COMMUNICATION AND HUMAN RELATIONS

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CONTENTS

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818

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COLONEL CAVE: One is almost hesitant about introducing the subject of communications to this audience, because certainly we in the military service have been dealing with it all of our service lives. The last few days we have been using the word around in a somewhat different connotation. And so I think in bringing to a close this week of executive skills discussion, we in the faculty would have been somewhat remiss if we did not give you an adequate opportunity to hear something about this human relations field--communications.

Our speaker this morning is Dr. Alex Bavelas, Associate Professor at Massachusetts Institute of Technology. He is in the forefront of those studying this subject in this country today. You have probably already read his biography and have noted the experience he brings to you; and from some of our discussions just a few moments ago I think some of these things are going to be a little disturbing to you in a beneficial sort of way.

Alex, it is a real pleasure for us to have you with us. It is a joy for me to introduce you to this audience.

DR. BAVELAS: I can't talk without a blackboard, not because what I say must be illustrated, but because it makes me feel more at home. It is the kind of environment that I am used to. I wonder if you have any idea how things look to me from up here.

I am not going to try to say anything relevant with respect to the case that you have read. What I will try to do is merely to give you a series of what I hope are clear examples of the kind of research we are trying to do in this field of communication between human beings.

We see the problem as being one in which the individual is faced with the necessity of making a choice of some kind. There may be a number of alternatives. We like to think of these alternatives as being a rather small, certainly a finite, number. Many of the choice situations that we encounter may appear to have almost unlimited possibilities of choice, but this is almost never the case.

It may be true that there are many millions of women in this country, but an unmarried man doesn't really choose a wife from among these millions. Studies have shown, for instance, that most people choose a mate from only about four or five acquaintances. And the same thing is true of almost any problem we have attempted to analyze. The information that a man has at the time when he makes his choice is usually such that many theoretically possible alternatives are seen as completely improbable. He knows that they won't work.

The problem is usually one of picking one out of four or five alternatives. The way a person makes his selection is by getting information which leads him to believe that one is more likely to be correct than the others.

Information may be so defined. Anything that makes it more likely that a certain one out of a number of choices may be right is information.

It is not necessary that we qualify such a definition of information by bringing in such things as the medium over which it arrives or the symbols in which it is put. Information is still information whether it consists of symbols on pieces of paper, whether it consists of noises that someone makes in your direction, whether it consists of an expression on another man's face, and so on. Any experience which a man has and which changes the likelihood that one of the possible choices is more likely to be a better choice than the others with respect to his purposes is information.

For instance, suppose there is a door which may be opened by a combination lock. If you have to open that door without damage, you need information; and that information presumably will be a set of numbers and instructions--to the right so much and to the left so much. No one would quarrel with the definition that these numbers constitute information needed to open that door. It is information because those numbers increase the likelihood that you can get that door open. There is, of course, a certain likelihood that you can get the door open by twirling the dial at random, but it is very small. The likelihood is increased by getting this paper with the numbers on it.

Suppose, however, that the door can be opened in another way, too--by a key which fits a lock on the door. Instead of giving you the numbers of the combination, I might give you the key. Well, now, according to such a definition suggested earlier, the key is information equivalent to that of the numbers on the piece of paper which enable you to open the door by way of the combination lock. What is the key in fact? The key is nothing more than information "in the metal." A key is information which has been coded into the shape of a metal bar.

A drill press that puts holes exactly in the right spot is a tool which has more "information" than a hand held because the likelihood that the correct choice will be made from all the possible choices of positions is increased considerably. The tool here is nothing more than information put into a certain form, coded in this case into a tool. A piece of paper with writing is information coded into visible signals. A street sign, an arrow which points the way--all these things are forms of information. What they do is help the individual make a choice.

Now let me jump immediately to an early experiment done at M.I.T. In this first experiment one man would be put in an office where there

was a table and a telephone. He would sit there. There was nothing else in the room, no other person. In another office was another man, and the task they had to perform was the following one: We had taken a sheet of paper, $8\frac{1}{2}$" x 11" in size and on this sheet of paper we had traced around a block of wood, a domino. We repeated this 12 times, so that we had a sort of pattern on this piece of paper. It doesn't matter what the pattern was, but there were 12 blocks outlined.

