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SOME DIFFERENCES IN ENCODING AND DECODING MESSAGES.

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LANGUAGE ENCODING AND DECODING PROCESSES WERE EXAMINED BY DETERMINING THE ABILITY OF SUBJECTS TO PREDICT OMISSIONS FROM A NATURAL LANGUAGE TEXT WHICH THEY HAD PREVIOUSLY PRODUCED THEMSELVES, AND BY COMPARING THIS PERFORMANCE WITH THAT OF OTHER SUBJECTS TO PREDICT OMISSIONS FROM THESE SAME TEXTS WHICH THE SECOND GROUP READ AT THE TIME OF PRODUCTION. SIXTY-FOUR SOPHOMORES AT CAMPBELL COLLEGE WERE ASSIGNED RANDOMLY TO FOUR CONDITIONS, TWO EXPERIMENTAL AND TWO CONTROL. THE EXPERIMENTAL CONDITIONS WERE ENCODING--A GROUP OF SUBJECTS PRODUCED WRITTEN STORIES IN RESPONSE TO TWO THEMATIC APPERCEPTION TEST (TAT) CARDS, AND DECODING--A GROUP OF SUBJECTS READ PRODUCTIONS OF THE ENCODING GROUP. ONE CONTROL GROUP WAS ASSIGNED THE TASK OF PRODUCING STORIES, AND THIS GROUP (IRRELEVANT ENCODERS-DECODERS) WAS GIVEN THE STORIES OF THE EXPERIMENTAL GROUP TO READ. THE OTHER CONTROL GROUP (NAIVE DECODERS) WAS GIVEN RANDOMLY ASSIGNED TAT STORIES TO READ. THE DEPENDENT VARIABLE WAS CLOZE TESTS. AN ORTHOGONAL COMPARISON OF MEANS WAS USED TO ANALYZE THE DATA. THE ENCODING GROUP HAD A SIGNIFICANTLY HIGHER MEAN SCORE THAN THE DECODING GROUP. THE ENCODING AND DECODING GROUPS HAD SIGNIFICANTLY HIGHER MEAN SCORES THAN THE IRRELEVANT ENCODING-DECODING GROUPS. NAIVE DECODERS WERE SIGNIFICANTLY LOWER THAN ANY OTHER GROUP. THE SIGNAL SYSTEM MAINTAINED VARIABILITY WHEN TRANSMISSION WAS ENTIRELY WITHIN THE ORGANISM. THIS PAPER WAS PRESENTED AT THE AMERICAN EDUCATIONAL RESEARCH ASSOCIATION CONVENTION (NEW YORK, FEBRUARY 1967). (BR)

"Some Differences in Encoding and Decoding Messages"

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The purpose of this study is to determine the ability of subjects to predict the omissions from a natural language text which they had previously produced themselves, as contrasted with the ability of other subjects to predict omissions from these same texts which they had read at the time of production.

Relationships between language production and language interpretation are still largely undefined. One difficulty is that of establishing from the use of the natural language the degree of organization and flexibility under encoding and decoding. One of the most productive ways to think of organization is in terms of predictability. The more predictable an event, the more organized. Variability implies a degree of unpredictability i.e. of disorganization. This holds true in the second law of thermodynamics as well as in the mathematical statements of the redundancy of a communication system. Language when viewed as the transmission of signals carrying a message through a communication channel might well be interpreted in terms of these "more or less predictable" paradigms also.

Considered in this manner it would seem that the individual organism would be more organized, that is, he would exhibit more predictable language behavior, if he were later decoding messages which he originated

as source, than if he were decoding messages originated by other sources.

There are obvious symmetries between "encoding"--the process whereby a message (originating in a source) is transformed intc signals that can be carried by a communications channel, and "decoding"--the process where a receiver transforms signals into messages for a destination. The physical form of particular signals are the same whether transmitted or received. For example, "dog" is sent and received in the same form. At the level of the sign-vehicle then, it seem appropriate to assume that in the neural code "dog" has the same representation whether it is transmitted or received. Within the interpretive system there are asymmetries however, as when a wife says to a husband, "you sly dog," and the husband decodes this as, "I'm a clever man," but the wife as source is originating the message, "you dirty dog."

Analysis of language a communications model is complicated by the fact that one unit i.e. the person, is both source, transmitter, receiver, and destination of messages. In his role as source the individual probably produces messages beyond his capacity to transduce into signals appropriate for communications. These incommunicable neurophysicological states, however, overlap with states of the organism which can be communicated, in such a manner that at many points difficulty arises within the organism in distinguishing those states which have been communicated from those which have not. It also would seem that as in all communications systems a matching of states, at the level of source and destination as well as at the level of transmitting and receiving, is necessary if communication is to occur. If this be true, messages of the transmitting

organism will be lost on certain receivers because to them, part of the transmission is in the form of misinterpreted signals i.e. noise.

