THE RELATION OF EXPERIMENTAL TESTS OF REASONING AND CREATIVE THINKING TO RESEARCH PERFORMANCE

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Studies of Aptitudes of High-Level Personnel

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In studies of abilities considered to be important to the success of high-level personnel, several types of intellectual activities are being explored: reasoning, creative thinking, evaluation, and planning. The general objectives of the project[2] have been to isolate and define various abilities underlying performance in each of these domains by means of factor-analysis techniques and to relate these abilities to appropriate aspects of performance of certain types of high-level personnel. While major emphasis has been directed toward psychological determination of intellectual abilities, the scope of the project investigations includes practical validation of experimental tests. Studies of industrial personnel afford one approach to practical validation when adequate criteria of performance can be obtained.

PURPOSE AND PLAN

The purpose of the investigation was to obtain from an industrial source evidence which would supplement the findings of factor-analytic studies. Interest in learning more about the abilities believed to be measured by the tests and in determining which abilities might be important in certain research jobs prompted the investigation. The study was undertaken in cooperation with a large chemical manufacturer that requested anonymity.

The general plan of the investigation was to analyze the relationships between performance on experimental tests of reasoning and creative thinking and ratings of observable reasoning and creative-thinking behavior. Specifically, the plan called for (1) the development of a rating scale describing certain reasoning and creative-thinking traits, (2) obtaining supervisors' ratings of scientists on each of the traits, and (3) relating performance on the experimental tests to ratings on the various abilities.

It was expected that there would be some correspondence between respective tests of primary abilities and ratings of those abilities. Also, it was expected that tests representing abilities would relate positively to different degrees to the "overall" ratings and rankings of creative thinking of individuals.

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[1] E. M. Glaser of Edward Glaser & Associates, was instrumental in initiating the investigation. We wish to thank D. E. Pye and David Martin for their cooperation in the planning and conduct of the study. H. L. Coderre, of Rohrer, Hibler and Replogle, kindly consented to rank the examinees.

[2] Contract N6onr-23810, Project NR 150-044, with the Office of Naval Research.

PROCEDURE

Experimental Materials

The Rating Scale

The broad principles of the rating scale were devised in conference among two company executives, an industrial psychologist retained by the company, and project personnel. Creative-thinking and reasoning abilities were discussed in their relation to observable performance of employees. In this conference, eight creative-thinking and reasoning abilities were selected and an overall-effectiveness-to-the-company trait was included. The final rating scale comprising nine traits developed by the project was of graphic form describing the abilities in nontechnical language (See Appendix A).

The Tests

Thirteen tests were included in the test battery. Table 1 shows the ability each test was believed to measure. Included is the trait name given to the ability for rating purposes. Ten of the tests are experimental, having been used only in previous factor analyses. Three of the tests are available commercially. Spatial Visualization was included to account for spatial-visualization variance; Verbal Comprehension was included to account for verbal-comprehension variance. The Watson-Glaser Critical Thinking Appraisal was included because of interest in its relation to the ratings.

The Subjects

The subjects made available for the study were research personnel. The research conducted by the company is primarily chemical research and the employees are largely chemists and chemical engineers. However, biologists, physicists, and other scientists were also employed and were included among the subjects. The group was considered to exemplify a creative industrial group in that their routine duties require solving problems, thinking up new processes of manufacture, and devising new products and methods. The possibility for observing creative activity should be very favorable among such a group.

Operations

Ratings

Ratings of examinees were made prior to the test administration. A project representative discussed each trait with the supervisors and pointed out some of the errors commonly made by raters. The supervisors made their ratings without any apparent difficulty.

TABLE 1

TRAITS, ABILITIES, AND TESTS

Trait	Ability	Test
A. Quantity of ideas	Ideational fluency Associational fluency	[a]1. Plot Titles (low quality) 2. Controlled Associations
B. Quality of ideas	Originality	[a]3. Plot Titles (cleverness)
C. Evaluation of ideas	Logical reasoning	4. Logical Reasoning
D. Adaptive flexibility	Adaptive flexibility	5. Match Problems
E. Versatility of ideas	Spontaneous flexibility	6. Unusual Uses
F. Sensitivity to problems	Sensitivity to problems	7. Apparatus Test
G. Analysis of problems	General reasoning Eduction of conceptual relations	8. Ship Destination 9. Verbal Analogies I
H. Improvising	Redefinition Eduction of correlates	10. Gestalt Transformation 11. Correlate Completion
I. Overall effectiveness		
Reference	Spatial visualization Verbal comprehension	12. Spatial Visualization 13. Verbal Comprehension 14. Watson-Glaser Critical Thinking Appraisal

[a]Although only 13 tests were included in the test battery, Plot Titles is scored for two abilities.

Test Administration

Testing was conducted in three four-hour sessions during one day and the following afternoon. Each test group numbered approximately 20; altogether 64 examinees were tested. Before each test administration, the general nature of the investigation was explained to the group and the examinees were told that they would be informed of their scores. A biographical data blank was completed by each examinee during the test administration (see Appendix B).

RESULTS

Description of the Sample

Table 2 describes the sample according to age, sex, length of employment and other characteristics. It will be noticed that the sample is much above the average in education. All of the group were high school graduates; only three people did not have a bachelor's degree and 31 of the group of 64 had attended graduate school. Twelve doctor's and 11 master's degrees were held by the group. The group was relatively young, and the majority of the sample had worked for the company less than three years.

Obtained Data

Ratings

Thirteen supervisors rated the examinees. However, every rater did not rate every examinee. Most of the raters were examinees who rated only those examinees they knew well enough to rate, not including themselves. Few examinees were rated in common by even three or four raters, and many were rated by only one.

Although every examinee had been rated, it was necessary to select only those cases in which certain statistical requirements could be met. For example, it was felt desirable to equate all of the ratings to a common mean and standard deviation. A standard deviation computed on a small N is likely to be unreliable; consequently, the ratings of raters who had rated only a few examinees were omitted. Five raters had rated between 13 and 21 examinees each, or a total of 53 examinees. This sample of 53 was considered for further study, and the ratings of four of the raters were adjusted to the mean and standard deviation of the fifth rater who had rated 21 examinees.

Reliabilities

Reliabilities of ratings could not be computed in the regular manner because the examinees were not rated in common, uniformly, by the five raters.

TABLE 2

DESCRIPTION OF THE SAMPLE (N = 64)

I. Sex:

	f
Male	55
Female	9
Total =	64

II. Age:

Years	f
48.0 - 51.9	1
44.0 - 47.9	5
40.0 - 43.9	4
36.0 - 39.9	9
32.0 - 35.9	9
28.0 - 31.9	17
24.0 - 27.9	11
20.0 - 23.9	8
Total =	64

III. Major Fields:

	f
Bio. Science	1
Botany	1
Chem. Engng	17
Chemistry	37
Electr. Engng	1
Entomology	1
Metallurgy	1
Nuclear Chem.	1
Physical Chem.	8
Physical Science	1
Physics	1
Plant Pathology	1
Total =	71[a]

IV. Education:

A. College

Years	f
3.1 - 4.0	63
2.1 - 3.0	0
1.1 - 2.0	1
0.1 - 1.0	0
Total =	64

B. Graduate School

2.1 - 3.0	13
1.1 - 2.0	7
0.1 - 1.0	11
Total =	31

C. Highest degree attained:

B.A.	12
B.S.	27
M.A.	1
M.S.	10
Ph.D.	12
None	2
Total =	64

V. Length of employment at company:

Years	f
18.0 - 19.9	2
16.0 - 17.9	2
14.0 - 15.9	1
12.0 - 13.9	5
10.0 - 11.9	5
8.0 - 9.9	1
6.0 - 7.9	6
4.0 - 5.9	7
2.0 - 3.9	11
0.0 - 1.9	24
Total =	64

[a]Some examinees reported more than one major field.