This 12-block pattern we called a blueprint. That picture was given to one man. The other, this man (indicating) had a blank piece of paper and 12 of the little wooden blocks.

The man who knew where the blocks should be positioned--but had no blocks to place--had to tell the other man who had the blocks, but didn't know, where to put them. It is a simple case, you see, of information which has to go from one place to the other. The second man had to pick out of all the possible locations for these blocks the right locations.

This experiment was done to test the often-repeated idea that one-way communication is not good; that you should have two-way communication, not only two-way communication, but that the communication up and down should be as unrestricted as possible.

Let us call the first man A and the sedond man B. We ran some pairs under this condition: The man A had a telephone that he could pick up and say anything that he liked to man B--give him any instructions he pleased. B, however, had nothing but a receiver. He could listen, but not speak. This is one-way communication down.

In the second set of experiments, with other pairs of subjects, man A again had a telephone on which he could say anything he wished. B had a telephone, but he could only respond by saying "Yes" or "No." This isn't really straining reality. In many organizations there are very real inhibitions against saying anything more than "Yes" or "No" in response to an instruction.

In the last case there was complete communication both ways. It was as free as a telephone conversation between friends.

We ran 20 pairs of subjects in each of these, a different 20 in each case. After running a dozen or so, in the first variation, we stopped, because we found no pair in which even the first task was completed. We had several versions of blueprints. We had intended, after the first had been completed, to present a second, a third, a fourth, and so on, in order to obtain a record which might show learning. But, in the first experimental variation, even the first task was not completed.

822

A, of course, knew that B could not respond. He would say to himself, quire obviously, that he must be very careful not to be misunderstood, that he must speak slowly, that he must give directions very exactly, that he must repeat his directions.

But in every case something was forgotten. Apparently it is not easy to think of everything that might happen to B when you are in A's position. This man sitting at this desk with the blueprint might forget that the paper was not square. So that the paper was oriented one way for A and the other way for B. Everything would go all right until A gave the directions for placing the fifth block. Those directions resulted in the block being off the paper. B was disturbed. There was nothing he could say to A so he cast back in his mind to see what he might have misunderstood. But by that time the directions for placing the sixth block were coming over the line.

B would stop working. When A was notified that B had given up A would ask, "What is the matter with him?" B, of course, in no uncertain terms could tell him what was the matter with him.

If you are like most people you are thinking "Well, if I were in A's spot, I could have done it. I could have been quite careful to give these directions in such a way that there would be no mistake." I think that is a universal illusion. The real problem is not a problem that can be solved by power of intellect. The problem is not only for A to analyze logically the necessary instructions. That is only a part of the problem. Another part of the problem is one on which A has no data, and that is to know all the possible misunderstandings, all the possible misconceptions, which might arise in B's mind, and which of those will arise in fact, so that they can be neutralized.

A can't know those in advance unless he is telepathic or unless he knows B like a book. And that is just the justification that many people give for having one-way communications. They claim to know in advance actually what the receiver is going to think and how he is going to respond. So they can, in advance, take care of the situation completely.

Now let us go on, because I don't want to use up our time entirely on this case. The other two groups were all able to do several patterns. There was no difference, very curiously, between the "Yes" "No" response and the full communication setting. This surprised us very much. There was no difference between the second and third variation either in speed or in accuracy of reproduction.

After the groups had finished the experiment, each of the individuals was interviewed separately. In every case both the persons in the "Yes" "No" variation indicated that, if they had to do the job over again, they would like another partner also, they had no confidence in the result. The typical response to the question: "How confident are you that the result you have gotten here will compare

favorably with those of other subjects?" was that B would say--he wouldn't always use these words, but it would always be this same reply--"Well, I know that I followed the instructions that were given to me. I don't know anything about how good they were." A, being asked the same question, would say: "Well, I told him exactly what to do. I don't know whether he did it or not." You will notice that the beggest difference with respect to getting the job done quickly and accurately is between no feedback and some; not between some feedback and a lot.

