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SOME APTITUDES AND ABILITIES OF VIETNAMESE TECHNICIANS: IMPLICATIONS FOR TRAINING

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SUMMARY

The use of complex military equipment requires operators and maintainers to read and understand technical manuals that contain not only written text but graphic materials as well, e.g., drawings, equations, and photographs. Extraordinary problems may develop when equipment is given to other countries. In the context of the turnover of American military equipment to the Vietnamese, IDA conducted a preliminary investigation of aptitudes specially related to the understanding of graphic material.

This study indicated that there are differences between American and Vietnamese (VNAF) military personnel in their abilities to cope with graphic representation. Data on such skills are necessary for planners of training programs as well as those who develop and produce technical documents. Our results lead us to suggest certain remedial steps to reduce these deficiencies.

METHOD

Two types of tests were administered to groups of Vietnamese and American helicopter technicians. The first measured various aspects of spatial and numerical abilities, as well as mechanical knowledge. Eighty-two VNAF helicopter technician trainees and a control group of 31 U.S. Army helicopter mechanics took the tests. The second was an experimental test of ability to interpret two-dimensional graphic figures, administered to 18 VNAF subjects and to 18 American controls. All tests were of the "culture-fair" variety, i.e., they were nonverbal.

RESULTS

Within the limits of our samples, there were differences in certain of the abilities of the two groups of subjects. VNAF subjects made higher average (mean) scores on two tests, the U.S. Army subjects scored higher on four, and five tests did not discriminate between the groups. Evaluating our results against other American data, we conclude that the major differences consist of deficiency in the Vietnamese ability to interpret two-dimensional representations of three-dimensional relationships, and in their ability to recognize line drawings of tools, especially when there are marked scale variations in the illustrations.

Results from the test of graphic interpretation were consistent with the above findings. That is, on 37 percent of the test items Vietnamese airmen tended to misinterpret--by Western standards--simple line drawings that portrayed relative positions of different objects. The same material was almost always correctly perceived (only 9 percent mistakes) by the American technicians.

CONCLUSIONS AND RECOMMENDATIONS

Vietnamese mechanics may experience much more difficulty in their interpretation of our technical illustrations than has been believed. This is particularly important in view of current efforts to provide heavily illustrated training and maintenance manuals. Overall, our findings confirm a growing body of research that people of different cultures employ different conventions in interpreting three dimensions represented on a two-dimensional surface. Another inference, based on the mechanical knowledge test, is that Vietnamese trainees might not select and use correct tools.

These findings suggest that illustrations will not compensate for written language. Of practical importance, we believe, is the suggestion that deficiencies in perceiving representations of spatial patterns can be eliminated or minimized through training. Training to increase accuracy of interpretation of drawings has been successfully demonstrated in other non-Western groups. We also propose

training in the identification and use of tools to compensate for previous limited exposure.

We recommend three immediate steps: (1) collection of more information on a wider sampling of abilities from a greater variety of Vietnamese subject populations, (2) collection and analysis of evidence about the actual performance of Vietnamese technicians on-the-job, and (3) development and evaluation of special training techniques designed to overcome whatever deficiencies may be confirmed.

I. INTRODUCTION

Industrialization and technological advances in developing countries are dependent on many factors, one of which is the emergence of a skilled labor force. Technicians and craftsmen must be trained who can operate and maintain, and ultimately build, the machines that a modern civilization requires. To date, industrialized countries--Europe, Japan, and the United States--have supplied the automobiles, aircraft, electronics, chemicals, and weapons that less developed countries have needed. For their part, the recipients have operated and maintained the machines that others have built, relying on foreign technicians, at least initially, in the case of more sophisticated equipment. Native technicians, drawn from the most Westernized segments of the society, have moved increasingly into more active and responsible roles. Assuming responsibility for sophisticated equipment involves not only learning how to operate it and repair it but also being able to schedule its utilization, to plan the necessary stocking of spare parts, and to manage the financial and administrative activities that go with the possession of modern complicated and costly equipment.

This paper reports on a small but important phase of the foundation of talent and skills necessary for modernization. We have concentrated on the level of special abilities among a particular group of Vietnamese technician mechanics who were being trained to maintain helicopters. While the actual performance of helicopters in Vietnamese hands depends on a host of factors, one critical consideration is the level of competence of maintenance personnel. A serious deficiency in this domain cannot readily be compensated for in other phases of helicopter operation. At the same time, deficiencies in other phases may lead to effects that are erroneously attributed to the incompetence of

maintenance personnel. Competence, in turn, depends on innate ability, training, supervision, and support.

Ability, or the capacity to benefit from training, is a matter of prior experience and genetic factors. While there are no proven differences between ethnic and racial groups attributable solely to genetic factors, there are tremendous differences due to cultural variables. Vietnamese are handicapped because maintenance manuals are not available in their language, and even if manuals were translated, their language does not have words for many of the parts, principles, or processes that make up an operating aircraft (Sinaiko and Brislin, 1970). (However, it has been demonstrated that highly skilled translators can produce usable, high quality translations.) Less obvious, but potentially as important, are the effects of growing up in an impoverished material and ideational environment when one is faced with the task of coping with the products of a markedly different, technologically advanced culture. The specific nature of these handicaps, the time required to overcome them, and the best methods of doing so remain unknown. What we do have is a body of anecdotal accounts of successes and failures, stories of people who make the transition easily, and the tales of others whose poor performance is attributed to limited exposure to mechanical devices and inanimate sources of power.*

*For evidence about Vietnam, see Sinaiko et al., 1969.

II. METHOD

In this research we administered tests to Vietnamese helicopter mechanics to assess the average level of certain abilities that may bear on their job performance. Having observed helicopter technicians at work, we concluded that the following abilities at least were important: visualizing relationships among parts, especially after some parts had moved; fine discriminations of short distances; rapid differentiation between identical and dissimilar parts; picking out some parts for attention from among all the parts that were visible; and, most important, retaining the illustrative material in manuals to the aircraft. From the results of these tests it should be possible to recommend special training that might enable Vietnamese to overcome the effects of their limited experience with complex equipment.

SUBJECTS

The subjects consisted of 31 U.S. Army and 82 Vietnamese Air Force helicopter mechanics. Both groups had just completed a 16-week training course given by the U.S. Army's Transportation Schools, and were awaiting assignment to Vietnam. Although they were trained as helicopter mechanics, the subjects are probably representative of military technicians of the respective countries. The VNAF trainees were high school graduates, 20 to 22 years of age, with special training in English prior to arrival in the U.S. The Americans ranged in age from 17 to 22 (median of 19), with a median education of Grade 11; two men had completed less than Grade 10, while four had finished a year of college. Both groups were informed that the results of the testing would not become a part of their records and would not affect their standing in the armed forces. Cooperation and effort of both groups were excellent.

TEST BATTERY

French's Tests

The tests were selected from French's Kit of Reference Tests. This is a set of tests of specific mental abilities, each of which has been found repeatedly to be a good measure of a specific skill such as verbal, numerical, or rote memory activities. Extensively documented in the psychological literature, each test has been standardized on American high school or college student groups (French et al., 1963). For the Vietnamese subjects, the instructions and examples were translated by a Vietnamese psychologist and were administered by Vietnamese officers.* The authors attended all sessions and administered the tests to the Americans. Except for instructions in the subjects' native languages, the test items themselves did not involve the use of words. Appendix A contains the instructions and sample items for each test.

Tests were selected to measure a number of abilities that might have some bearing on performance of technical military occupational skills.** (Although there are extensive test batteries used for the classification of U.S. Army personnel, they were not directly applicable because many of these tests involve considerable use of language.) Table 1 lists the tests by general factor, test name, and time limit.

---

*The translator, who had completed 40 hours of technical translation in an earlier study (Sinaiko and Brislin, 1970), was judged as excellent, based on back-translation as well as knowledge and performance testing results.

**An obvious question arises about the applicability of giving tests, standardized in one culture, to subjects representing a very different culture. We feel the practice is justified here because the Vietnamese airmen were being trained in U.S. Army methods to maintain American equipment. Thus, the abilities necessary to perform the technician's job were those measured by our test battery.

TABLE 1. TEST BATTERY DESCRIPTION

Factor	Test	Time Limit, min
Numerical	1. Addition	4
	2. Division	4
Spatial Orientation	3. Card Rotation	8
	4. Cube Comparison	6
Visualization	5. Paper Folding	6
Perceptual Speed	6. Number Comparison	3
	7. Identical Pictures	3
Length Estimation	8. Length Estimation	6
	9. Nearer Point	4
Flexibility of Closure	10. Hidden Patterns	4
Mechanical Knowledge	11. Tool Knowledge	10
Total		58

More specifically, the abilities measured by tests shown in Table 1 can be described as follows:

Numerical: 1. Addition and 2. Division--the ability to manipulate numbers rapidly and accurately in arithmetical operations.