To estimate the reliability of ratings, an analysis-of-variance procedure was used. The within-variance was divided by the total variance, and the quotient was subtracted from one. However, the reliabilities computed in this way are estimates of individual-rating reliabilities. As each examinee was, on the average, rated by two and one-half raters, an estimate of the reliability of the composite rating was computed using a correction factor of 2.5 in the Spearman-Brown formula. Table 3 shows both the individual-rating reliabilities and the composite-rating reliabilities. Ratings for trait D, adaptive flexibility, have the lowest reliability, and for trait I, overall effectiveness, the highest.

Intercorrelations

Table 4 shows the correlation based on average ratings of every trait with every other trait. Trait D, adaptive flexibility, has the lowest average intercorrelation with the remaining traits, and trait I, overall effectiveness, has the highest average intercorrelation. The correlation of trait I with the other traits is spurious to the extent that the description of this trait, "...this trait is made up of all the previous traits, but in addition..." effected overlap.

Tests

Scoring. The tests were scored by hand and accuracy of scoring was checked. In one test administration, only 35 minutes was allowed for the Watson-Glaser Critical Thinking Appraisal instead of the customary 45-50 minutes. As the test is composed of five untimed subtests, it was decided to use only the scores on subtests completed by every examinee. The first two subtests, Inferences and Assumptions, were completed by everyone, and these two were included for further study.

Reliabilities. Reliabilities, based on the sample of 64, were computed for all tests. Odd-even or alternate-form estimates were obtained and corrected for length. The reliabilities are shown in Table 5.

Relationships

In determining the relationships between tests and ratings, two procedures could be followed. By one method, ratings would be averaged and then correlations between average ratings and test scores would be computed. In the second method, correlations would be computed for individual raters and then their individual trait-test correlations averaged. The first method would require computing 135 correlations (9 traits x 15 tests). The second method would require computation of 675 correlations (9 traits x 15 tests x 5 raters).

Correlations between Tests and Averaged Ratings

In the interests of economy, it was decided to compute correlations between test scores and averaged ratings for the sample of 53. These correlations are shown in Table 6. Seventeen of the correlations are significant at the five per cent level of probability and three are statistically significant at the one per cent level.

TABLE 3

ESTIMATES OF RATED-TRAIT RELIABILITIES

Traits	1-W/T[a]	Corrected[b]
A. Quantity of ideas	.40	.62
B. Quality of ideas	.43	.65
C. Evaluation of ideas	.26	.47
D. Adaptive flexibility	.31	.53
E. Versatility of ideas	.37	.59
F. Sensitivity to problems	.42	.64
G. Analysis of problems	.42	.64
H. Improvising	.47	.69
I. Overall effectiveness	.68	.84

[a] $1 - \frac{\text{within variance}}{\text{total variance}}$

[b] Corrected by 2.5 with Spearman-Brown formula

TABLE 4

INTERCORRELATION OF RATED TRAITS

	A	B	C	D	E	F	G	H	I
A. Quantity of ideas									
B. Quality of ideas	.71								
C. Evaluation of ideas	.60	.83							
D. Adaptive flexibility	.76	.62	.59						
E. Versatility of ideas	.87	.71	.69	.73					
F. Sensitivity to problems	.81	.78	.79	.67	.79				
G. Analysis of problems	.65	.82	.89	.65	.69	.78			
H. Improvising	.69	.72	.74	.64	.75	.72	.80		
I. Overall effectiveness	.72	.86	.89	.66	.78	.84	.88	.80	
M_r	.73	.76	.75	.66	.75	.77	.77	.73	.80

TABLE 5

RELIABILITIES OF TESTS

Tests	Reliabilities	Est.[a]
Plot Titles (low quality)	.83	AF
Controlled Associations	.86	OE
Plot Titles (Cleverness)	.73	AF
Logical Reasoning	.77	AF
Match Problems	.70	AF
Unusual Uses	.66	AF
Apparatus Test	.78	AF
Ship Destination	.84	OE
Verbal Analogies I	.45	AF
Gestalt Transformation	.29	AF
Correlate Completion	.70	OE
Spatial Visualization	.96	OE
Verbal Comprehension	.91	OE
Watson-Glaser Inferences	.41	OE
Watson-Glaser Assumptions	.80	OE

[a]AF = alternate-form reliabilities;
OE = odd-even reliabilities.
All estimates are corrected for length.

TABLE 6

CORRELATIONS BETWEEN TESTS AND AVERAGED RATINGS

Test	Ratings								
	Qn	Ql	Ev	Af	Vs	Sn	An	Im	Cm[a]
Plot Titles (low quality)	.00	-.02	.08	.04	.06	.08	.07	.25	.11
Controlled Association	.21	.20	.24	.40*	.20	.28*	.28*	.28*	.32*
Plot Titles (cleverness)	.20	.04	.15	.11	.21	.13	.18	.16	.13
Logical Reasoning	-.01	.06	.08	.12	-.15	-.13	.07	.21	-.02
Match Problems	.23	.28*	.20	.23	.09	.31*	.16	.08	.21
Unusual Uses	.13	.09	.12	.32*	.28*	.18	.05	.12	.22
Apparatus Test	.07	-.01	.19	.17	.13	.13	.12	.08	.16
Ship Destination	.29*	.30*	.25	.27	.17	.24	.22	.17	.26
Verbal Analogies I	.17	.22	.31*	.28*	-.05	.20	.26	.10	.26
Gestalt Transformation	.26	.16	.17	.30*	.24	.17	.02	.24	.20
Correlate Completion	.05	.16	.17	.16	-.02	.07	.11	-.16	.19
Spatial Visualization	.16	.24	.20	.24	.07	.11	.22	.02	.19
Verbal Comprehension	.20	.28*	.47*	.22	.18	.28*	.31*	.34*	.35*
Watson-Glaser Inferences	.06	.13	.05	.07	.04	.02	.05	.07	.03
Watson-Glaser Assumptions	.01	-.04	.11	.08	-.02	-.16	.17	-.03	.03

*For 50 df's: r = .273 is significant at 5% level.
r = .354 is significant at 1% level.

[a]Abbreviations are as follows:

Qn = Quantity
Ql = Quality
Ev = Evaluation
Af = Adaptive flexibility
Vs = Versatility
Sn = Sensitivity
An = Analysis
Im = Improvising
Cm = Composite

Verbal Comprehension had significant correlations with six of the nine traits, two correlations being significant beyond the one per cent level. Controlled Associations had five significant correlations with the traits. Match Problems, Unusual Uses, Verbal Analogies I, and Ship Destination each had two significant correlations with the traits. Gestalt Transformation had one significant correlation. Eight tests had no significant correlations with the traits.

Examining the relationships from the standpoint of the traits, it will be noticed that every trait has at least one significant correlation with a test. Trait D, adaptive flexibility, has significant correlations with four tests. Trait F, sensitivity to problems, and trait B, quality of ideas, each has three significant correlations with tests. The remaining traits have one or two significant correlations with the tests.

These results yield little information concerning the factorial nature of the tests, although the indications are that the most verbally fluent person is the person most apt to obtain high ratings on the traits.

Average Correlations Between Tests and Individual Ratings

Averaging ratings before computing correlations between tests and traits may have obscured individual differences among raters. In order to examine this possibility, correlations were computed between individual-rater ratings and test scores for selected tests. Table 7 shows these correlations and also averages of them.