Let me describe another experiment very quickly, because there is only one point about it that is important. Suppose you are trying to hit a target. It should be useful to know how much each shot is off. This ought to be important information. We did the following experiment: Five men were separated from one another, sitting in cubicles, so that they could not communicate with one another. Each man had a pad of paper and a desk that he could write on.

The men were told the following: "You constitute a team, but you can't communicate with one another." You are to try to hit a target. The way you are going to hit the target is this: The experimenter will post a number. The number may be any number between 2 and 25. Now, each of you may contribute on a slip of paper any number from zero to 5. These slips will be collected and the numbers will be added. If the sum of the numbers that you have contributed is the same as the posted number, you have hit the target.

"The target may be announced as 17. You will all write down some number which you believe will help to make 17. The slips will be collected. The experimenter will say, for example, "Your sum is 14. Try again. You will try again. The experimenter will collect the slips, and say, "This time your sum is whatever it is. You will continue until you hit the target. Then you will be given a new target."

Now in the experiment we compared this situation--in which the group is given the size of the error and the direction of the error--with another in which the group is merely told, after each attempt, "You have missed. Try again." No one in the group knows by how much the target was missed. All that is known is that the target was missed.

Let me make a long story short and tell you that the performance in the one situation is no better than in the other.

Without going into a detailed analysis, let me assure you that it can demonstrate repeatedly that the amount of information (all of it being relevant, all of it being accurate) that can in fact be used in such a way as to improve the performance of this kind of group is very closely related to how much intercommunication this group has available. If the intercommunicating facilities are below a certain level, the amount of information that is made available for the solution of the problem may very well be "too much;" so that impairment

824

results rather than improvement. The reason for this result is that the information available may, under certain conditions, lead to creating more and more hypotheses, all of which have little chance of being correct.

If, for instance, you don't know anything but the fact that you missed and you know the target is 17, what you are likely to say to yourself is: "There are five of us. I will divide 17 by 5, which gives 3. So I will either put in 3 or 4." So the distribution of responses, instead of being from zero to 5 is clustered very highly around 3 and 4.

In the other group what happens is very different. Consider the man who has contributed 3. The feedback is; "Your target is 17. Your sum was 15. Try again." Now, he says to himself: "Well, obviously we must go up. I should put in 4. But, of course, that is what they are all going to do. Therefore I should cut down." But then he may think: "But this is precisely what the others are likely to do therefore, I should put in 5." The result of all this "calculating" maybe a distribution in which any number is as likely as any other. This means that the probability of hitting the target is materially reduced.

The second factor which contributes to this rather peculiar result is that in the first group there was never any feeling that one could calculate--that one could arrive at a system for hitting the target. The only thing one could do was to guess. So when this group was told that it had succeeded in hitting 17, each of the men realized that they had hit it by guessing. So if that target appeared again at a later time all they had to do was to remember what they had contributed the last time. There was no "System" involved in this process--just memory and blind repetition.

In the other group, however, each man was groping for a system, based upon calculations on what the other fellows in the group would do. He would try not to remember the number he put in; but to devise a system. Unfortunately in this case it is only an illusion that one can calculate. No calculation leading to a system is in fact possible.

This illusion of calculability forms very easily when one has great amounts of information which is relevant and correct. We have been trained to prefer the use of the most powerful tools we have, even though they may not necessarily be the best ones in a given instance.

If a group of people must work together to do a job, or solve a problem, does the method or pattern of communication they use affect the learning process which must occur?

It has been shown that some problems, such as group-mazes, may change their entire structure when the pattern of communication used

for their solution is changed. However, even those problems whose nature is not altered by a change in the communication net used for solution may require simpler or more difficult processes of group learning, depending on which such change is made.

