Astronauts, Antarctic Scientists, and Personal Autonomy

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THE USUAL approach in developing a selection procedure is to find out what sorts of information distinguish between those who presently do well on the job and those who do not. When it comes to selecting astronauts, however, this approach is closed to us. Commander Shepard and Captain Grissom are the only men we have who have been into space, and two men is a mighty narrow basis upon which to do much generalizing.

The alternative is to look for a situation here on earth which comes as close as possible to space. And the situation that many people think of first is the Antarctic—for several reasons. The scientists who go to the Antarctic have educational backgrounds which are very similar to those of the astronauts. In both groups the men have bachelor's or more advanced degrees in the physical sciences or engineering. Then, there is the element of exploration, of adventure and hazard, which is common to both space and to the Antarctic. There is also the fact of isolation from the rest of the world, except by radio; during the winter, it is almost as difficult to retrieve a man from an antarctic station as it would be to retrieve one from space. Finally, both situations are largely or completely artificial. The astronaut never leaves his capsule and the antarctic scientists usually leave the protection of their buildings only when their work requires them to do so. Indeed, there are many who never go out at all during the winter.

Of course, there are differences too. Scientists remain in the Antarctic a great deal longer than astronauts do in space or even plan to do for the next decade or so. And they have much more room in which to move around than an astronaut does. Nevertheless, the antarctic situation, taken as a whole, is about as similar to the astronaut's as we are likely to find on earth.

Despite these considerations, the work that has been done on selection for polar regions is quite meagre, and what there is has been concerned almost exclusively with enlisted men or non-scientific personnel in the Arctic.[1,2,5,7] These populations, however, are not at all comparable to the sort of people presently in training or likely to be trained as astronauts—in education, intelligence, or motivation. One arctic study, for example, indicated that men with mechanical sophistication tended to do better during the winter, apparently because they found more to do.[5] In a strictly scientific group, however, it is not at all certain that this relationship would hold. To the glaciologist or geophysicist the Antarctic represents a professional opportunity. Many of these men do research of their own choosing and design, either exclusively, or in addition to the specific job they are charged with carrying out. Moreover, the results of their efforts are often in the form of dissertations for an advanced degree or scientific articles which they publish. This is not to say that time may not be a problem for the scientist. To some it is, but to a lesser degree than for the support personnel. To others it is not, and depending on whether he is doing his own research or collecting data for some institution, the antarctic scientist often has too little, rather than too much, time in which to get his work accomplished. Although, the resources of the scientist and the manner in which he uses his time (or kills it) are quite different.

The selection of astronauts is already handicapped by the necessity of extrapolating from a terrestrial situation. This fact makes it all the

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Opinions or conclusions contained in this report are those of the authors and do not necessarily reflect the views or the endorsement of the Navy Department.

more imperative that the *subjects* we study be as comparable to prospective astronauts as possible. This paper compares some test results ob-

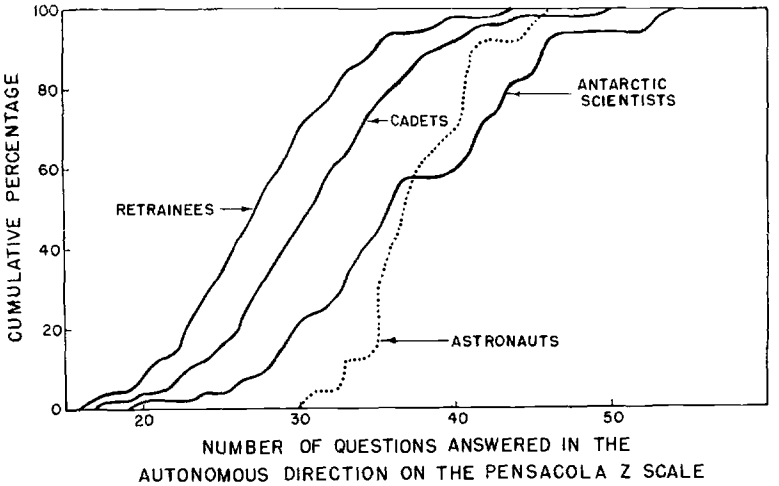

Fig. 1. Cumulative distributions of the Pensacola Z Scale among astronauts, antarctic scientists, cadets, and retrainees.

tained with astronauts and antarctic scientists, and then presents the relationship of the tests, among the antarctic scientists, to rated performance in the Antarctic.