The results from this phase of the investigation shows that each rater was rating largely on the basis of one or two traits. Evidence that these traits were not the same for all raters is found in Table 7 in which a certain test tends to correlate substantially with all the traits for a particular rater but correlates low with the traits for a different rater. For example, one rater appeared to be rating primarily on a logical reasoning ability, a second apparently rated on the basis of originality, and a third on the basis of the redefinition ability.

Combining the positive and negative individual rater correlations tended to produce an average correlation that was statistically insignificant. It seems evident that little confidence can be placed in the ratings as criteria for determining what the tests are measuring.

Correlations Between Rank Order and Tests

Three supervisors and an industrial psychologist were asked to rank the employees they knew well enough to rank on a continuum of creativity. That is, the employees were placed in rank order from the most creative to the least creative. Product-moment correlations were computed between these rankings and test scores.

TABLE 7

INDIVIDUAL-RATER CORRELATIONS

Logical Reasoning

Trait	T	U	V	Y	Z[a]	Average[b]
A	-.17	-.20	.14	-.23	.40	.12
B	-.27	.07	.18	-.31	.63	.08
C	-.33	-.19	.30	-.05	.52	.06
D	-.12	.14	.52	-.31	.75	.25
E	-.17	-.27	.13	-.43	.18	-.12
F	-.32	-.25	.26	-.36	.35	-.07
G	-.40	-.16	.35	-.27	.73	.09
H	-.31	.17	.28	-.15	.58	.13
I	-.29	-.22	.28	-.36	.52	-.06
M_r	-.26	-.09	.27	-.26	.54	.07

Gestalt Transformation

A	.16	.07	.18	.56	.23	.24
B	.03	.14	.28	.20	-.01	.13
C	.05	.32	.21	.09	.15	.17
D	.19	.28	.51	.57	.13	.35
E	.12	.14	.44	.09	.17	.20
F	-.28	.32	.56	.41	-.13	.20
G	-.03	.34	.47	.27	.09	.25
H	.00	.19	.41	.38	-.14	.18
I	-.13	.31	.39	.33	.13	.21
M_r	.01	.24	.39	.34	.07	.22

Plot Titles (cleverness)

A	.44	.29	.33	-.09	.42	.30
B	.46	.00	.12	-.04	.09	.10
C	.44	.18	.08	-.05	.21	.29
D	.50	.12	.24	-.32	.25	.17
E	.55	.20	.22	-.02	.45	.32
F	.33	.20	.13	-.19	.18	.13
G	.33	.18	.05	-.02	.03	.12
H	.44	.32	-.23	.88	-.02	.27
I	.29	.20	.19	.26	.17	.23
M_r	.42	.19	.13	-.02	.19	.22

[a]Rater T had an N of 21; rater U, 14; V, 14; Y, 21; Z, 17.

[b]Correlations were converted into corresponding Fisher's z coefficient before averaging.

Table 8 shows the correlations for each ranker. Again it is apparent that there is some variation between rankers, although the correlations of two of the supervisors most actively associated with the examinees were in substantial agreement. Averages of these two supervisor's (Y and Z) rankings are also shown in Table 8. Four of the average correlations approach statistical significant and represent relationships between rankings and general reasoning, eduction of correlates, originality, and sensitivity to problems. The tests for these abilities are, respectively, Ship Destination, Correlate Completion, Plot Titles (cleverness) and Apparatus Test.

It will be noticed that these results do not substantiate the results obtained with averaged ratings in which verbal facility appeared to be related to ratings of performance.

CONCLUSIONS AND RECOMMENDATIONS

1. Ratings could not be used as unique indicators of the factors since their intercorrelations were much too high relative to their reliabilities. It was therefore impossible to validate the factor measures against ratings as criteria.

2. A number of significant validity coefficients were found between tests and average ratings, but these were low and not substantiated by evidence from correlations between tests and rankings.

3. When individual rater's ratings were correlated with tests it appeared that each rater tended to emphasize one or two of the factors measured by the tests, regardless of what trait he was rating. Each rater seemed to emphasize a different factor or factors. Thus, averaging ratings tends to obscure the meaning of the validity coefficients obtained.

4. Rankings of the examinees for creativity were significantly (but not very significantly) correlated with two creative-thinking and two reasoning tests. None of these four correlations were significant when average ratings were used as criteria.

5. On the basis of these inconclusive results, we cannot recommend any of these tests for predicting performance of research personnel.

6. It is recommended in future research of this kind that considerably more time and attention be paid to obtaining analytical evaluations of research performance.

TABLE 8

CORRELATIONS BETWEEN RANK ORDER AND TEST SCORES

Tests	Rankers W	X	Y	Z	Averages[a]
Plot Titles (low quality)	-.13	-.08	-.06	.02	-.02
Controlled Associations	.25	.19	.39	.05	.23
Plot Titles (cleverness)	.15	.13	.31	.32	.32
Logical Reasoning	.23	-.13	.12	.43	.28
Match Problems	.36	.09	.22	.28	.26
Unusual Uses	.15	.15	.34	.26	.28
Apparatus Test	.03	.11	.33	.43	.38
Ship Destination	.28	.05	.28	.37	.33
Verbal Analogies I	.15	-.06	.07	.12	.10
Gestalt Transformation	.11	.36	.10	-.04	.03
Correlate Completion	.25	.-33	.38	.27	.33
Spatial Visualization	.22	-.03	.11	.18	.14
Verbal Comprehension	.07	.18	.11	.00	.06
Watson-Glaser Inferences	.10	-.15	-.33	-.06	-.20
Watson-Glaser Assumptions	.00	-.10	-.15	-.04	-.10

[a]Average correlations for Y and Z. Correlations were converted to corresponding Fisher's z coefficients before averaging.

	Correlations Between Rankers W	X	Y	Z
W		.25	.23	.23
X			.41*	.41*
Y				.44*
Z				

*Based on 12 examinees ranked in common; others based on 22 ranked in common.

APPENDIX A

INSTRUCTIONS TO RATERS

Name of Rater _____

In connection with a research investigation in which Company X is participating, you are asked to give your opinions on several different traits of men who work under your supervision, either directly or indirectly. On the succeeding pages each trait will be described; for each person you know well enough to rate you will be asked to place a mark on the line that, in your opinion, best describes him.

Your rating will be most helpful if you will follow these rules when making your ratings.

1. Consider each trait separately.
2. Consider each man's relative position among all research personnel you have known.
3. Avoid giving ties.

Rate the entire group on one trait before proceeding to the next trait. It should be emphasized that a person is likely to be high on some of the traits and low on others. It is not likely that an individual will be high on all of the traits or low on all of them, although this is possible.