One such aspect of group learning--the ability of a group to adapt itself to a simple change in the problem-enviroment--was studied in this experiment. We asked this question: If a group which has learned a given task thoroughly must relearn certain parts of it due to a change in the environment, is the group's ability to adapt to the new situation related to the communication net which must be used?

Five subjects were seated at a table, separated from one another by partitions through which they could communicate in a specified pattern, using written messages. The experimenter gave them instructions concerning the experiment, following roughly the form of a prepared sheet. The actual wording used was on a more direct, colloquial level, and points which seemed unclear to the subjects were repeated with greater emphasis.

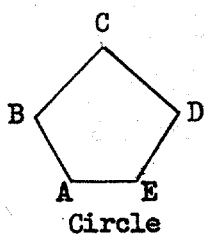
Each man had a series of small boxes before him (labeled from 1 to 30), in each of which were five marbles. At the signal to start, each of the five men opened his box for trial one and could then write anything he wished to the men with whom he could communicate.

There was only one color in the marbles which appeared in everyone's box, and the group continued sending messages until everyone in it had the answer (that is, knew which marble was common to them all). The subjects had been tested previously for correct color vision.

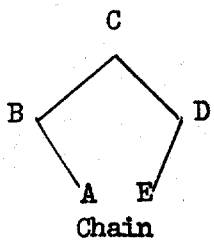
When a man found which was the common marble, he removed it from his box and dropped it into a tube, through which it rolled into a container observed by the experimenter. The experimenter took data on time-for-solution, and recorded any errors made (wrong marbles sent).

The subjects' primary incentive was for speed: they were told that their group would be compared with others on the basis of how quickly everyone in the group sent in the answer on each trial; that is, for all five men to drop the marbles down their tubes.

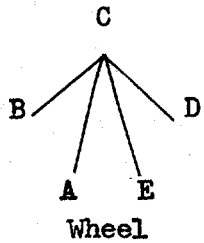
In this experiment three of the four communication patterns used by Leavitt were studied: the "circle," "chain," and "wheel"--with four groups being run for each of the three patterns:



Circle



Chain



Wheel

During these first 15 trials, the subjects worked with marbles of distinct, solid colors: red, white, blue, yellow, green, and black. At the sixteenth trial, however, and continuing to the end of the experiment, the marbles in the boxes were streaked, milky types--distinguishable, but not easily describable. These marbles for trials 16-30 were substituted exactly for the marbles in trials 1-15, so as to equate the second half of the experiment to the first in everything except that (1) the marbles were changed in appearance and (2) at the time of this change each group had already completed 15 trials using its given communication net.

Observation of the groups run showed that the subjects experienced noticeable shock and temporary dismay upon opening the sixteenth box, and that these new marbles remained a considerable challenge to them for a number of trials.