THE TEST

The results reported in this paper were all obtained with the Pensacola Z Scale.[3] This test is a 66-item questionnaire in forced-choice form. Each item consists of two statements, between which the subject must choose, even though neither statement really applies. The items of the Z Scale are all designed to get at one facet or another of "personal autonomy" or self-reliance. For example, some of the items are pointed at self-confidence:

Item 3. (A) You are anxious.
(B) You are conceited.

In this item, the autonomous response is, "You are conceited." The use of the word "conceited" with its anti-social overtones is deliberate. In all the items of the Z Scale the autonomous response requires the subject to say that he is a little "different." Other items are aimed at independence:

Item 20. (A) You are rebellious.
(B) You like discipline.

Here, the autonomous response is, "You are rebellious." A third group of items concerns sympathy, for example,

Item 50. (A) You have felt so sorry for someone you have cried.
(B) You have gotten so mad you cried.

The autonomous response is, "You have felt so sorry for someone you have cried." And finally, there are items which are pointed at intellectual flexibility:

Item 60. (A) You are dogmatic.
(B) You are sloppy.

The autonomous or, better, the non-rigid self-description, is, "You are sloppy."

All items of the Z Scale fall into one or the other of these four clusters: self-confidence, independence, sympathy, or flexibility. The total score is simply the sum of the four cluster-scores and ranges, therefore, from 0 to 66. All items were scored for autonomy so that a high score means an autonomous self-description.

APPLICANT POPULATION

In Figure 1, the cumulative percentages in four different groups, astronauts, antarctic scientists, cadets, and retrainees, are plotted against Z-Scale score. The "astronauts" are 26 of the

31 men who were administered psychological tests in the selection program for Project Mercury.† The "antarctic scientists" are 57 civilians who wintered over in Antarctica during the International Geophysical Year, 1957-1958. The "cadets" are 766 college sophomores who had just reported for naval air training at Pensacola, Florida. And the "retrainees" are 407 retrainees (prisoners) at the Retraining Command, Portsmouth, New Hampshire.

A glance at the figure is enough to indicate that there are wide differences among these four groups. The two scientific groups have much higher scores, i.e., they describe themselves in far more autonomous terms, than do the other two groups. The lowest scoring astronaut answered three more items in the autonomous direction than the average retrainee. And 80 per cent of the cadets (94 per cent of the retrainees) had scores below the mean for the antarctic scientists.

In part, these differences may be due to intelligence. The average IQ among the cadets, for example, is 110; and among the astronauts, it is 133.* In terms of standard deviations this difference is 20 per cent larger than the corresponding difference in Z-score. And, within these two groups, the correlation between Z-score and IQ is approximately .25.** It is possible, therefore, to attribute as much as 30 per cent of the observed difference in self-described autonomy to IQ—but no more. The remaining 70 per cent cannot be explained in this way.

There are also differences between these groups in age: the astronaut and antarctic groups are decidedly older than the other two groups. Age, however, bears an uncertain relationship to the Z Scale. In the antarctic group the correlation is —.38; among the astronauts it is +.38, and in the cadet population it is +.08.‡ Altogether, therefore, the correlation between age and the Z Scale is much too small to account for any appreciable proportion of the differences in self-described autonomy.