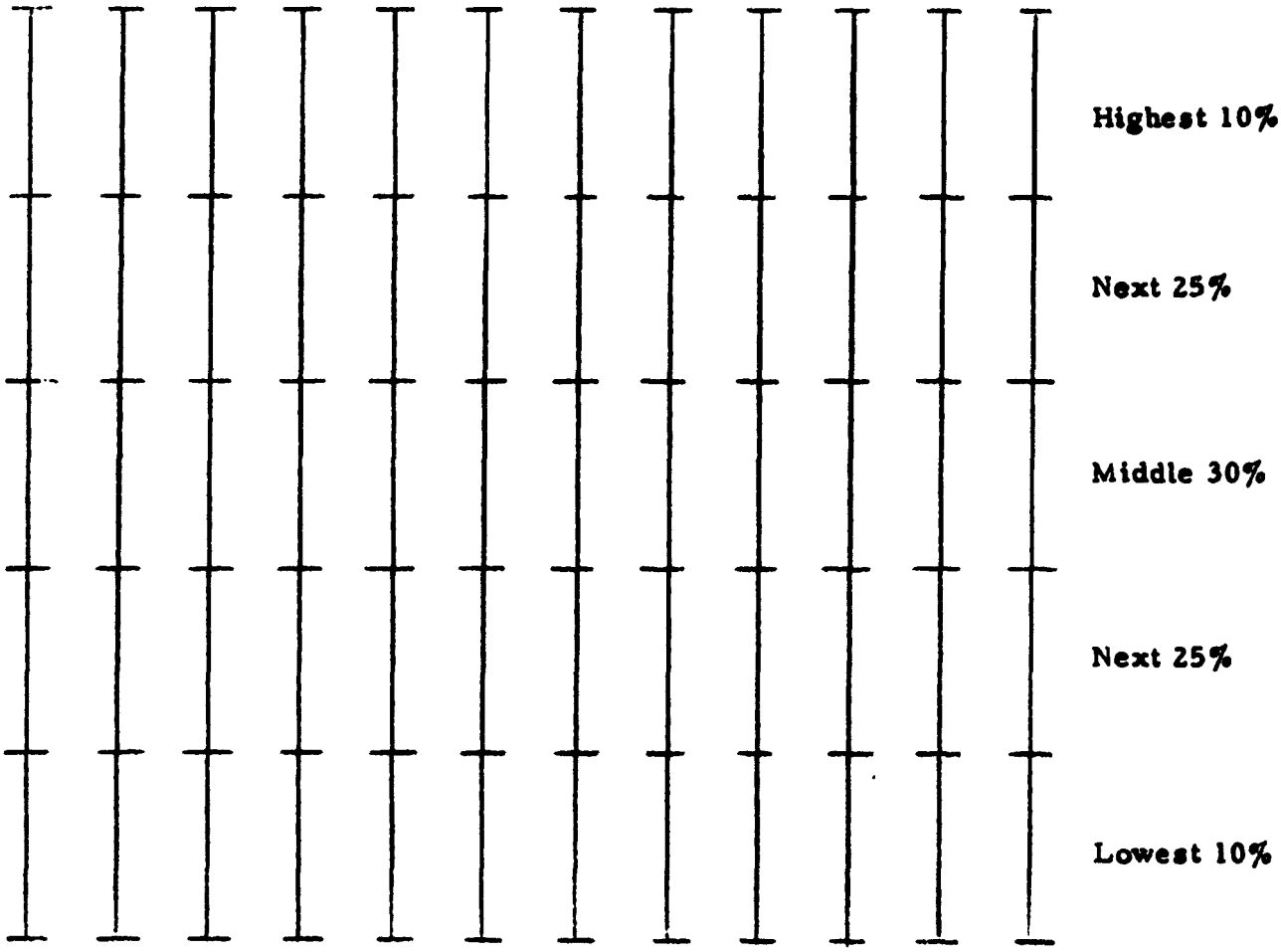
Concerning the second point, it should be noted that these ratings are relative to all similar research personnel you have known. The individual's standing in comparison to the research personnel you have known should determine his position on this scale. For example, does the person being rated compare favorably with the highest 10%, is he just average, or, as the case may be, is he, in your opinion, in one of the low categories. Unless you happen to be rating a group that is uniformly good or poor, some of the people will be high and some will be low on each of the traits. The percentages along the side of the lines indicate the approximate distribution of ratings for a typical group. For example, approximately 10% will be in the highest category and 10% will be in the lowest. Twenty-five per cent will be in the second highest and in the next to the lowest categories. Thirty per cent of such a group will be in the middle category.

Finally, avoid rating two people at exactly the same level if possible. Within a category, a mark can be placed at the upper or lower end or at any other points to indicate the person's position in the category. For example, if the person has been judged to be in the highest 10% of the group he may be placed at the top of this category, in the middle portion of it, or at the lower end. An illustrative example of the rating procedure is on the next page.

These ratings will in no way affect the standing of any employee. They are for experimental purposes only. Company X will receive an analysis of the investigation but no individual will be identified with a rating or test score.

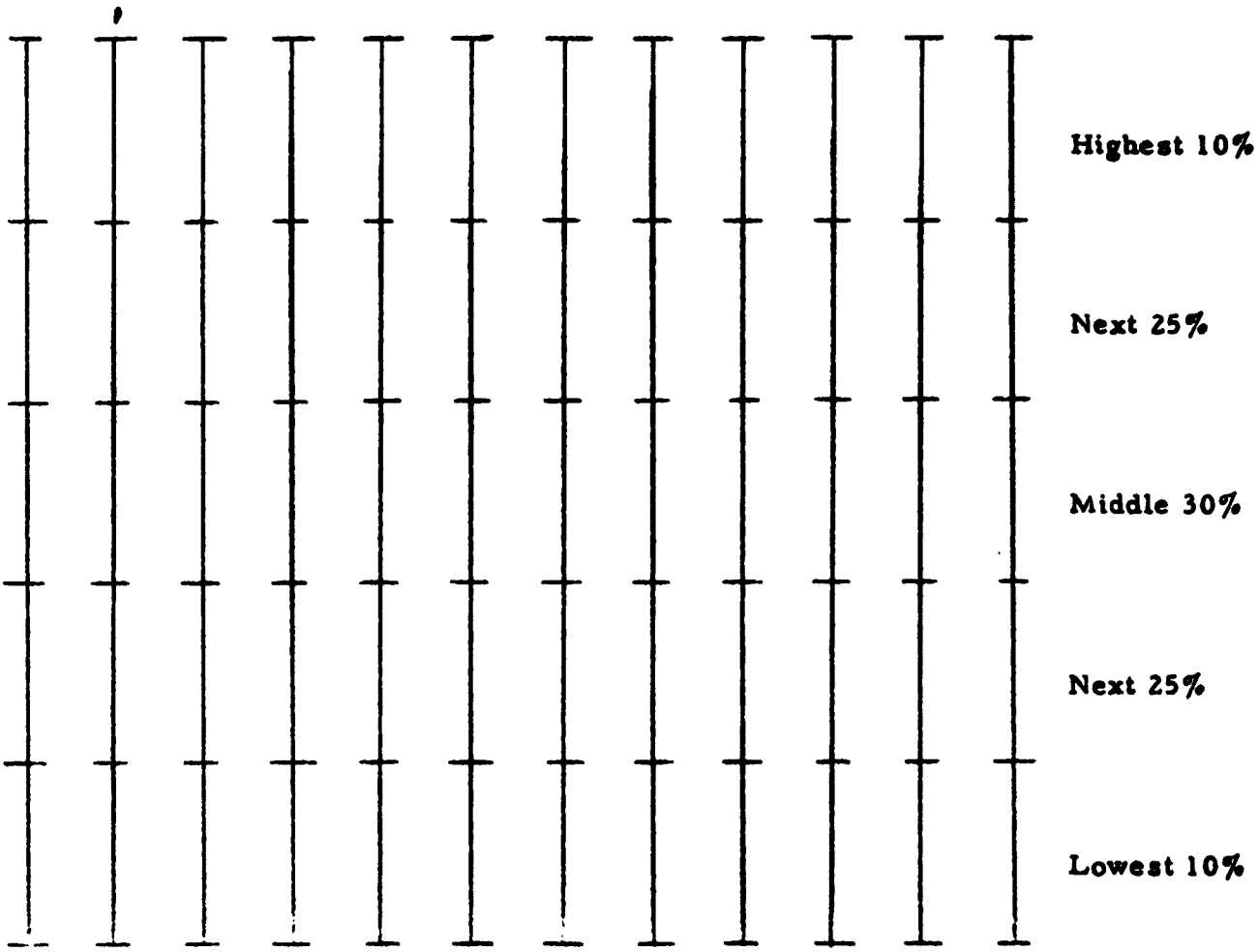
Trait A: <u>Quantity of ideas</u>

Definition: When this person is faced with a question or problem he immediately has a lot of ideas about it. It does not matter for this trait whether the ideas are any good or not. It is the number of ideas per unit of time that counts.