Spatial Orientation: 3. Card Rotation and 4. Cube Comparison--the ability to visualize an object turned in either two or three dimensions and to choose how it would appear.

Visualization: 5. Paper Folding--the ability to rearrange spatial patterns. (This test does not correlate highly with Tests 3 and 4 above.)

Perceptual Speed: 6. Number Comparison and 7. Identical Pictures--the ability to compare numbers or symbols quickly; the second test requires subjects to recognize whether shapes are identical or different when the pictures are not rotated or turned over.

Length Estimation: 8. Length Estimation and 9. Nearer Point--the ability to judge short distances in line drawings with and without distracting lines.

Flexibility of Closure: 10. Hidden Patterns--the ability to keep one or more definite configurations in mind so as to make identification in spite of perceptual distractions.

Mechanical Knowledge: 11. Tool Knowledge--the ability to identify common tools from illustrations and to associate pairs of tools by function rather than similarity to appearance.

Each test began with a printed and an oral explanation and practice items. Proctors, both the authors and Vietnamese officers, who made sure that all practice items were solved correctly, were available to answer questions about the tests. Each test consisted of two parts, presented consecutively with strict time limits. The time for each part was generally brief, ranging from 1.5 to 5 minutes.

Each test was in a multiple-choice format so that the subject marked on the test sheet itself the correct answer from two to five alternatives. The tests were scored with corrections for guessing: number right minus number wrong for the two-alternative items, number right minus one-half number wrong in the case of three-alternative items, and so on.

Hudson's Test

The second test series, based on the work of Hudson (1960, 1967), consisted of simple line drawings which are used to determine whether a subject can interpret the conventions used to portray certain three-dimensional information. The pictures shown in Fig. 1 are from Hudson's test. They produce widely differing interpretations among viewers of different degrees of sophistication. Nearly all Western subjects, who are experienced with books and other printed matter, have no problem noting (1) converging lines indicating distance, (2) the relative size of the animals and the tree, and (3) the superimposition of lines indicating the relative position of the hills. These people correctly interpret the artist's intended message: the hunter is trying to kill the antelope since the elephant is too far away. Hudson has shown, however, that rural Africans tend to say that the hunter is trying to kill the elephant, noting that the elephant is

closer to the hunter on the paper than is the antelope. The rural Africans miss the three cues mentioned above, cues that are Western conventions.

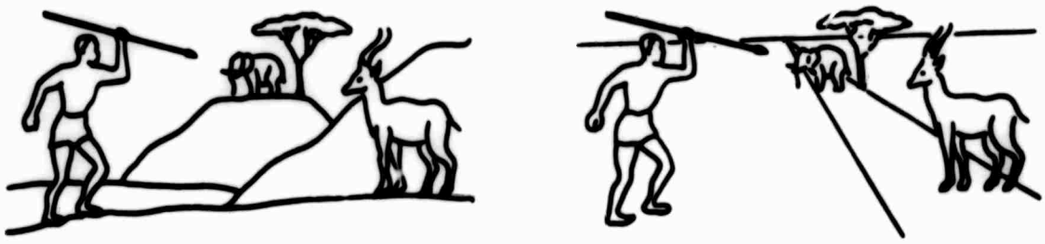


FIGURE 1. Hudson's Test: Sample Items

Since the Vietnamese are another non-Western group, we considered that a preliminary test of their ability to interpret drawings would be appropriate. If the Vietnamese made many mistakes, this should be noted so that instructors who use pictures in training courses can compensate for it.

The full set of Hudson's 6 pictures were shown individually to 18 Vietnamese helicopter technician trainees at Ft. Eustis, Virginia. In each picture, the experimenter pointed to the four main elements: the hunter, the elephant, the antelope, the spear. The Vietnamese subjects were asked to identify each element, and all were able to do so. Then, the subjects were asked the critical question: "Who is the hunter trying to hit with the spear?" An error was counted if the subject answered "elephant," indicating that he did not interpret the three-dimensional cues in the picture correctly. If the subject answered "antelope," the response was marked as correct: the subject had correctly interpreted the three-dimensional cues. The pictures were also shown to a control group of 18 U.S. Army helicopter trainees at Ft. Eustis, the testing procedure being the same. Both groups were tested in English by one of the authors.

(Although not directly related to the main focus of this study, we administered a simple test of physical strength: a hand dynometer was used to measure static strength of grip. Results appear in Appendix B.)

III. RESULTS

FRENCH'S TEST BATTERY

The results presented in Table 2 indicate that Vietnamese mechanics do as well as American mechanics and high school students on tests of Visualization, Perceptual Speed, Length Estimation, and Flexibility of Closure. The Vietnamese subjects performed significantly better than our American sample on Addition and on the Hidden Patterns test. But the VNAF scores on these two tests were almost identical with those from samples supplied by the Educational Testing Service (ETS). The American subjects performed significantly better than the Vietnamese on Card Rotation, Cube Comparison, Identical Pictures, and Tool Knowledge. We are inclined to discount the difference on the Identical Pictures test of Perceptual Speed because, while our U.S. Army sample scored higher than the Vietnamese, the latter were higher than the ETS sample.

We are led to conclude that the major differences of practical significance were that the Vietnamese did significantly worse on the tests of Spatial Orientation (Card Rotation and Cube Comparison tests) and Mechanical Knowledge. The fact that there were no differences between the VNAF and American samples on five of the tests, and that the VNAF subjects were significantly better on Addition and Hidden Pictures, rules out the possibility that the Vietnamese scores on tests of Spatial Ability and Mechanical Knowledge are low because of a general unfamiliarity with testing procedures. An interpretation must be sought in the tasks presented or in the content of the test items themselves.

Mechanical Knowledge differentiated the American from the Vietnamese subjects: mean scores of the 30-item test were 22, 24, and 14 for the U.S. Army, American high school students, and VNAF subjects,

TABLE 2. FRENCH'S TEST BATTERY: SCORES OF VNAF, U.S. ARMY, AND OTHER AMERICAN SUBJECTS

Ability and Test	Mean Scores (S.D.) U.S. Army (N = 31)	VNAF (N = 82)	Difference in Means (U.S. Army - VNAF)	"t"	Other Norm Group[a] Mean (and S.D.)
Numerical					
1. Addition	32.5 (11.7)	38.8 (10)	- 6.3	2.63[b]	38.2 (10.5) (200 HS Students)
2. Division	22.7 (15.1)	27.6 (11.7)	- 4.9	1.64	39.4 (14.2) (200 HS Students)
Spatial Orientation					
3. Card Rotation	139.2 (32.4)	109.0 (37.1)	30.2	4.23[b]	140 (Various Groups)
4. Cube Comparison	16.4 (8.5)	7.2 (6.5)	9.2	5.49[b]	9.8 to 10.9 (Various Groups)
Visualization					
5. Paper Folding	9.8 (3.7)	9.4 (4.3)	0.04	--	9.4 to 13.1 (Various Groups)
Perceptual Speed					
6. Number Comparison	39.9 (8.2)	40.2 (7.8)	- 0.3	--	(No Data Available)
7. Identical Pictures	68.6 (10.9)	61.5 (13.1)	7.1	2.89[b]	55.9 (10.4) (329 HS Students)
Length Estimation					
8. Length Estimation	20.5 (12.6)	18.9 (10.2)	1.6	--	17.1 (9.0) (215 HS Students)
9. Nearer Point	28.9 (14.9)	34.7 (14.3)	- 5.7	1.8	29.0 (11.5) (200 HS Students)
Flexibility of Closure					
10. Hidden Patterns	134.2 (25.3)	152.0 (43.9)	-17.8	2.68[b]	153.4 (200 HS Students)
Mechanical Knowledge					
11. Tool Knowledge	21.6 (4.7)	14.2 (4.8)	7.4	7.46[b]	23.9 to 27.4 (Various Groups)

[a] Data supplied by Educational Testing Service; S.D. = Standard Deviation.

[b] Difference significant at P = < 0.01.

respectively. We did several item analyses of responses to the Tool Knowledge test. The first was a comparison of familiar tools (i.e., those that had been part of the helicopter mechanics' course) with unfamiliar tools (i.e., those that would be recognized only from previous experience). An Army officer instructor at the Transportation Schools indicated which of the 30 tools portrayed in the test were actually used by the VNAF airmen during their training. In this analysis we tested the hypothesis that VNAF subjects' lower scores could be explained on the grounds that over half of the Tool Knowledge test (17 of 30 items) contained pictures of unfamiliar objects. Thus, if the VNAF technicians did significantly better on that part of the test related to previous experience, we could attribute their overall low scores to a cultural or learned bias. Table 3 summarizes this item analysis.