It might also be argued that the astronauts and antarctic scientists got lower scores on the Z Scale because they had more reason to fake their responses. The difficulty with this interpretation is that the mean of the Z Scale shows very little change when people deliberately try to "beat the test." And what change it does show is in the direction of decreased, not increased, autonomy.[3]

Actually, however, the reasons for these differences are not as important as the facts themselves. To the extent that these self-descriptions are accurate, they strongly support Sir Ernest Shackleton's observation,[4] made 50 years ago, that "men whose desires lead them to the untrodden paths of the world have generally marked individuality."

CRITERION RELATIONSHIPS

The Z Scale was administered to the antarctic scientists three to four months before they went South.*[6] And at the end of their 14-month to 16-month tour, the performance of each man in Antarctica was rated by his station scientific leader on a five-point scale: "outstanding," "superior," "average," "inferior," and "unacceptable." This rating** correlated +.20 with

†Of the 106 men who qualified for the Mercury Program, i.e., who were graduate test pilots, in uniform, not taller than 5' 11", and with a degree in the physical sciences, mathematics, or engineering, only 31 survived the early stages of selection and got as far as Wright Air Development Center, where the bulk of the psychological testing was done. Of these 31, five failed to take the Z Scale because of scheduling difficulties. For the use of these data we are indebted to Dr. William F. O'Connor.

*The figure for the cadets was derived from the cadet average on the American Council on Education Psychological Examination; and the figure for the astronauts was their mean score on the Wechsler Adult Intelligence Scale.

**Among the astronauts the correlation was +.13; and in a sample of 220 cadets (who were included in the total sample of 766 cadets) the correlation was +.22. Actually, therefore, the figure of .25 is probably a bit high.

‡This value is based upon an independent sample of 217 cadets.

*The antarctic portion of this report was supported by the National Science Foundation, Grants 6692 and 13555.

**For the purposes of this report the more favorable ratings were assigned the larger numbers, i.e., "outstanding" was scored "5," "superior" was scored "4," . . . down to "unacceptable," which was scored "1."

the Z Scale as a whole, which is not significant at the .05 level. However, with the 19-item independence cluster the criterion rating correlated +.32, which is significant well beyond the .05 level. The other three clusters, self-confidence, sympathy, and flexibility, all showed weak positive relationships to the criterion, +.04, +.04, and +.12 respectively. The one significant result was that those men who described themselves as more independent got the better ratings.

This result was borne out by an analysis of the items. Of the 66 items, 10 related to the criterion at or beyond the .05 level (by a t-test). These items appear in Table I in the order of their relationship to the criterion. As the reader can see, exactly half of these items, including the three items which were most strongly related, were from the independence cluster. Two items were from the flexibility cluster, with which the independence items are positively related. And the three remaining items, those which are starred, showed inverse relationships to the criterion, i.e., in these items the non-autonomous response was associated with good performance. Altogether, the more successful of the antarctic scientists said that they were sexually appealing, did not admire anybody very much, were selfish, were forgetful, knew some people they could never like, liked or disliked people, were good Joes, did not particularly like to march, lost things, and did not go for groups. This portrait contrasts sharply with the well-adjusted, extroverted, group-oriented type that many people seem to think should succeed under antarctic conditions.

Again, however, we have a problem of interpretation. Unfortunately, no intelligence test was given to the antarctic scientists. However, educational level, which ordinarily correlates well with IQ, was not related to the criterion rating. This circumstance, though certainly not definitive, does make it rather improbable that the observed results can be explained in terms of intelligence-test performance. Age, on the other hand, is definitely not a mediating variable, since it correlated only —.04 with the criterion rating.