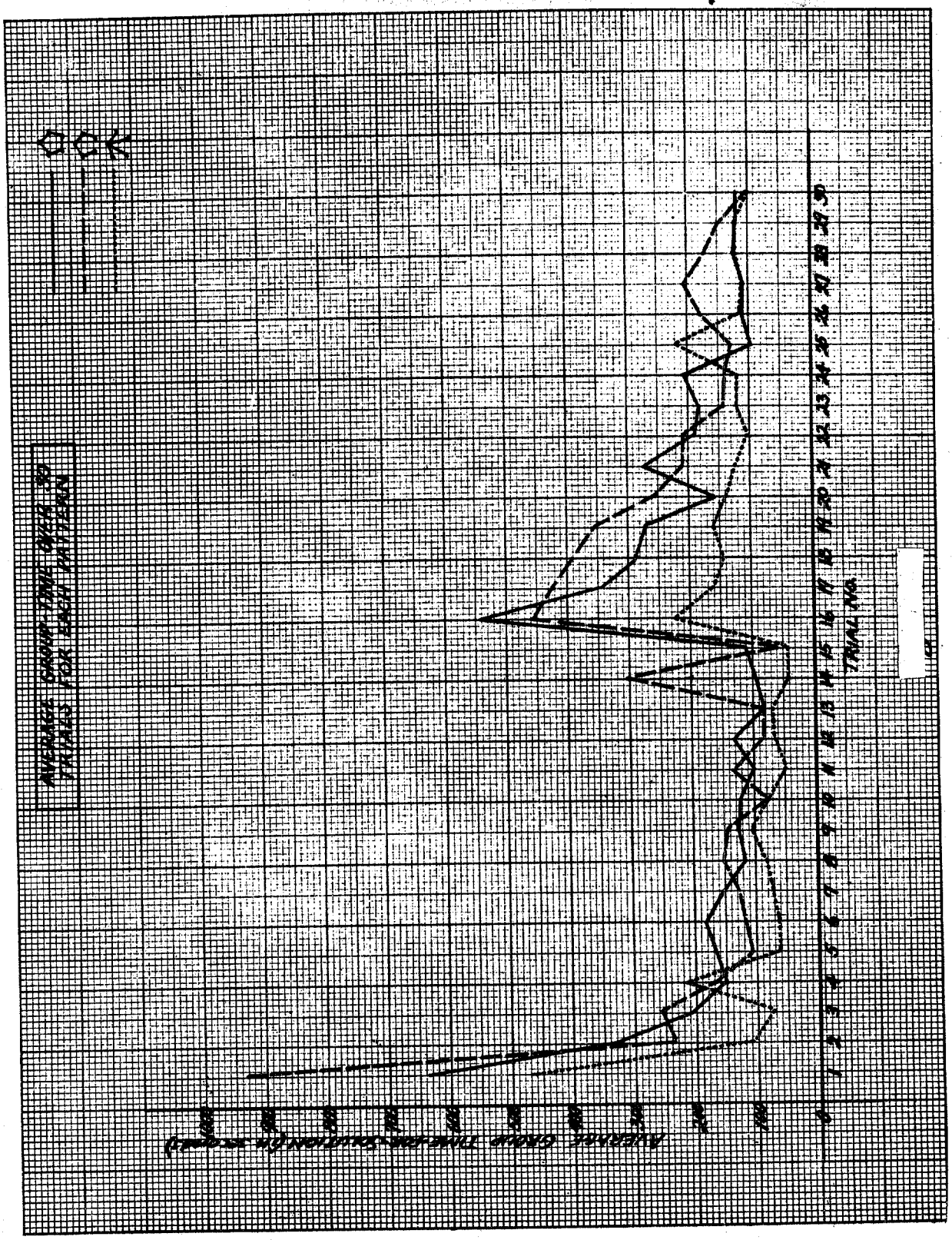
This is the change of problem-environment, then, against which the group's adaptability is measured.

In accord with previous experiments on the same nets but with different tasks, organization was achieved almost immediately in the wheels where the center man rapidly collected the information and sent out the answer. The chains organized about their centers, relaying information in and the answer being sent out again. Two of the four circle groups run never did organize their message sending about a leader; one group, however, developed a leader chainwise late in the experiment (trial 23) and another group operated chainwise from the beginning, but rotated the center position so that each man held it sometime during the 30 trials. Even in these latter "chains," however, the vestigial link form "A" to "E" was frequently used.

Chart 1, following page, represents the average time-for-solution for groups working under the three different communication nets over the 30 trials. The chains seem to be significantly slower on the first trial (averaging 931 seconds) compared with circles (636) and wheels (467). Initially, the more central men in the chain do not realize that the "end men" (A and E) are relatively isolated and dependent upon them for information; considerable time is spent during the first trial in discovering this situation and passing along "the word." (The average time for the first man in the group to send in the answer for the first trial is 285 seconds in the chain, 254 seconds in the circle, 226 seconds in the wheel--a much smaller difference, though in the same direction, than is shown in their group-times for that trial).

The average group-times over trials 1-15 seem to show that the wheels are somewhat speedier than the other nets. This difference in speed is no longer significant during the later trials from 16-30, even though the wheels are slowed up less on trial 16 itself than the other nets. The new situation of altered marbles remains so difficult for them that they cannot regain their former speed.