One difficulty present in drawing analogies between human and electronic communications system is the differing effect of "noise" in the two systems. In an electronic system noise is introduced in the "channel" and there is a constant attempt to overcome its distorting effects. In the human communication system noise in the channel is likewise undesirable, but this is not the only noise present. There is noise introduced by the prior organization i.e. the past learnings, of the destination of a message. This noise may take the form of "misreadings" or the form of "variant readings" to use I. A. Richards' (1960) terms. Because they ordinarily indicate deficient decoding skills, misreadings should be eliminated, but varient readings are quite another matter. Strictly speaking, communication only occurs when the intent of the author is interpreted precisely by the desination. One would guess however, that much of advancing knowledge is built on the use of one individuals verbal production to buttress conceptual structures quite foreign to the intention of that individual. Communication fails, but the intended communication has an effect, and perhaps a profound one, nevertheless. Noise, then, in a human communications system may have, socially, a facilitating effect. Also, within a single organism these problems of transduction and matching should be greatly attenuated.

In a communications system constructed by a communications engineer the function of the various parts of the system are readily separable and thus the characteristics of each element easily ascertained or designed.

In animate matter, however, functional relationships of elements can only be inferred from confounded organismic output, either elicited or emitted.

Since the system most open to us is the signal system, the transmitting and receiving functions of human communication are more open to us. The great difficulty is that of going beyond the signal production and signal perception mechanisms to examine the source and the destination of messages. Here, apparently, lie most of the asymmetries in human communications systems; this is where most of the "noise" originates. Some of these asymmetries undoubtedly have genetic bases; other probably are of a chemical and physical nature relating to the specific structure and metabolism of the organism; others are related to the differential storage of information concerning the environment i.e. learning. A message, then, having its source, transmission, reception, and destination in one organism would seem to be the most highly organized, i.e. the most predictable, message possible for that individual. One would expect the person to be able to reproduce his own language productions with higher accuracy than he would be able to reproduce the language productions of another.

In this paper the terms "source," "transmitter," "channel," "receiver," "destination," "message," and "noise" are used in the technical communication theory sense. The idea is that when a person writes he codes internal neurophysiological messages into a language display which permits its transmission through a communication channel; when a person reads he decodes incoming signals from a language display into an internal neurophysiological messages.

Method

The experimental procedure involved requiring language production (encoding) of one group of Ss in response to TAT stimulus cards. Another group of subjects read these productions soon after they were finished. Later, all subjects (producers and readers) were tested for their ability to replace words which had been deleted from these productions.

Cloze tests are made by a language mutilation technique developed by Wilson Taylor in 1953. All cloze tests in this study were made by completely deleting every seventh word, beginning the count with the first word, in the TAT stories which were produced by one experimental group. This is generally called an "any-word" cloze deletion. The task of the subject is to try to supply the exact word which was removed from the passage.

The subjects were 64 sophomores randomly selected from 255 sophomores at Campbell College and assigned, again at random, to four conditions.

Two experimental and two control treatments were designed. One experimental group was assigned the task of producing written stories in response to two TAT cards (numbers 2 and 17GF). Two days later they were given cloze tests which were made by deleting every seventh word of their own stories. The second experimental group was assigned the task of reading the stories produced by the first experimental group above. Two days later they were given cloze tests covering the material they had read, and which, of course, was the same cloze test that the producer of the story had completed.

One control group was assigned the task of producing written stories

in the same manner as the experimental group. They did not see these stories again. As soon as they had finished writing their stories they were given stories produced by the experimental group, above, to read. Two days later they were given cloze tests covering the material they had read. The other control group did not produce but were given randomly assigned TAT stories to read. Two days later these were given cloze tests produced by the experimental group but which they had not seen before. To summarize: the four treatments were encoding (i.e. producers), decoding (i.e. readers) and the two control groups, irrelevant encoders--decoders, and naive decoders.

The statistical analysis was by a planned comparison among means. Weights were assigned as in Table 1. The reasons for the orthogonal com-

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Insert Table 1 about here

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parisons are as follows.

1. The encoding group should have a significantly higher mean score than the decoding group. The encoding group having encoded a message which they subsequently re-encoded, in part, should score higher than the group who encoded, in part, a message which they had only decoded before.