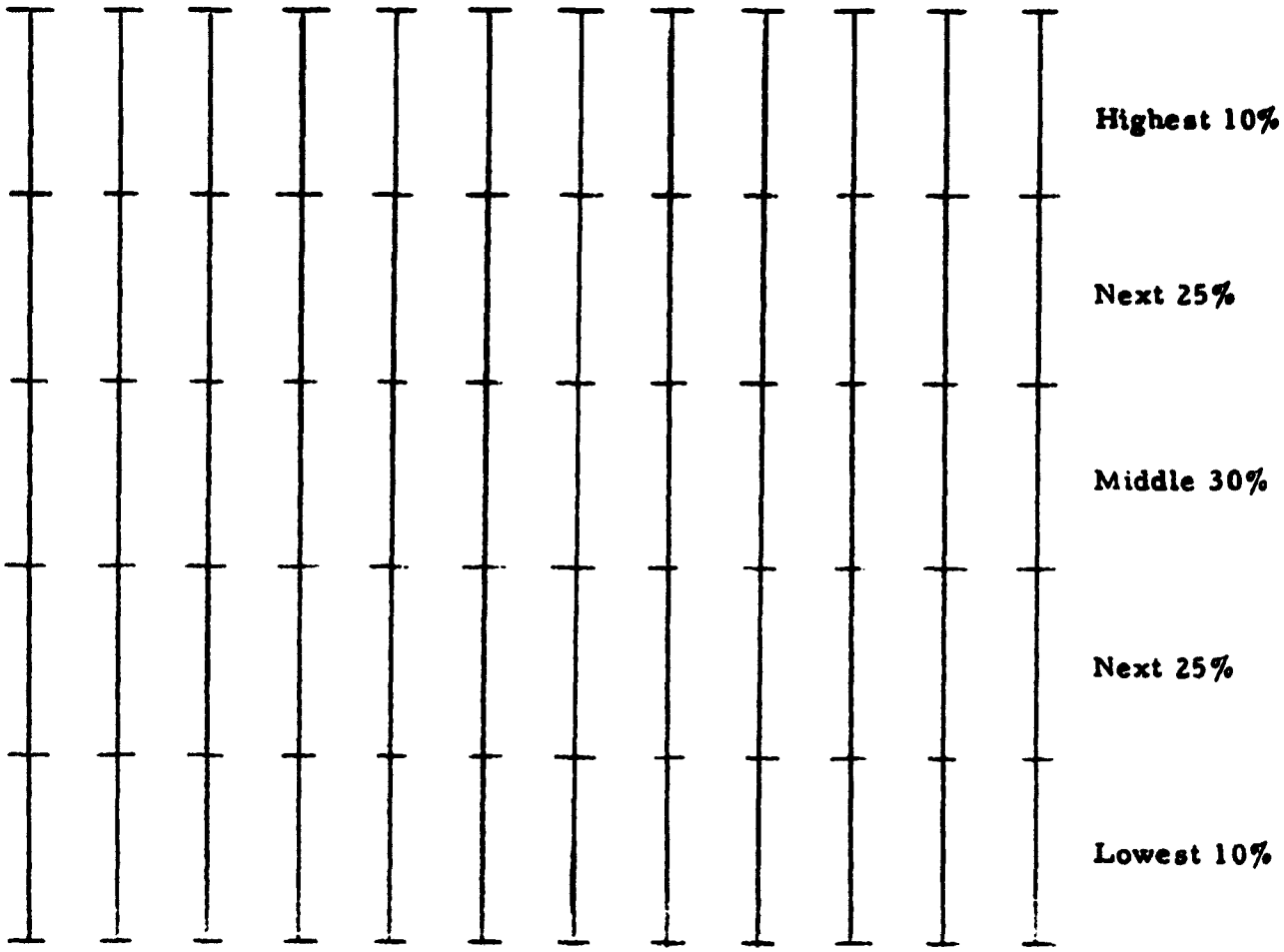
Trait B: Quality of ideas

Definition: This person usually has very good ideas to offer. He has often made suggestions of real value to the company and many of his ideas have proven to be major contributions. When approached for a suggestion or idea for solving a problem, this person can usually come up with a good one.