CHART 1


AVERAGE GROUP TIME SAVED IN TRIALS FOR EACH PATTERN
TRIAL NO.
AVERAGE GROUP TIME SAVED IN SECONDS

828

As can be seen, all three nets were slowed initially by the marble change, but eventually returned to a reasonably "steady-state" condition of operation.

The sharp rise in average group-time for the chains in the fourteenth trial does not in any way represent an "anticipation" of the marble-change, but rather was caused by confusion due to error occurring coincidentally at that trial in two of the four groups run with that pattern.

Chart 2, following page, shows the average errors made by a group operating under each of the three nets during successive five-trial periods. During trials 1-15 there was little difference in error occurrence among the three patterns. Trials 16-20 show a large increase in errors caused by the confusion due to the marble change. The chief cause of this confusion lies, of course, in the area of semantics, since initially everyone in a group gives his own names to the new marbles. A marble may receive as many as five different descriptions from the group initially, a situation worsened by the more subtle difficulty arising when the same description is applied by two subjects to two different marbles.

It is interesting to observe the circle groups decrease their errors consistently so that in the last five trials it is no greater than the errors made using the original marbles. The chains show a similar but very small decrease in errors, ending the experiment still sending in a large number of "wrong" marbles. The wheels, which seem to make a bad enough showing in regard to errors already, are redeemed from an utter chaos of errors only by "wheel 3" which made an unusually low number of errors.

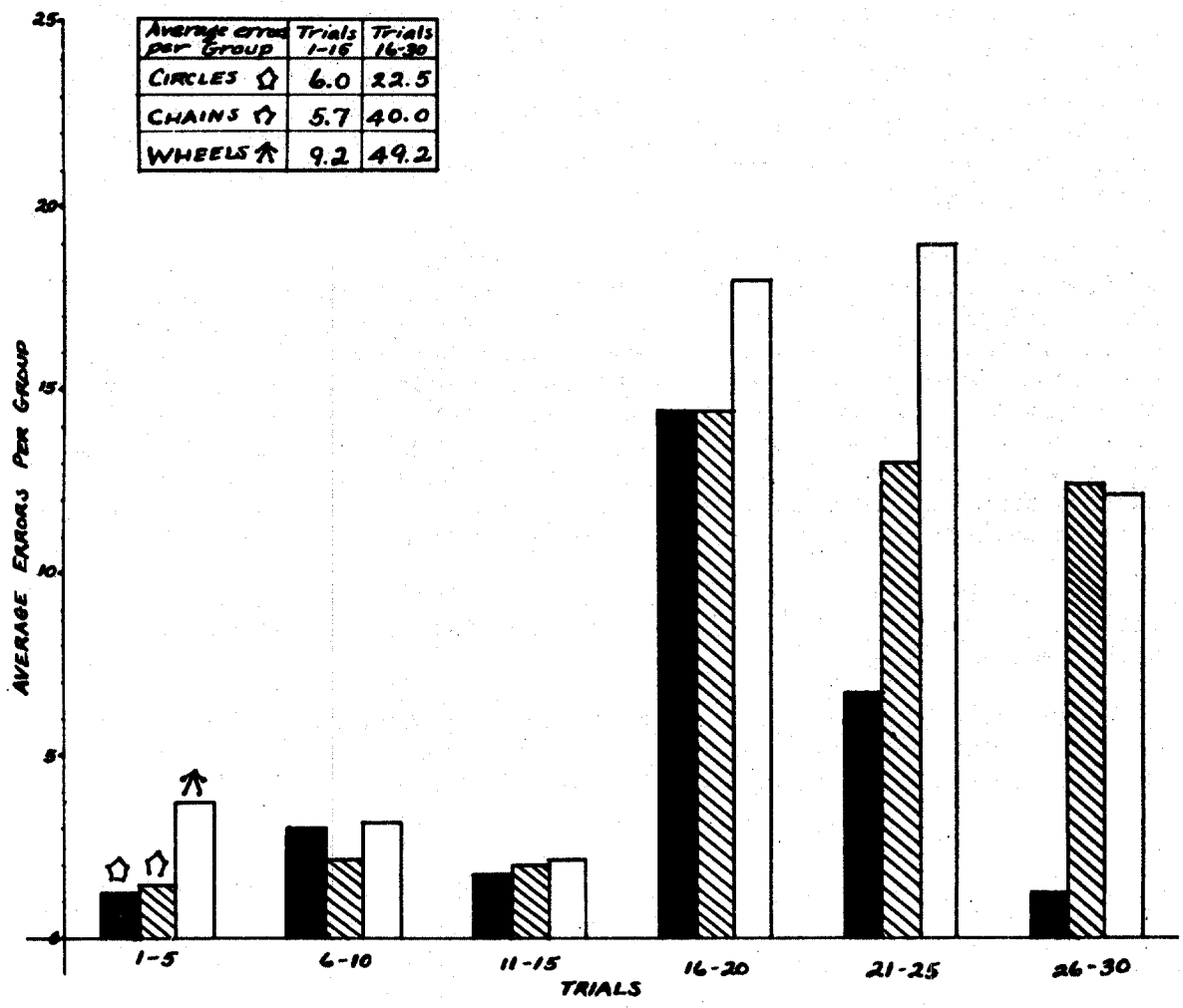
Preliminary observation would suggest that this happy result can be attributed to the larger and less-constrained message flow characteristic of the circle pattern. Messages sent in the chains and wheels have decreased considerably in volume during trials 1-15 and suggestions and opinions from the more peripheral members of these groups have not been encouraged.