TABLE 3. ITEM ANALYSIS OF TOOL KNOWLEDGE TEST: PERCENTAGE CORRECT AS A FUNCTION OF FAMILIARITY

Subject Group	Familiar Tools (13 items), %	Unfamiliar Tools (17 items), %
VNAF	62	59
U.S. Army	86	74

It is apparent, considering the upper row in the table, that recent experience had little to do with performance on this test for the Vietnamese; there was virtually no difference in percentage of correct responses for test items that were related to course content. In contrast, the U.S. Army subjects tended to do better on tools that had been used in the course; i.e., their scores differed (74 percent versus 86 percent) when we separated the two types of test item. Still another interesting comparison, perhaps reflecting an often-stated claim of much more technical or mechanical experience among Westerners, is that the Army group did better on even the "unfamiliar" tools (74 percent) than the VNAF subjects did on the "familiar" (62 percent). From these data we infer that differences on this test are not a matter only of recent experience with the tools.

We also analyzed performance on this test in another way: How did overall VNAF and U.S. Army scores differ with respect to test items that were left blank? In a very crude way, unanswered questions can be taken as a measure of difficulty or uncertainty. The difference between the two subject populations was striking:

TABLE 4. TOOL KNOWLEDGE TEST: ITEMS LEFT BLANK

	VNAF, %	U.S. Army, %
Questions Unanswered	11.7	0.4

Third, we analyzed particular test items in terms of how accurately the two groups of subjects responded to them. Again, there was a marked contrast. Among the VNAF group, ten items were answered correctly by less than 50 percent of the subjects; this was true for only three items among the U.S. Army group. This is shown in Table 5.

TABLE 5. TOOL KNOWLEDGE TEST: "DIFFICULT" ITEMS
(Fewer than 50 percent correct responses)

Item	VNAF (N = 82), %	U.S. Army (N = 31), %
2	33[a]	90
5	18	93
7	46	52
8	35	39
11	28	52
13	37	49
20	23	84
23	73	49
24	37	58
27	38	100
29	32	77

[a] Percentage of subjects who responded correctly.

There are at least two possible explanations for the relatively poor performance of the VNAF group on this test. First, there could be a difference in previous experience with tools that puts the Vietnamese subjects at a disadvantage. Considering what we know about growing up in Southeast Asia versus the United States, this hypothesis is tenable. Second, the difference could be an artifact of the testing situation. That is, something about the way Tool Knowledge was measured with this test could favor the U.S. Army group of subjects over the VNAF group. Inspection of French's test indicates that this might, in fact, have been true. There could have been a possible perceptual problem, at least for subjects who have demonstrated spatial relations deficiencies as shown on other tests in the battery. Approximately half of the pictures in the Tool Knowledge test items are shown in incompatible scales. The point is best made by reproducing two items. The wide range of scales presents no problem to anyone with sufficient experience to identify the four objects pictured in Fig. 2.

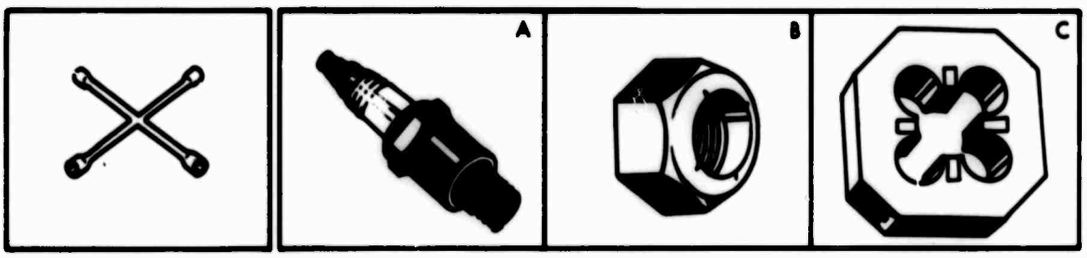


FIGURE 2. Question 27. Tool Knowledge Test

Thus, the lug wrench (left-most sketch) appears to be smaller than the nut (Sketch B) although, in fact, such a lug wrench would probably be larger by a factor of 20. In contrast, Fig. 3 offers a highly consistent scale. VNAF subjects were 95 percent accurate on this question, while only 38 percent answered question 27 correctly. (U.S. Army scores were 97 percent and 100 percent, respectively.)

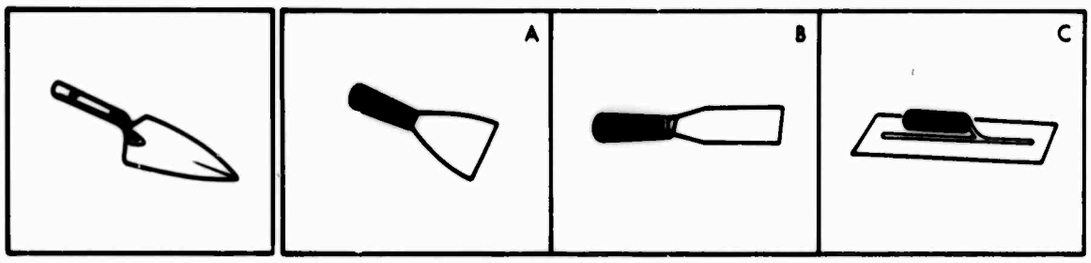


FIGURE 3. Question 14. Tool Knowledge Test

Experience enables Westerners to interpret correctly the real-life size of objects, irrespective of size discrepancies in illustrations. But, non-Westerners, as we will show later, do not always perceive pictures this way. We suggest, therefore, that the low Tool Knowledge scores among the VNAF subjects may be as much due to an unintentional characteristic of the test as to true inability to understand mechanical relationships. However, the important point for this research is that errors will likely also arise when Vietnamese look at illustrations in manuals where there are marked variations in scale.

Although it was not the purpose of this research to develop a selection battery, we did examine the correlations between the 11 tests from French's Kit and English Comprehension Level (ECL) at the beginning of training and the final numerical grade earned in the course. The correlations, based on 69 of the 82 Vietnamese airmen, are shown in Table 6. The results indicate that performance on the tests is not a matter of comprehension of English since most correlations in the first column are low and negative. In the second column the three tests on which the Vietnamese are deficient correlate positively with performance in the course, a pattern which suggests that the deficiency makes a difference in the performance of the Vietnamese.

TABLE 6. CORRELATIONS OF TESTS WITH TWO CRITERION MEASURES ON VIETNAMESE SUBJECTS (N = 69)

Test	English Comprehension Grade at Beginning	Performance Grade at End
Addition	-.19	.7
Division	.7	-.3
Card Rotation	-.16	.23
Cube Comparison	.4	.22
Paper Folding	.1	.14
Number Comparison	-.23	.9
Identical Pictures	-.3	.1
Length Estimation	-.13	.0
Nearer Point	-.22	-.3
Hidden Patterns	-.15	-.11
Tool Knowledge	-.12	.39

English grade at beginning versus Performance grade at end $\gamma = 0.19$

HUDSON'S TEST

In this test of the ability to interpret line drawings of three-dimensional relationships, each of 18 Vietnamese and 18 American subjects examined six different drawings for a total of 108 responses per group. Forty of the Vietnamese responses were marked as errors because the subjects did not correctly interpret the three-dimensional cues. Nine subjects (50 percent) made at least two errors. The 18 American subjects misinterpreted only 10 (9 percent) of the 108 presentations.

Table 7 presents these data in a different format so that a statistical test can be computed. The difference between American and Vietnamese responses is statistically significant ($X^2 = 10.5$, $p < 0.01$).

TABLE 7. VIETNAMESE AND AMERICAN RESPONSES TO HUDSON'S TEST

Nationality	0 Errors	1 to 2 Errors	More Than 2 Errors	Total
Vietnamese	9	0	9	18
American	14	3	1	18
Total	23	3	10	36

Within the limits of our small samples of subjects, these results suggest that the Vietnamese may not be able to interpret two-dimensional drawings as well as Westerners. It is interesting to note that the present results for the Vietnamese are similar to those for Hudson's group of Africans who had lived in an urban environment. That is, urban Africans did better than rural Africans, and more technically sophisticated people did better than both. It should be remembered, also, that our sample of 18 Vietnamese may have been able to interpret pictures better than many of their countrymen because they had been in the United States for 16 weeks, and were thus somewhat "Westernized."

These preliminary results suggest that more testing should be done on larger samples of Vietnamese subjects to determine the extent to which they can use and interpret two-dimensional drawings and other graphic material. If the above results are supported in subsequent testing, those who use pictures in training courses should make sure that the Vietnamese can understand them. Finally, the most effective techniques and the length of time necessary to train non-Western people to use graphics should be determined.