TABLE I. ITEMS OF THE Z SCALE WHICH WERE SIGNIFICANTLY RELATED TO THE CRITERION RATING

11.	(A) You are sexually appealing. (I)	
	(B) You are faithful.	
61.	(A) There are some people you admire so much you would not question their opinion.	
	(B) You don't admire anybody very much. (I)	
45.	(A) You need someone in whom you can confide completely.	
	(B) You are selfish. (I)	
29.	(A) You are forgetful. (F)	
	(B) You have a meticulous memory.	
*28.	(A) You could like anyone if you tried. (S)	
	(B) There are some people you know you could never like.	
*58.	(A) You are indifferent to most people. (F)	
	(B) You like or you dislike people.	
*66.	(A) You are self-confident.	
	(B) You are a good Joe.	
44.	(A) You don't particularly like to march. (I)	
	(B) You like to march with a group you feel proud to belong to.	
35.	(A) You collect things.	
	(B) You lose things. (F)	
57.	(A) You are very proud of your membership in some groups.	
	(B) You don't go for groups. (I)	

The letters in parentheses indicate the autonomous response and the cluster: "I" means independency, "F" means flexibility, "C" means self-confidence, and "S" means sympathy.

THE ROLE OF EXPERIENCE

A more fruitful approach to the problem of interpretation centers in the role of previous antarctic experience. Of the 57 antarctic scientists, 29 had had no previous polar experience; and in this group the correlation between Z-score and the criterion rating was —.04. Among the remaining men, however (those who had had some amount of polar experience), the correlation was +.51, which is significant well beyond the .05 level. These results make it quite clear that the relationship between self-described autonomy and performance in the Antarctic did not hold generally. Only in the experienced group did the high Z-scorers do better.

But again we have the question, why did they do better? The most likely answer has to do with the conditions under which a man will go back to Antarctica. Consider, for example, two men who have already been to the Antarctic once; and let us suppose that one of these men has a low and the other a high Z-score. If we

can believe the descriptions these men give of themselves, the high Z-scorer is primarily interested in his own individual performance; and any decision he makes will be based primarily on his past and prospective showing as an individual. In other words, if he did well the first time he went South, the chances are good that he will go back; and if he did poorly, the chances are that he will not. The low Z-scorer, on the other hand, is primarily interested in group membership and other, more peripheral aspects of the antarctic situation. What concerns him is not how well he does but *what* he does or, better still, who he is, whether he is an "old explorer," a scientist, a university professor, or what have you. For the low Z-scorer, therefore, his own performance in the Antarctic is much less decisive. If he did well on his first tour, he may be somewhat more likely to return than if he hadn't. But with him his own performance plays nothing like the role it does in determining the decision of the high Z-scorer.

The consequence of this difference is that in an experienced group the high Z-scorers are mostly good, because the poor ones don't come back. But the low Z-scorers are almost as often poor as they are good. If this is true, however, Z-score and performance will be postively correlated. In other words, if people really are the way they describe themselves in the Z Scale, it follows necessarily that there will be a strong positive correlation between Z-score and performance in the Antarctic among those men who have had previous polar experience. And the more experience they have had the stronger the relationship should be.

The selection of astronauts will always be a relatively high-level process. Unless the candidates are experienced as test pilots or in some other relevant way, they are not likely to receive serious consideration. In other words, becoming an astronaut is a matter of returning; it is a logical continuation of a career already begun. But if this is so, and if our interpretation of the antarctic results is correct, the Z Scale has definite promise as a selection instrument. In the populations from which we shall select our astronauts, self-described autonomy should be strongly related to aptitude, not because these two things go together as a general rule, but because an autonomous individual wouldn't be in these populations, he wouldn't have chosen these careers, unless he was also good at them.

SUMMARY

A group of astronauts, 26 of the men who reached the final stage in the selection program for Project Mercury and a group of 57 antarctic scientists, described themselves as far more individualistic on the Pensacola Z Scale than did comparison groups of naval aviation cadets and naval retrainees. Within the antarctic group, self-described individualism was positively associated with performance ratings made by the station scientific leaders after the men had wintered over in the Antarctic. This relationship held only among those men who had had previous polar experience, a fact which suggests that the predictive value of the Pensacola Z Scale for the Antarctic and, perhaps, for space may increase with the experience and level of the applicant population.

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