In the circles, the initial names given to the new marbles seem to become modified toward a standard terminology as increasing contact occurs between the varying nomenclatures. Some slight modification takes place in the chains where subjects at positions B and D attempt to make the descriptions from the end men consistent with their own. Even where this does occur, the center man (C), who has been sending out answers with no difficulty in trials 1-15 will presumably receive two different lists from either side of him with resultant translation problems. The center man of the wheel receives lists using four different naming systems from four men, which in itself could explain the overwhelming number of errors made by this pattern.

This analysis does not maintain that an unusually imaginative center man with considerable executive ability could not find the way

CHART 2

AVERAGE GROUP-ERROR OVER 30 TRIALS



out of his dilemma in either of these patterns. The excellent performance of "wheel 3" as a group might be attributed to this possibility, though a preliminary inspection of the messages received by C on trial 16 shows that, by accident, the marble lists he was given by his group were definitely more similar than those received by the center men in the other wheel groups.

Chart 3, following page, represents average group-performance if both speed and accuracy are taken into account. Our groups were stopped on each trial as soon as a marble had been received from each member of the group, whether this marble was the answer or not. This meant that if a subject had sent in an incorrect marble, he could send the correct one after it if the group had not yet been stopped. Some errors were corrected in this way. Though these errors are included in the error count, only "final" (uncorrected) errors were considered as making the entire trial incorrect. From the plot in Chart 3, then, we could find out what percent of the trials done by circle groups before the marble-change were completed correctly (without final error) in less than 300 seconds, for example.

The difference in these performance curves for the three communication patterns during trials 16-30 is striking when compared with their similarity during trials 1-15. The fewer errors made by the circle groups after the marble-change stands out clearly. The wheels are again redeemed (only in comparison with chains) by "wheel 3" during trials 16-30. The three high-error wheels completed among them only seven trials correctly (out of a possible 45) while the low-error group completed 12 of its 15 trials correctly. If this latter group were omitted from consideration, the remaining wheels would have a performance curve considerably below even that for the chains during trials 16-30.

It has been definitely shown that difference in communication pattern may have a marked effect on the adaptability of groups to environmental change.

Whether this effect can be generalized to the pattern alone, or whether it depends also upon the group-task used, as well as other variables, cannot be determined from this work.

