in the following manner: Only the set of aircraft that was being taught during each session was introduced during paired comparisons training (Activity 4); however, during identification practice and review (Activity 5) all preceding sets were introduced in addition to the set that was currently taught; therefore, Activity 5 was cumulative for aircraft and provided additional review and practice during each session for those sets that had been previously learned to the 80% criterion. This procedure resulted in the average achievement of 95% by the 16th training session.

Activities 4 through 7 can be briefly described as follows:

The *paired comparisons* activity consisted of displaying pairs of projected images *simultaneously*. Several views of each aircraft were shown, but the view was the same (or similar) for each aircraft in a pair. The aircraft names were also displayed along with the images. The instructor called on each subject to designate (oral response) each aircraft by name and describe the observable differences in identification features between each pair of images. This procedure was designed to improve discrimination between similar aircraft, by allowing the subjects to make direct comparisons of similar features. Only the particular set of aircraft that was being taught during the session was introduced during this activity.

The *identification practice and review* activity consisted of a stimulus-response-feedback sequence. This was conducted by first displaying only an image by the *successive* procedure, then the image was displayed with its name. The subjects' task was to identify (written response) the aircraft within five to eight seconds before the correct name was shown. All aircraft that had been introduced during the current and previous paired comparisons were presented by this procedure in the current session. This procedure was designed to provide cumulative practice and review on identification.

The *achievement testing* activity consisted of displaying the aircraft by the *successive* procedure without providing response (name) feedback. The subjects' task was to identify each aircraft within five seconds before the next image was displayed. The images were different views of the aircraft that were presented during the paired comparisons activity of the same session. This procedure was designed to test the class achievement level (80% was required) before progressing to the next set. This test identified subjects who were having difficulty and needed remedial training.

The *remedial training* activity was given to subjects who were having difficulty. This type of training might be given to the whole class if all members had difficulty with particular aircraft. Both the simultaneous and successive procedures were used as appropriate. The instructor called on each class member to describe the observable identification features and to name each aircraft. The successive procedure was employed when the aircraft that was causing difficulty was being confused with more than just one or two others. The simultaneous procedure was employed when only two or three aircraft were being consistently confused with each other.

It has been mentioned that one of the objectives of the STAR program was to compare its efficiency with that of the WEFT-Renshaw program. Two separate groups of trainees were administered one or the other type of training. Then, each group was given a generalization test in which the men were required to identify different views of the same aircraft that were learned during training. The generalization images were also smaller than the training images. The results showed that an average of 61% identification performance was attained on the generalization test by the STAR group, while only 20% was attained by the WEFT-Renshaw group.

Although these scores indicate that the STAR program was superior, it should be noted that the average training time per aircraft was

2.3 times that of the WEFT-Renshaw program. Whether the WEFT-Renshaw group would have benefited significantly from additional training time remains an empirical question. There is reason to believe that differences in training time was not the critical factor to account for these results. It will be recalled that the STAR program incorporated training procedures which had been found to be superior, and which were not included in the WEFT-Renshaw program. The systematic study of these procedures appears to be a more worthwhile goal of future research in the area of aircraft identification training.

It is apparent from the studies discussed in this review that most research has focused attention on the area of training. It is not surprising that earlier studies narrowed their research to this area, since little was known about the variables that might influence aircraft identification performance. However, HumRRO research has suggested that at least three other areas might be examined in future studies—generalization, retention, and transfer.[1] These areas are important because they provide criterion measures for the effectiveness of training. For example, since only a limited sample of aircraft views can be employed in training, it is important to determine the generalization effects of training views on non-training views. Similarly, the effects of selected training procedures on subsequent retention for aircraft identification should be examined. Also, the transfer effects of learning one set of aircraft to learning a new set should be determined. The current research efforts of HumRRO are designed to coordinate studies of training with generalization, retention, and transfer in order to provide a better assessment of training effectiveness.

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[1]Another area of research that may be relevant to aircraft identification is *predictor variables*. Luborsky (6) found that the best predictors of aircraft identification performance from a battery of psychological tests were Memory for Complex Figures and Interest. Intelligence did not correlate significantly with identification performance. HumRRO is conducting studies to determine the validity of these and other variables for predicting aircraft identification performance. Visual acuity is another variable that has been examined. Wright (7) found that far visual acuity did not materially influence identification when acuity was 20/25 or better. However, it should not be assumed that poorer visual acuity will not reduce identification performance.

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13. ABSTRACT

The paper presents a selective review of previous and contemporary methods of teaching aircraft recognition to personnel manning forward area air defense weapons. Methods in use since about 1940, including the WEFT System (image-analysis concept), the Renshaw System (whole-image concept), the modified WEFT-Renshaw System (learning of aircraft features), and a HumRRO method are examined. HumRRO research designed to coordinate studies of training with generalization, retention, and transfer in order to provide a better assessment of training effectiveness, is described.

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