IV. DISCUSSION AND IMPLICATIONS

SPATIAL ABILITY

The use of pictures in technical information presentations assumes that illustrations aid the technician in his understanding of the accompanying text. In the case of technicians working in a second language (e.g., Vietnamese using American materials), pictures are generally believed to be even more important because, presumably, they transcend limitations of words written in an unfamiliar (or marginally familiar) language. Some people have proposed that new training and maintenance materials for equipment going to Vietnam be heavily illustrated; there have even been suggestions that picture books or "books without words" be developed to avoid the language barrier. Our results, with both Hudson's test and the Spatial Ability tests of French's battery, suggest that the Vietnamese will misinterpret pictures unless they are given special training.

Hudson points out that any picture or drawing must use certain arbitrary conventions in order to represent three dimensions on a two-dimensional surface. There is little doubt that most Americans, having extensive experience with pictures, interpret Western conventions better than Vietnamese. Our findings, confirming what Hudson learned with rural Africans, underscore the need to provide special training in interpreting technical illustrations.

The deficiency on the Spatial Ability tests has been found among peoples in many developing countries: Philippines (Guthrie, 1963), Vietnam (Cassel, 1963), Samoa (Alailima, 1961), and in Africa (Mundy-Castle, 1966). It cannot be attributed to unfamiliarity with testing situations since the Vietnamese did as well as or slightly better than American subjects on other tests given at the same time and place. It

is a specific circumscribed deficit since we find no differences on tests of Perceptual Speed, Visualization, and Length Estimation, and tests which require the subject to locate embedded or hidden figures. This spatial ability involves "perception of the position and configuration of objects in space with the observer himself as a reference point" (French, 1963). A high degree of such an ability would seem to be important for persons responsible for the assembly and care of equipment where the individual must consult diagrams and illustrated operating and maintenance instructions.

PICTORIAL DEPTH REPRESENTATIONS

Cross-cultural researchers have used visual illusions and other types of stimuli to compare the percentual abilities and habits of Westerners and non-Westerners. These studies are useful because they demonstrate that, when well-learned conventions are violated, sophisticated subjects misinterpret what they see. Segall et al. (1966) found that Americans were more likely to misinterpret the Muller-Lyer figures than were Africans. In this task, shown in Fig. 4, the subject is asked which horizontal line is longer. In the illustration below line A is equal to line B. However, a majority of Western subjects sees line B as longer, because of the artist's use of the "arrowheads," which is convention for depicting angles.

Leibowitz et al. (1969) had American and non-Western subjects (Pacific Islanders) look at an abstract form of the Ponzo illusion (Fig. 5) and also at a photograph of the illusion in the real world (boards on railroad tracks). The non-Western subjects had seen railroad tracks only in books and motion pictures. All subjects reported identical illusions to the abstract figure, but Western residents were more subject to the illusion in the railroad track picture, a situation with which they were familiar. These differences have recently been replicated with African residents (Pick, 1970).

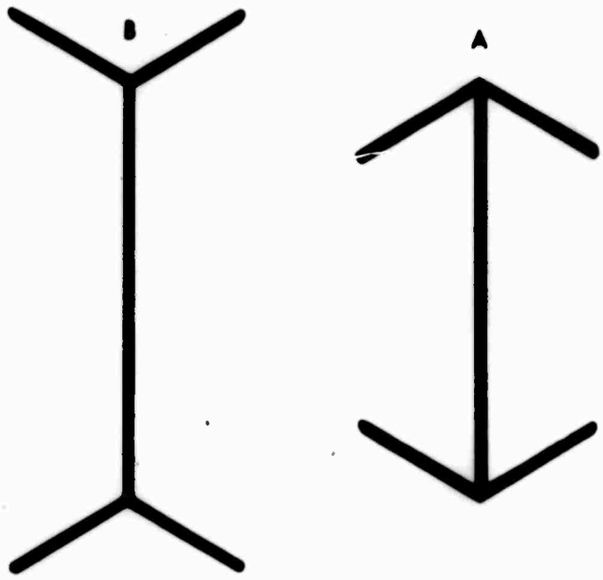


FIGURE 4. The Muller-Lyer Illusion

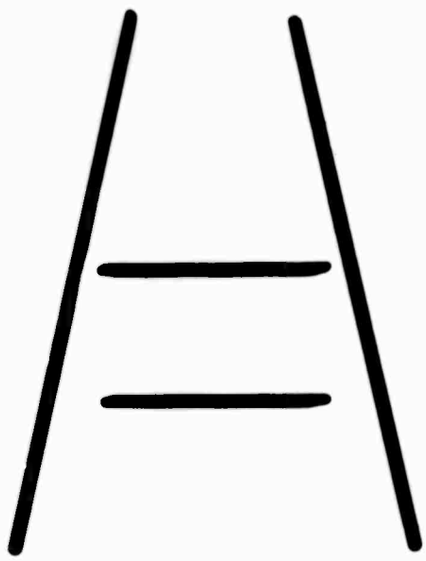


FIGURE 5. The Ponzo Illusion

In addition to studies with illusions that have demonstrated the role of experience in perception, Hudson's work in Africa (1960, 1967) has shown that people have to learn conventions designed to indicate how far an object is from the viewer. The work of Deregowski (1968) supported Hudson's findings and suggested that while African subjects could identify the objects in the picture, they did not accurately interpret the relative positions of the hunter and animals.

Especially interesting is Hudson's findin that urban African groups who have had contact with pictures do better than their rural counterparts. This suggests that the ability to use pictures accurately can be learned.

I day-to-day activities, Vietnamese do not confuse the relationships in space of real objects when they see and work with them; the problem may come when they deal with certain kinds of pictorial representations. This becomes a matter of potentially great importance when a Vietnamese is asked to look at a diagram or illustration in a technical manual and then to take the appropriate steps with equipment. It has been shown that line drawings, even photographs, are not culturally universal; there are conventions by which positions and relationships are depicted, conventions which vary from one culture to another as surely as the conventions of sounds which we call language.

OTHER GRAPHIC CONVENTIONS

It may be useful to consider cultural variations in the depiction of spatial relationships in two dimensions. The artist's first impulse is to draw something the way he knows it rather than as he sees it from a single specific vantage point. Ancient Egyptian figures, for example, had eyes and torsos in front views but noses and profiles in side views.

Rubbings from Angkor Wat show elaborate scenes of victory celebrations in which the most important figure is placed in the center; the crowd's depth is shown by superimposition of one figure over another and not by relative size or position on the tableau. Other events re present above and below the main scene although these secondary mat

bear a different spatial relationship in real life to the central hero. In this case, varying size is related to social standing rather than to distance from the viewer.

Art historians indicate that renaissance artists developed current Western techniques of dealing with perspective. But these are not universal. Present-day Chinese, Japanese, and Indian art may not be pleasing to a Western observer who has not learned to use an oriental artist's techniques of representing spatial relationships.

Finally, in a review of research in Africa, Hudson (1967) points out that many persons of limited literacy misinterpret the messages contained in posters and illustrations, graphic devices chosen to circumvent the handicap of their limited ability to read. He concluded, "Representation which depends upon specific graphic conventions, upon symbolism and serialization will increase the likelihood of misperception and reduce the probability of comprehension." Even skilled workmen, in Hudson's samples, failed to understand that a sequence of pictures implied a sequence of events and did not interpret correctly artists' conventional portrayals of human emotions or activities. The partially acculturated were not able, for instance, to interpret safety posters that encouraged certain work procedures.

There are so many conventions involved in illustrations that pictorial material should be tested for comprehension just as is done with written material.

PSYCHOLOGICAL TESTING IN OTHER CULTURES

There is evidence from still another country of the direct applicability of testing procedures to military personnel from a cultural background markedly different from that of American military personnel. Kotula (1965) reports the adaptation of U.S. military tests to the Korean situation. It was assumed from the outset that skills and abilities required for Republic of Korea Army (ROKA) jobs were much the same as for U.S. Army jobs, an assumption based on similarities of organization and identity of equipment. Koreans and Americans developed

a general Mental Qualification test that contains Vocabulary, Arithmetic Reasoning, Cube Counting, and Spatial Relations items. This was followed by eight tests to help with classification. Again, following U.S. experience, these tests included Attention to Detail, Spatial Clerical Aptitude, Transport, Arithmetic Reasoning, a Personal Inventory, a Job Specialties test, and a Vocabulary Reading test. Validation and application of these tests to classification procedures followed U.S. Army procedures. Other than translating established tests into Korean, relatively few adaptations were made to take Korean cultural factors into account. The pressures of the immediate situation ruled out any other approach. Unfortunately, we do not know the extent to which the testing program proved useful to the Koreans.