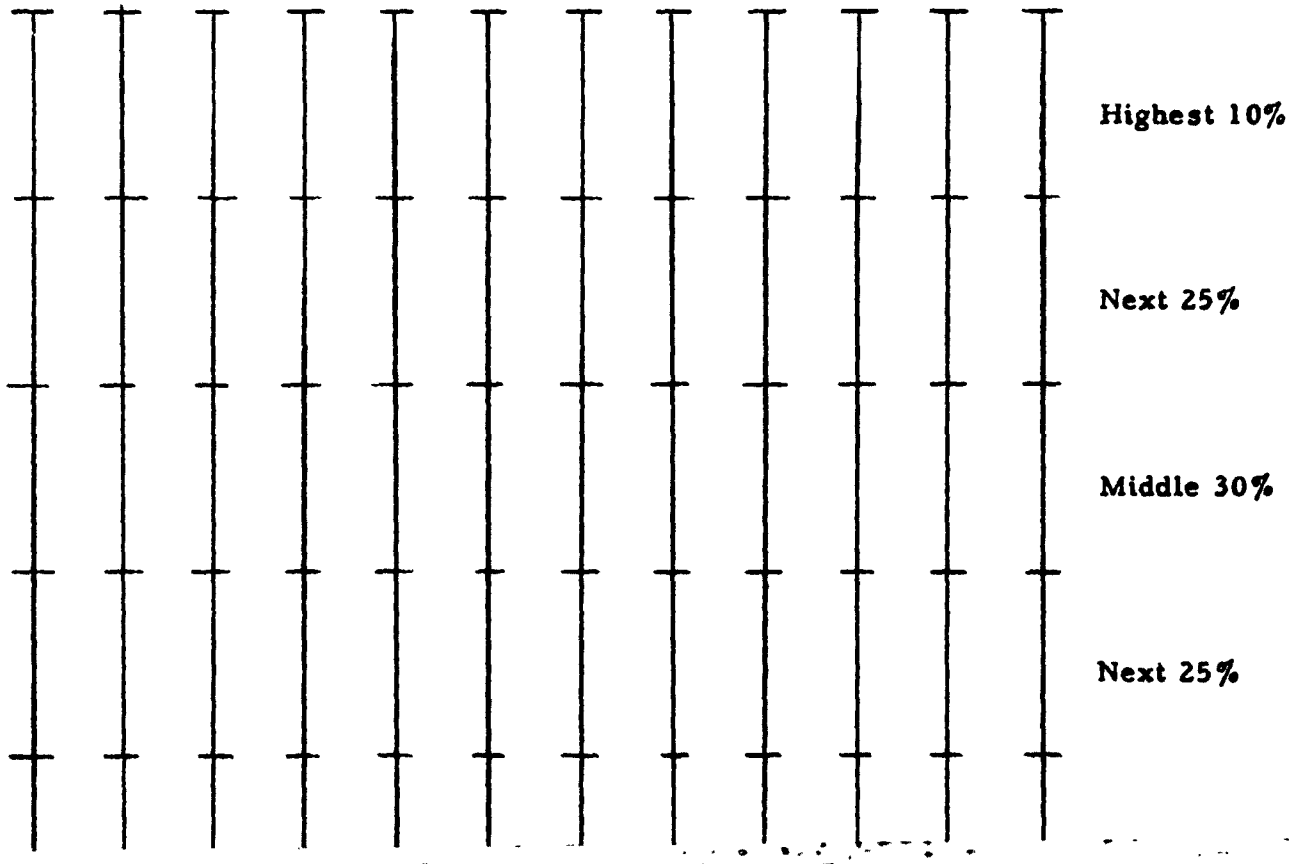
Trait C: Evaluation of ideas

Definition: This person is able to judge the value of his ideas rather accurately. He does not suggest things which on close examination prove to be hasty opinions or ill-considered suggestions. Not all of his ideas are necessarily good ones, but, on the other hand, they are usually carefully judged. He has shown ability, not only to evaluate his own ideas, but also to judge the worth of other people's ideas.



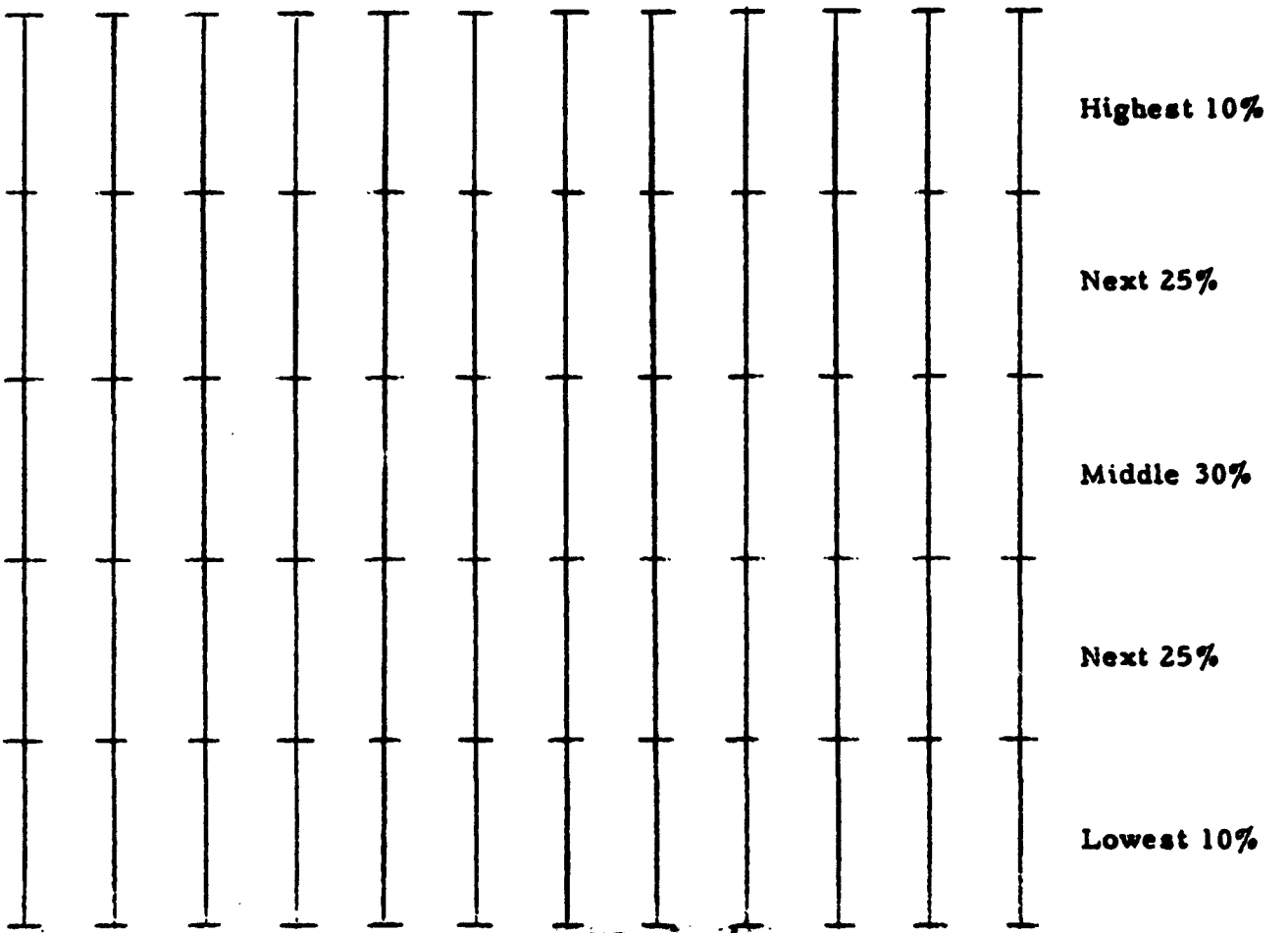
Trait D: Adaptive flexibility

Definition: This person can adapt his work to meet changing conditions; he is very open to new ideas. If a method or technique he is using fails to bring about the desired result, he is able to take a new approach in an attempt to obtain a solution. He does not unfruitfully pursue the same approach of a problem over long periods of time. In a situation where achieving a very new mental outlook is required before the solution to the problem is seen, this person is more likely than the average person to achieve this outlook.