2. The encoding and decoding group should have a significantly higher mean score than the irrelevant encoding--decoding groups. The encoding--decoding group had previously encoded a message using the same stimuli as that of the decoding group. Their cloze scores however

are based on material which they had previously decoded. They were thus encoding, in part, the specific message which they had only decoded before and thus, should be more like the decoding group. A nonsignificant difference here would indicate a relationship between encoding and decoding related to prior encoding or messages on topics similar but not identical to the original topic.

3. The naive decoders should have a mean score significantly lower than the mean of all other groups. Numerous studies have noted differences between pre-cloze--cloze test given with previous experience without the particular language passage, and post-cloze--cloze tests which are given after experience with particular language passage. This differential exists in this comparison.

Results

The results of the planned comparisons were as follows:

Insert Table 2 about here

The level of confidence was set at .01 (one-tailed test) before statistical computations were carried out. The three comparisons were statistically significant in the predicted directions.

It is also important to note here that the results from two previous pilot studies confirmed the relationships exhibited here. In addition, both pilot studies varied the time between the same treatments discussed here and the measurement by the cloze tests for the fixed conditions of two and eight days. There was no significant difference between days or of interaction between days and treatments.

Discussion

When the subject sees his production in the reading display, he receives his own message by his "language" cue system. If length of the message is beyond the span of his immediate memory he must use the same system to reduce uncertainty that he uses for messages which he did not produce. The message, however, a product of his nervous system is more predictable in its more variant aspects i.e. those parts which are most uncertain, because the structure of "markers" and lexical selection restrictions are more congruent with the form of the display, than they would be in a non-producer of the language.

The producer does not reproduce, exactly, his own prior production however. As destination of his own message he does not have identical internal states with those under which he produced the message. He has a degree of uncertainty, therefore, about what he has produced.

The fact that the producer does not reproduce his own production exactly indicates that the producer cannot communicate with himself precisely, at least not, when parts of his original encodings are destroyed. That is, supposedly, if a producer views substantial parts of his own language production and his productive and interpretive codings were one-to-one transductions, there is no obvious reason he (the producer) could not repeat his original production verbatium.

It is demonstrated here that predictability of missing elements in a language passage is increased when a subject is source of a message as well as destination. Predictability is not perfect however. Reconstruction of the original message is, on the average, 86%. In

other words, at least, the signal system of the language maintains a degree of variability when transmission is entirely within the organism.

Predictability of missing elements in a language passage is increased when a subject is the destination of a message, parts of which he later attempts to encode, but there is less reconstruction as compared to the original encoder, reencoding. Here, after two days, reconstruction is down to 70%. The reconstruction of the "pre-cloze" tests was about 60%.

Memory differentials do not seem to be a factor in predictions covering the periods of time studied. Though in all three studies, subjects were instructed to remember, as they would be tested later, in both pilot studies, there was no difference in recall from two to eight days, nor was there interaction between treatments and recall. The low difficulty of the TAT stories might be a factor here. Nevertheless under these conditions no "memory" loss over time is exhibited.

If the difference between the encoders and the decoders it a true one, the prior sturcture of the communication system itself must determine the differential between encoders and decoders. In the encoder, it would seem, the hierarchy of language elements exhibit a more stationary characteristic over time. That is, identical context leads more probably to the same response as before. The decoder who is asked to encode parts of a previous encoding of another person does not have the same probabilities of supplying a particular signal in a particular language context which the original encoder would supply. The implication is that the characteristic which allow the encoder to reencode parts of his message more precisely than a decorder attempting

the same reconstruction is the individual probabilities of response. On the other hand there is much more agreement than disagreement.

An interesting question here is, "what happens to 'meaning' under these circumstances." If two individuals respond to the same language signals in different manners this implies that psychologically the two individuals derive different messages, to some degree, from this particular signal. Communication under these conditions would be very different from an electronic system for every message would only convey an approximate meaning.

Reference

Richards, I. A. "Poetic Process and Literary Analysis," Style in Language, T. Sebeok (ed.). N.Y.: Technological Press of MIT and John Wiley, 1960.

Table 1

Weights for Orthogonal Comparison of Means

	Encoding	Decoding	Irrelevant Encoding-Decoding	Naive Decoding
Comparisons	I	II	III	IV
1	1	-1	0	0
2	-1/2	-1/2	1	0
3	-1/3	-1/3	-1/3	1

Table 2

Planned Comparisons-- t's

Comparisons	Difference in Means	Variance Estimate	t
1. Encoding; Decoding	3.625	.554	4.87*
2. Encoding + Decoding Irrelevant Encoding-- Decoding	1.563	.416	2.44*
3. Post-Cloze; Pre-Cloze	3.1957	.369	5.26*

Variance	SS	df	Mean Square
Within groups	266	60	4.433

*Significant at .01 level (one-tailed)