At the end of the report, Kotula, paying attention to the effect of cultural differences on abilities and performance, offers some principles that he feels are important for selection and classification in other societies; since these same factors influence performance on the job they are significant to our concerns as well. He emphasizes the importance of "taking into consideration such cultural characteristics as the general educational level in the culture, technological level of development, ethnic origins, language structure, social structure, general economy, military strength and structure, and value systems" (Kotula, 1965, p. 18). Insofar as these factors differ from those found in the United States, different strategies have to be developed to make optimum use of indigenous manpower. A strategy common to America and Korea did not seem possible. Kotula also pointed out that skills have to be developed since there is not a reserve of mechanical information and a technical vocabulary in recruits from an underdeveloped country.

At the level of attitudes and values Kotula observed that Koreans tended to encourage the development of a different adjustment to military service, emphasizing obedience and trustworthiness more than intelligence, leadership, and stamina. By implication, some attention in Vietnam should be directed to the patterns of relationships between different levels of command because there may be elements in the

indigenous command structure, patterns of authority and responsibility, which impede the acquisition and implementation of good maintenance procedures. For example, in many countries it is not considered dignified for a person of high status to get his hands dirty or even to know much about machinery. This can lead to a dangerous division between technical understanding of equipment and authority to make decisions about its maintenance and use. These considerations, however, are beyond the scope of the present study.

V. TRAINING TO INTERPRET DRAWINGS

We know of at least one published experience with training unsophisticated people to understand mechanical drawing. Dawson (1967) has tested a simple training technique for teaching inexperienced subjects how to interpret three-dimensional drawings. Subjects were told to look through a small square cut out of a piece of cardboard; beyond the square hole was a window. Using this view, subjects were to sketch the dominant lines in the outside scene on the window surface. Dawson says of his method, "...The result was a three-dimensional representation of the outside scenery on a flat surface, the window. The use of this technique made it much easier for Ss to understand the methods used for representing scenery in three dimensions on a flat surface...." Subjects continued the "window drawings" until they could make drawings of three-dimensional objects using standard cues of size, overlap, and convergence. There was one one-hour session each week over an eight-week period. As the sessions progressed, subjects sketched similar scenes on paper. More complex spatial forms were used as models for sketches. The last phase of training required subjects to view photographs of the same area they had been drawing.

Dawson's trainees were compared on three-dimensional perception test scores with a control group that had not received training. A statistically significant difference was demonstrated favoring the specially trained group.

VI. CONCLUSIONS AND RECOMMENDATIONS

As part of a larger study of the problems associated with training the Vietnamese to take over American military equipment we have examined certain special abilities and aptitudes of samples of Vietnamese and American helicopter mechanics. The tests assessed skills considered important to effective work as a mechanic, including various numerical, spatial, and perceptual aptitudes. Instructions were given in Vietnamese or English, but the test items themselves were nonverbal (see Appendixes A and B).

There were no differences of practical or applied importance between the groups except on tests of Spatial Abilities and of Tool Knowledge. In both cases the deficiency of the Vietnamese can be attributed to experience and background factors and can probably be corrected by training and special care in preparing illustrations.

These results call into question the assumption that language barriers can be lowered by a more liberal use of illustrations. This research and that of others, especially in Africa, indicate that even literate subjects may have poorly developed abilities to deal with pictorial representations of three-dimensional relationships. The evidence from Africa, as well as our data, indicates that subjects have to learn to utilize the illustrator's cues if they are going to perceive three dimensions as the illustrator intends.

There is evidence suggesting that the difficulty with interpreting the pictorial representation of three dimensions can be handled by a short period of special training (see Dawson, 1967). Teaching Vietnamese to use the various conventions of Western illustrations should enable them to interpret illustrations more quickly and accurately. Once this instruction has been provided, more illustrations may help to

reduce language difficulties. The significance of our data is the implication that people have to learn to read illustrations in the same sense as they have to learn to read print.

In addition, when objects illustrated are relatively unfamiliar, great care must be taken to make sure that the Vietnamese see the object in the proper scale. The danger that they will be confused by different scales may be quite great when an illustration is offered of various parts of the structure with blowups, side views, and other illustrative aids. Such a page in a manual may have several different scales without giving any indication of this fact to the viewer.

These problems of scale differences in drawings can be reduced if the illustrator constantly bears in mind the need to minimize scale shifts and presents whenever possible a familiar reference, such as an illustration of a human hand, so that the Vietnamese can infer immediately the real size of the object illustrated.

A third point is that Vietnamese are unfamiliar with some of the tools that Americans recognize immediately. The converse would also probably be true. The Tool Knowledge deficit can be overcome by additional experience on the part of the Vietnamese. The implication, however, is clear that we should not assume familiarity by the Vietnamese with many tools that are commonly used by Americans.

What is most important, however, is not so much the measured abilities of Vietnamese but, rather, how well they do their jobs. We recommend, then, that much more needs to be learned about actual performance of military tasks, under field conditions. This would involve systematic, large-scale observation of day-to-day performance of Vietnamese technicians in a wide range of tasks. It is as important to identify areas of strength as well as areas of weakness.

REFERENCES

Alailima, Fay C., Education Researcher, personal communication, Western Samoa, 1961.

Cassel, R. N., AID Education Consultant, personal communication, Saigon, 1963.

Dawson, J.L.M., "Cultural and Physiological Influences Upon Spatial-Perceptual Processes in West Africa--Part 1," International Journal of Psychology, 2. pp. 115-125, 1967.

Deregowski, J., "Pictorial Recognition in Subjects from a Relatively Pictureless Environment," African Social Research, 5, pp. 356-364, 1968.

French, J. W., Ruth B. Ekstrom, and L. A. Price, Kit of Reference Tests for Cognitive Factors, Princeton, N.J.: Educational Testing Service, 1963.

Guthrie, G. M., "The Structure of Abilities in a Non-Western Culture," Journal of Educational Psychology, 54, pp. 94-103, 1963.

Hudson, W., "Pictorial Depth Perception in Sub-Cultural Groups in Africa," Journal of Social Psychology, 52, pp. 183-208, 1960.

Hudson, W., "The Study of the Problem of Pictorial Perception Among Unacculturated Groups," International Journal of Psychology, 2, pp. 90-107, 1967.

Kotula, L. J., "Research for Selection and Classification in the Korean Army," U.S. APRO, Research Study 65-5, 1965.

Leibowitz, H., R. Brislin, L. Perlmutter, and R. Hennessy, "Ponzo Perspective Illusion as a Manifestation of Space Perception," Science, 166, pp. 1174-1176, 1969.

Mundy-Castle, A. C., "Pictorial Depth Perception in Ghanaian Children," International Journal of Psychology, 1, pp. 290-300, 1966.

Pick, H., personal communication, May 1970.

Segall, M., D. Campbell, and M. Herskovits, The Influence of Culture on Visual Perception, Indianapolis: Babbs-Merrill, 1966.

Sinaiko, H. W., and R. W. Brislin, "Experiments in Language Translation: Technical English-to-Vietnamese," Institute for Defense Analyses, Research Paper P-634, July 1970.

Sinaiko, H. W., G. M. Guthrie, and P. S. Abbott, "Operating and Maintaining Complex Military Equipment: A Study of Training Problems in the Republic of Vietnam," Institute for Defense Analyses, Research Paper P-501, July 1969, FOUO.

APPENDIX A

FRENCH'S KIT OF REFERENCE TESTS:

INSTRUCTIONS AND SAMPLE TEST ITEMS

FRENCH'S KIT OF REFERENCE TESTS:
INSTRUCTIONS AND SAMPLE TEST ITEMS

ADDITION TEST -- N-1

This is a test to see how quickly and accurately you can add. It is not expected that you will finish all the problems in the time allowed.

You are to write your answers in the boxes below the problems. Several practice problems are given below with the first one correctly worked. Practice for speed on the others. This practice may help your score.

Practice Problems:

4	7	12	84	7	34	17	45	31	80
9	6	5	54	38	81	50	41	52	78
1	15	67	72	80	51	74	89	19	15
14									

DIVISION TEST -- N-2

Practice Problems:

64 ÷ 4	150 ÷ 6	648 ÷ 8	238 ÷ 7	423 ÷ 9
16				

Name _____

CARD ROTATION TEST -- S-1

This is a test of your ability to see differences in figures. Look at the five triangle-shaped cards drawn below.