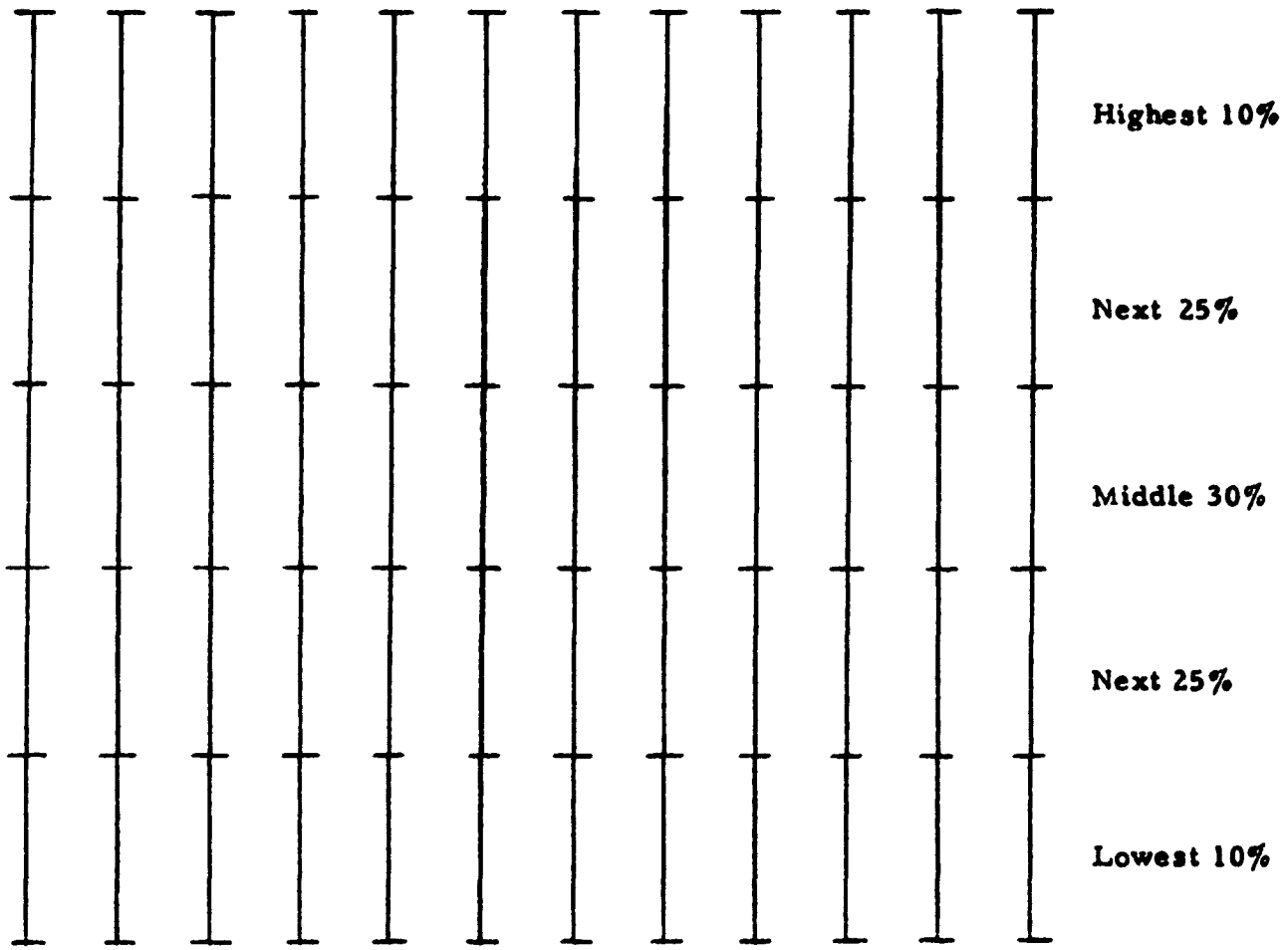
Trait E: <u>Versatility of ideas</u>

Definition: This person has many highly diversified interests and can offer helpful suggestions and ideas on a number of different subjects. He can suggest solutions to problems outside the field of his specialization. He has useful knowledge on a number of seemingly unrelated topics and could work effectively in any one of several different fields. He is not narrowly specialized in his interests and thinking, nor does he become "lost" when he gets outside of his field.



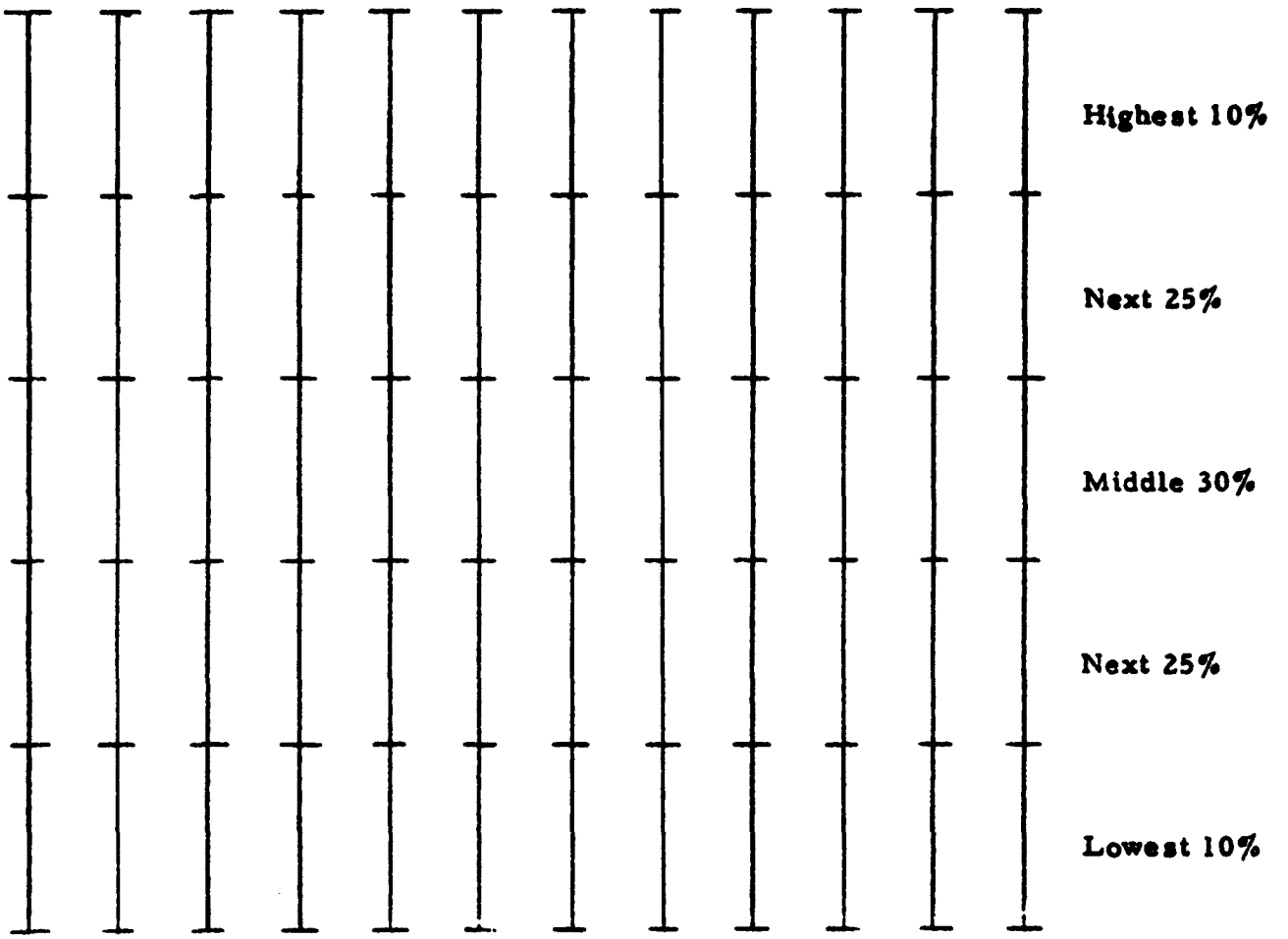
Trait F: <u>Sensitivity to problems</u>

Definition: This person is able to point out the existence of problems, either theoretical or practical, that would ordinarily go unnoticed. He has often shown the significance of a factor overlooked or dismissed as trivial by others. He is aware of needs for changes or for new devices and has seen defects or deficiencies in things as they exist. He may or may not suggest improvements for the problems he has pointed out. The important thing in this trait is the ability to recognize that a problem exists, whether corrective action is suggested or not.