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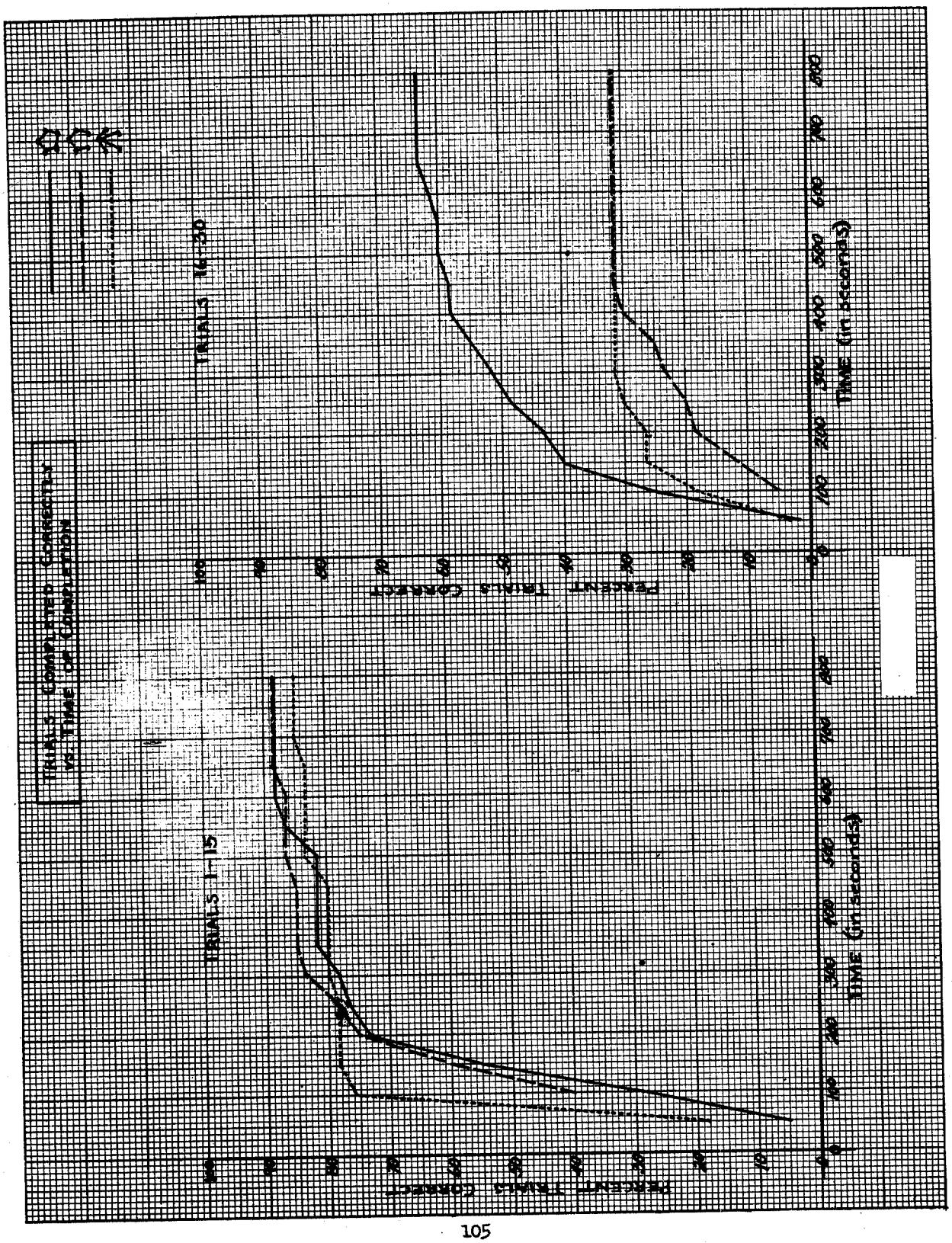
CHART 3


TRIALS 1-15 Compared to Correct vs Time of Correlation
TRIALS 16-30
TRIALS 1-15
PERCENT TRIALS CORRECT
TIME (in seconds)

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