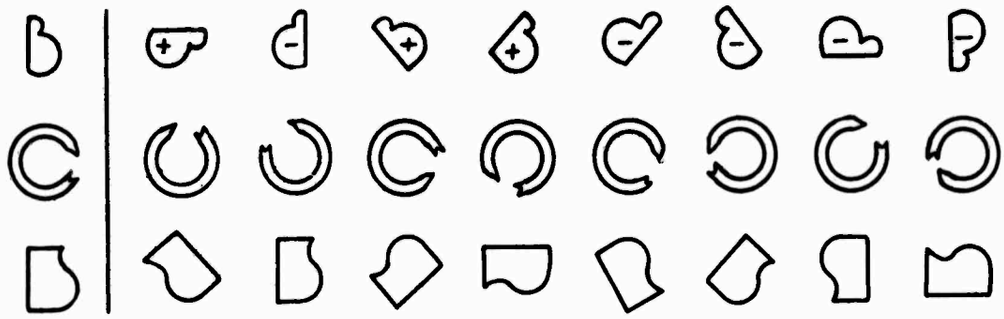
All of these drawings are of the same card, which has been slid around into different positions on the page.

Now look at the two cards below:

These two cards are not alike. The first cannot be made to look like the second by sliding it around on the page. It would have to be flipped over or made differently.

Each problem in this test consists of one card on the left of a vertical line and eight cards on the right. You are to decide whether each of the eight cards on the right is the same as or different from the card at the left. Put a plus (+) or cross (X) on the card if it is the same as the one at the beginning of the row. Put a minus (-) on the card if it is different from the one at the beginning of the row.

Practice on the following rows. The first row has been correctly marked for you.



Your score on this test will be the number of cards marked correctly minus the number marked incorrectly. Therefore, it will not be to your advantage to guess, unless you have some idea whether the card is the same or different. Work as quickly as you can without sacrificing accuracy.

You will have four minutes for each of the two parts of this test. Each part has one page. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

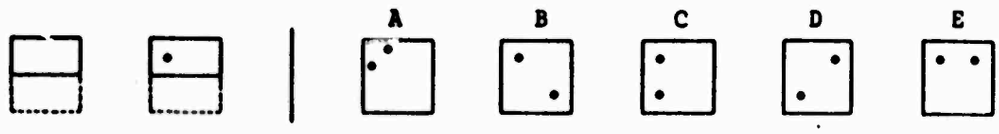
DO NOT TURN THIS PAGE UNTIL ASKED TO DO SO.

Name _____

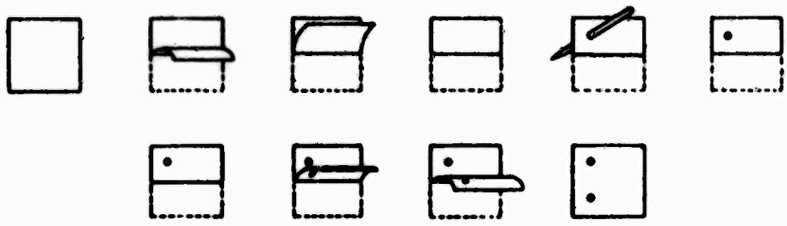
PAPER FOLDING TEST -- Vz-2

In this test you are to imagine the folding and unfolding of pieces of paper. In each problem in the test there are some figures drawn at the left of a vertical line and there are others drawn at the right of the line. The figures at the left represent a square piece of paper being folded, and the last of these figures has one or two small circles drawn on it to show where the paper has been punched. Each hole is punched through all the thicknesses of paper at that point. One of the five figures at the right of the vertical line shows where the holes will be when the paper is completely unfolded. You are to decide which one of these figures is correct and draw an X through that figure.

Now try the sample problem below. (In this problem only one hole was punched in the folded paper.)

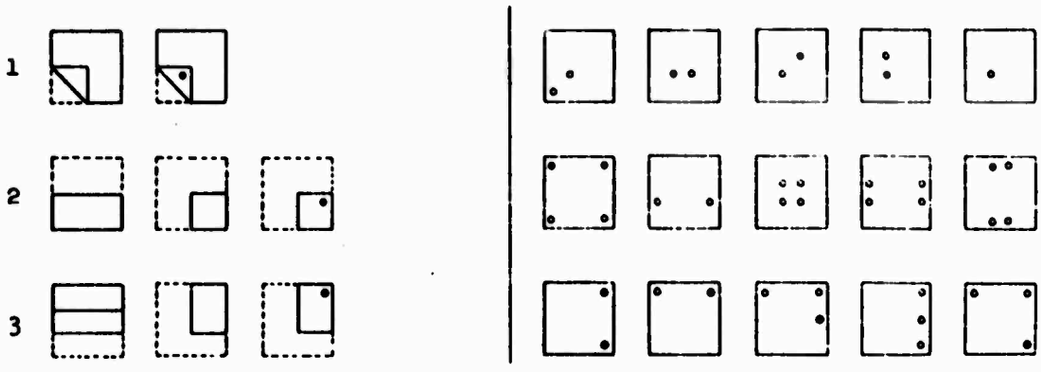


The correct answer to the sample problem above is C and so it should have been marked with an X. The figures below show how the paper was folded and why C is the correct answer.



In these problems all of the folds that are made are shown in the figures at the left of the line, and the paper is not turned or moved in any way except to make the folds shown in the figures. Remember, the answer is the figure that shows the positions of the holes when the paper is completely unfolded.

Part 1 (3 minutes)



Name _____

NUMBER COMPARISON TEST -- P-2

This is a test to find out how quickly you can compare two numbers and decide whether or not they are the same. If the numbers are the same, go on to the next pair, making no mark on the page. If the numbers are <u>not</u> the same, put an X on the line between them. Several examples are given below with the first few marked correctly. Practice for speed on the others.

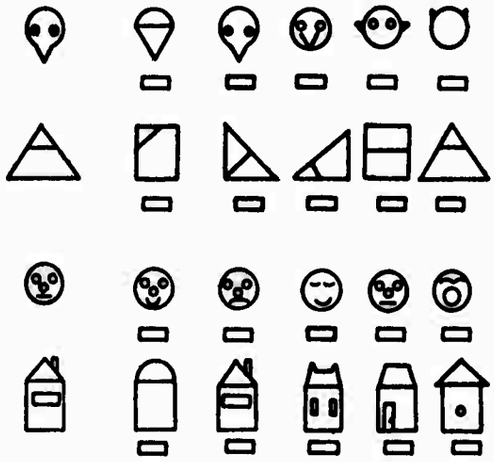
659	____	659	7343801	____	7343801
73845	__X__	73855	18824	____	18824
1624	____	1624	705216831	____	795216831

IDENTICAL PICTURES TEST -- P-3

How fast can you match a given object? This is a test of your ability to pick the correct object quickly. At the left of each row is an object. To the right are five test objects one of which matches the object at the left. Look at the example below:

The third test object has been marked by blackening the space below it because it is the same as the object at the left.

Now practice on the problems below. Mark them as fast as you can:



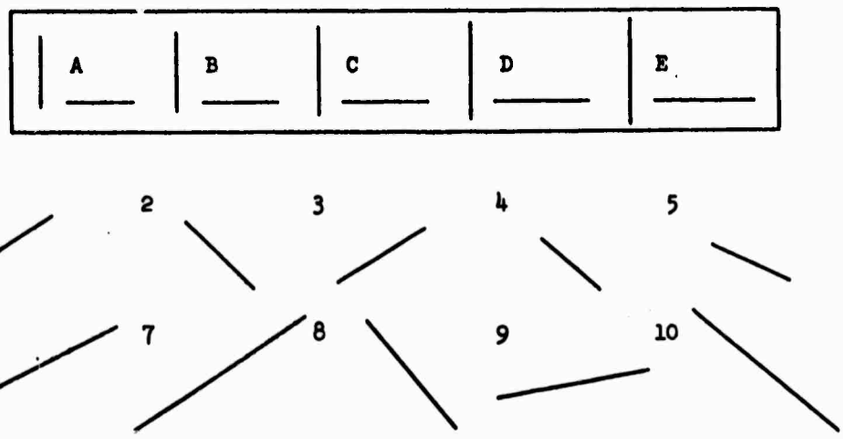
Name _____

LENGTH ESTIMATION TEST -- Le-1

This is a test of your ability to compare lengths of lines by eye. Shown below is a box containing five pairs of lines of differing lengths marked A, B, C, D, and E. Each pair consists of a vertical and a horizontal line of the same length. The lines marked A are the shortest and those marked E are the longest. (Both vertical and horizontal lines are shown in the box because some people think that two lines of the same length look different lengths when one is vertical and the other is horizontal.)

Below the box of lines are two rows of test lines numbered from 1 to 10. The lines in the first row are the <u>same length</u> as ones in the box. The lines in the second row are <u>twice as long</u> as ones in the box. Beneath the number for each test line write the <u>letter</u> of the line which is the <u>same length</u> or <u>half as long</u> as the test line. Measure the lines with your eyes. Do not use your fingers or your pencil.

Now try the practice items. The correct letter has been written beneath the number of the first item in each row.