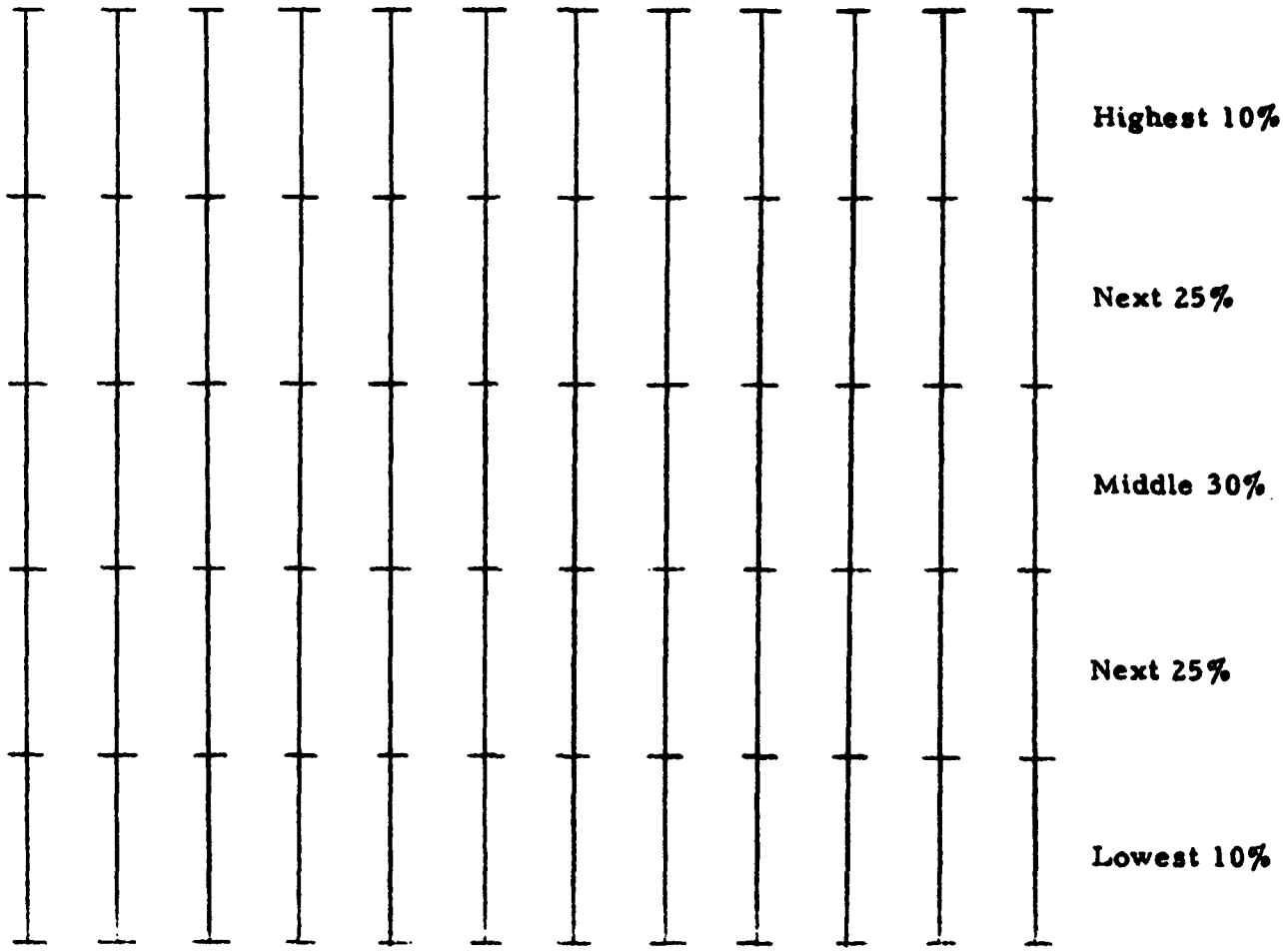
Trait G: Analysis of problems

Definition: This person is able to reduce a problem successfully into its fundamental components. He can separate the more basic factors from the irrelevant or less fundamental ones. He is able to formulate clearly the problem at hand by stating what the important features are. When faced with a complex mass of data, this person is usually able to formulate the problem clearly and simply. The person who is low on this trait cannot see the relationships between different factors of a problem. He is unable to distinguish between the more important and the less important. He frequently "misses the point" in his explanations of problems.



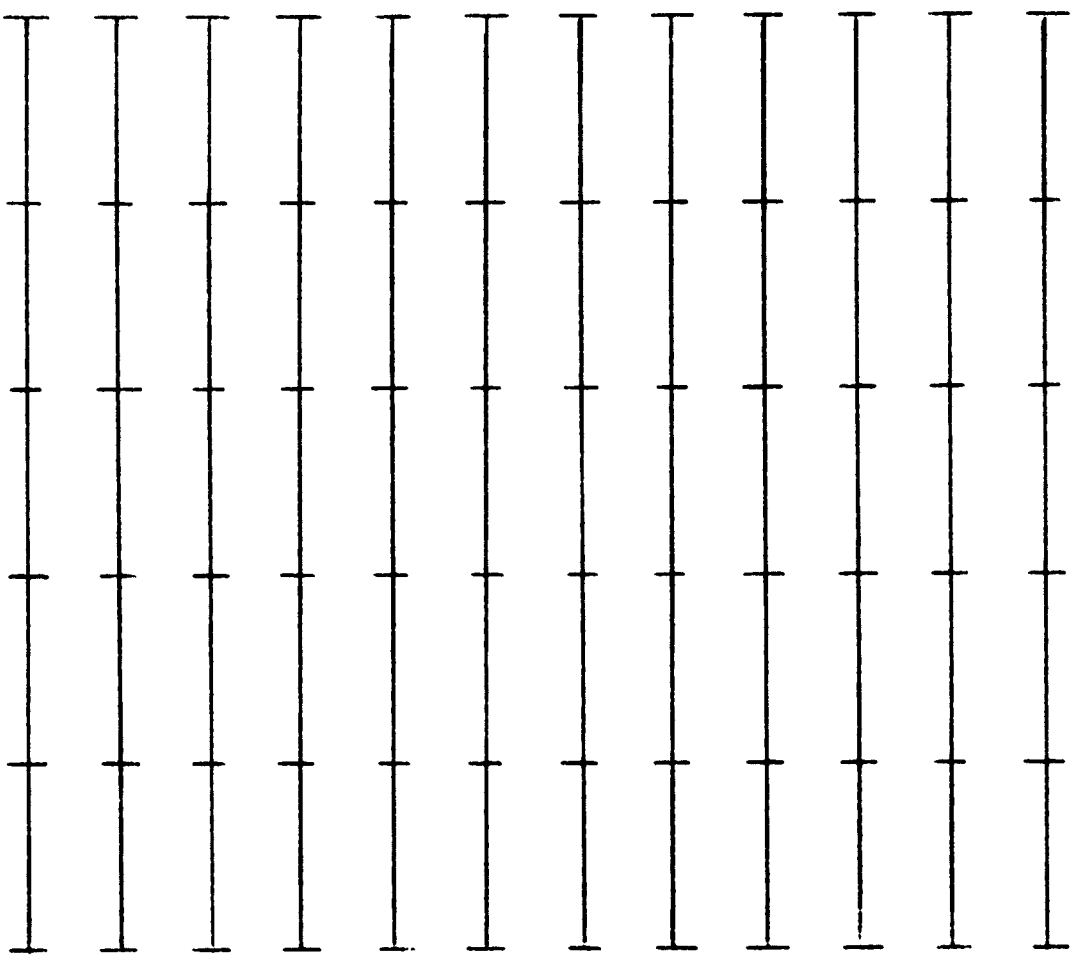
Trait H: Improvising

Definition: This person is able to adapt material, methods, or techniques to meet the demands of his particular problem. He is able to improvise with equipment and to adapt methods of one procedure to meet the requirements of another. He can see ways of using things that are different from the most common use. If the proper equipment is not available, this person is rarely at a loss as to how to proceed. He will devise a satisfactory procedure with whatever equipment is at hand.



Trait I: Overall effectiveness

Definition: This trait is composed, in part, of all the previously mentioned traits, but, in addition, includes any other qualities that should be considered. Considering everything you believe to be important, how much of a contribution does this man make to his organization. If you were hiring men to staff a research group, how well would he "stack up" with the others?



know well enough to rate.