The answers to the other practice items are as follows:

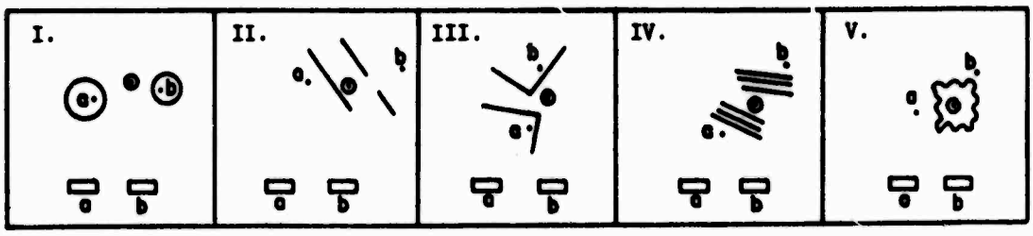
2 - D ;	3 - E ;	4 - B ;	5 - C ;
7 - E ;	8 - A ;	9 - B ;	10 - D .

Name _____

NEARER POINT TEST -- Le-3

This is a test of your ability to compare small distances quickly. Each problem has a central point (●) surrounded by some lines and circles, among which there is a dot marked "a" and a dot marked "b." You are to decide which of the two lettered dots is nearer to the central point. Pay no attention to the circles or lines that come between the dots and the central point. Blacken the correct box to show your choice. You are allowed to use your fingers or pencil to help you, but this will be to your disadvantage if it makes you work more slowly.

Practice on the following problems:



The answers to the above problems are as follows: I is b; II is a; III is b; IV is a; V is a.

HIDDEN PATTERNS TEST -- Cf-2

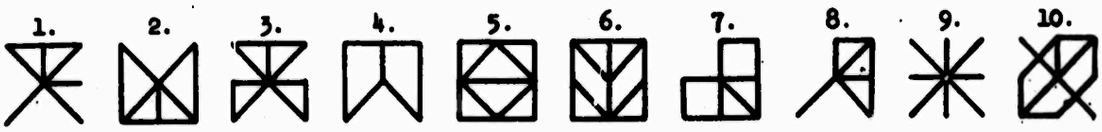
How quickly can you recognize a figure that is hidden among other lines? This test contains many rows of patterns. In each pattern you are to look for the model shown below:

The model must always be in this position, not on its side or upside down.

In the next row, when the model appears, it is shown by heavy lines:

( ) (X) ( ) ( ) (X) ( ) ( )

Your task will be to place an X in the space below each pattern in which the model appears. Now, try this row:



( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )

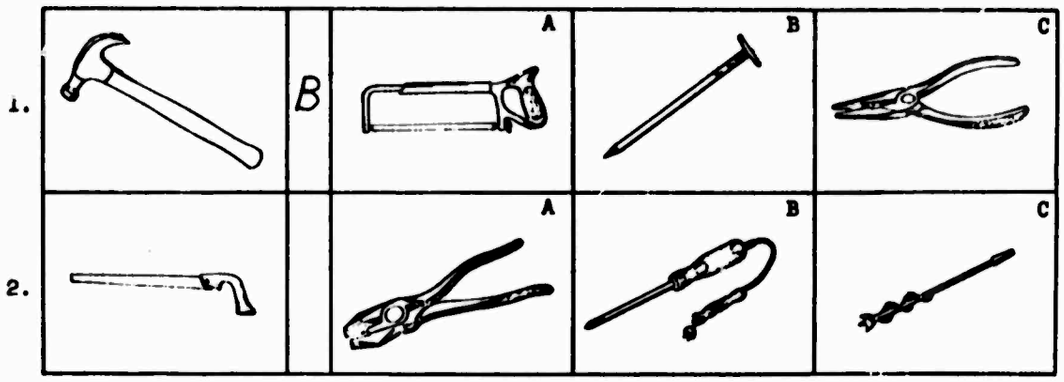
You should have marked patterns 1, 3, 4, 8, and 10 because they contain the model.

Name _____

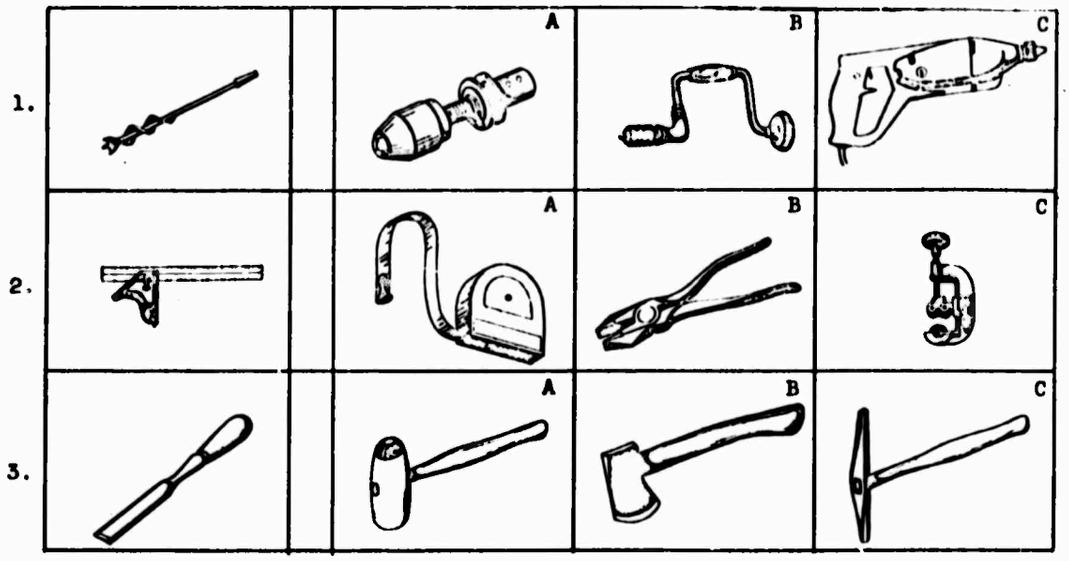
TOOL KNOWLEDGE TEST -- Mk-1

This is a test of what you know about tools and their uses. Each problem in the test consists of a row of pictures. There is a picture at the left of the double lines, and there are three pictures on the right of the double lines. The pictures on the right are lettered A, B, and C. You are to decide which piece of equipment shown in the pictures on the right most commonly used with the piece of equipment pictured at the left. Indicate your answer by writing the letter of the correct picture between the double lines.

Now try the examples below. Example 1 has been correctly answered for you.



In example 1, B is the answer because the hammer at the left is used to hammer nails. In example 2, the right answer is C. The keyhole saw at the left can be used after a wood bit is used to make a hole in which the saw may start its cut.



Name _____

CUBE COMPARISON TEST -- S-2

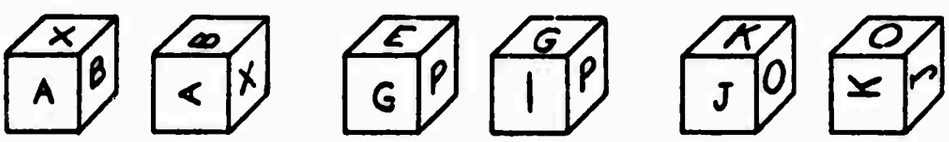
Wooden blocks such as children play with are often cubical in shape and have a different letter or number on each of their six faces (top, bottom, and four sides). Each problem on the test consists of drawings of two cubes of this kind. Look at the two pairs of cubes below:

The first pair of cubes is marked D because the two drawings must be of different cubes. If the left cube is turned so that the A is in front, the N on this cube will be hidden and will be on the side opposite from where it is shown on the right-hand cube.

The second pair is marked S because the two drawings can represent the same cube. When the left cube is rolled over to the left, the X will no longer show, a C will appear, and the cubes can be the same.

RULE: When a face is hidden on one cube and is turned up on the second, the letter or number on that face is correct unless that letter or number has already been shown in a different position on either of the cubes.

Be sure you see that this pair can represent the same cube.



The first pair should be marked "different" because X cannot be next to the top of A on the left cube and the bottom of A on the right cube. The second pair is "different" because P has its side next to G on the left cube and its top next to G on the right cube. The third pair is "same."

Your score on this test will be the number marked correctly minus the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you have some idea which choice is correct. Work as quickly as you can without sacrificing accuracy.

You will have three minutes for each of the two parts of this test. Each part has one page. When you have finished Part 1, STOP.

DO NOT TURN THE PAGE UNTIL YOU ARE ASKED TO DO SO.

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Adapted from Cubes by L. L. Thurstone

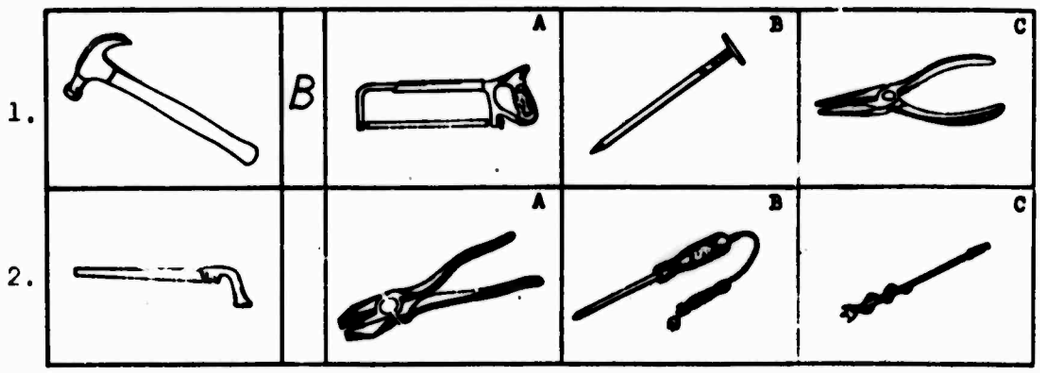
NOTE: Page 40 was inadvertently printed in the English version of the Tool Knowledge Test--Mk-1. It was our intent to show the Vietnamese version here, which explains this addendum page.

Tên: _____

TRẮC NGHIỆM KHẢ NĂNG HIỂU BIẾT DỤNG CỤ - Mk-1

Đây là cuộc trắc nghiệm để ấn định tầm hiểu biết về các dụng cụ và lợi ích của nó. Mỗi bài làm trong cuộc trắc nghiệm này gồm có một dãy hình vẽ. Ở phía trái đường đứng thẳng kép có một hình vẽ và ở phía tay mặt đường kẻ kép này có ba hình vẽ khác. Các hình vẽ bên tay mặt được ghi chữ thứ tự A,B,C. Bạn hãy xét xem dụng cụ nào trong các hình vẽ bên tay mặt là thường được dùng nhất với dụng cụ trong hình vẽ bên phía trái đường kẻ kép. Hãy ghi chữ cái trong hình vẽ của vật dụng được lựa chọn vào giữa hai đường thẳng kép.

Hãy làm thử bài tập sau đây. Thí dụ thứ nhất đã được trả lời đúng để làm mẫu.



Trong thí dụ thứ nhất, B là câu trả lời đúng vì chiếc búa ở phía trái thường được dùng để đóng đanh. Trong thí dụ thứ hai, câu trả lời đúng là C. Chiếc của để khoét lỗ ở phía trái có thể được dùng tới sau khi chiếc khoan gỗ được dùng để khoan một lỗ đủ luồn chiếc của vào.

Điểm số của bạn là số các câu ghi trúng trừ đi một phần số các câu ghi sai. Vì vậy, đoán mò không có lợi trừ khi bạn có thể loại bỏ một hay nhiều câu trả lời sai.

Bạn có 5 phút để làm mỗi phần. Bài trắc nghiệm có hai phần, mỗi phần gồm 2 trang. Khi xong phần 1, hãy ngừng lại, và dùng tiếp qua phần 2 nếu chưa được yêu cầu.

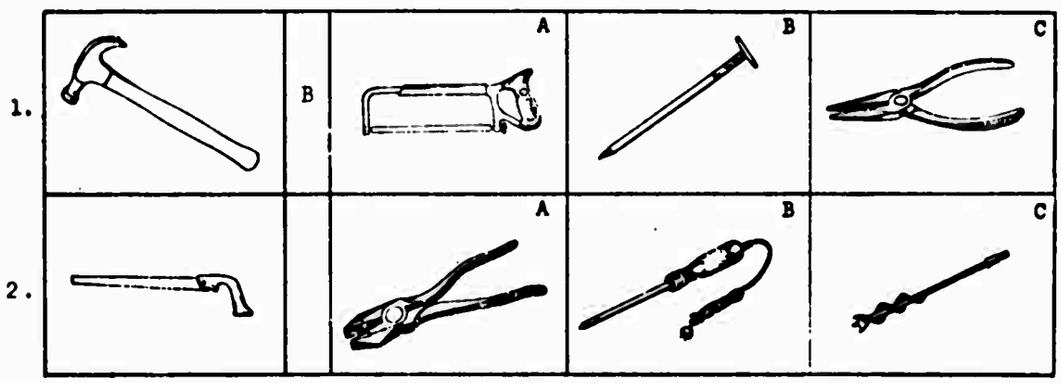
ĐỪNG LẬT QUA TRANG TRƯỚC KHI ĐƯỢC YÊU CẦU

Name _____

TOOL KNOWLEDGE TEST -- Mk-1

This is a test of what you know about tools and their uses. Each problem in the test consists of a row of pictures. There is a picture at the left of the double lines, and there are three pictures on the right of the double lines. The pictures on the right are lettered A, B, and C. You are to decide which piece of equipment shown in the pictures on the right is most commonly used with the piece of equipment pictured at the left. Indicate your answer by writing the letter of the correct picture between the double lines.

Now try the examples below. Example 1 has been correctly answered for you.



In example 1, B is the answer because the hammer at the left is used to hammer nails. In example 2, the right answer is C. The keyhole saw at the left can be used after a wood bit is used to make a hole in which the saw may start its cut.

Your score on this test will be the number marked correctly minus a fraction of the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you are able to eliminate one or more of the answer choices as wrong.

You will have five minutes for each of the two parts of this test. Each part has two pages. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

DO NOT TURN THIS PAGE UNTIL YOU ARE ASKED TO DO SO.

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APPENDIX B

A NOTE ON PHYSICAL STRENGTH

A NOTE ON PHYSICAL STRENGTH

Obvious culture-related characteristics of Vietnamese are physical size and appearance: By Western standards most Vietnamese are of short stature and slight build. In terms of Vietnamization these are important facts because equipment that is transferred to the VNAF must fit the men who are to operate it.

Equally important, but not obvious on inspection, are physical strength and endurance. Not only must items of hardware fit the bodies of operators, but physical strength demands cannot exceed the limitations of those men. We have heard anecdotal evidence of air crashes brought about by VNAF pilots who were not strong enough to pull back control columns.

While data exist on body dimensions of Vietnamese and other groups, very little is known about distributions of physical strength. We took the opportunity afforded during the psychometric testing, which makes up the main part of this report, to obtain some very rudimentary measures of static strength. A simple hand dynamometer was used to get two strength-of-grip readings on each of 82 VNAF airmen. As a control, we made similar measures on a group of 18 U.S. Army technicians. The results are shown in Table B-1.

While it is not possible to extrapolate directly from these figures to performance, we think even this small amount of data is worth consideration. First, it is the case that there is a quantitative difference between Western and Vietnamese subjects in the expected direction. The 75 percentiles of both American groups exceeded all but the top 25 percentile of the VNAF subjects. Second, we recommend much more data collection on other indicators of dynamic strength of

Vietnamese military men. At the same time there should be an anthropometric survey of representative equipment in the Vietnamization inventory to identify possible mismatches in both the body size and strength domains. We have been told, for example, that tail-rotor surfaces for the CH-47 helicopter are particularly inaccessible to men of average or short stature. If this were verified, then special ladders or platforms would have to be provided for VNAF technicians.

TABLE B-1. STRENGTH OF GRIP HAND DYNAMOMETER SCORES (kilos)[a]

	VNAF Airmen	U.S. Army Technicians	18-Year-Old Students[b]
25 Percentile	36[a]	45	46
Median	39	49	52
75 Percentile	43	53	57

[a] To convert to pounds, multiply by 2.2.

[b] From Fleishman's Structure and Measurement of Physical Fitness.

We also have ample anecdotal evidence that heavy construction equipment can be operated by Vietnamese, but that they have to stand in order to see over the front of the vehicles. Here is another instance calling for field modification in the form of special seating or control extensions.

In summary, we feel that assumptions about physical strength of Vietnamese have to be based on data. To be most useful, such data should be obtained on live subjects working on representative tasks with real equipment.

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13. ABSTRACT

Complex equipment cannot be used and maintained effectively without the ability to understand technical manuals. In addition to textual material, such manuals contain information in graphic form: line drawings, photographs, and engineering diagrams.

In the context of transferring American military equipment to the Armed Forces of the Republic of Vietnam, certain abilities related to interpreting technical graphic material were investigated. A sample of 82 Vietnamese Air Force technicians served as subjects in several experiments. It was shown that the men performed less effectively than American controls in several measures of spatial aptitude, i.e., the ability to comprehend graphic conventions.

Recommendations include the development of special training methods to overcome deficiencies in interpreting technical illustrations.

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