An Automatic Analyzer for the Study of Speech in Interaction and in Free Association

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The study of speech (verbal activity) in the interview situation and in free association is being undertaken as a preliminary investigation of the process of psychotherapy. An attempt is being made to determine the relationship between the tempo and distribution of units of speech and the progress of therapy. Further relationships between verbal behavior and other personality characteristics and clinical diagnosis are being investigated. In previous work the verbal and gestural behavior of subjects and patients have been studied by the use of the "interaction chronograph" (*2*). This device records the interaction by having an observer depress a key during periods of activity and release the key during periods of inactivity. In observing an interview two keys were used simultaneously, one to record the activity of each of the participants.

In the close observation of so many fleeting phenomena even the trained observer is faced with a difficult task. The variability of the observer's reaction time, the practice effect, and the effects of fatigue are the major sources of error. The analysis of the record which is done by other workers may be an additional source of error.

In order to obtain more accurate information, an analyzer was designed and built which automatically performs all the operations required for the recording and analysis of verbal activity—thus eliminating the human observer.

The automatic speech analyzer consists of four parts. The first computes the duration of speech and the total number of units of speech (a unit of speech is defined as any period which is separated from the subsequent one by a minimum pause of a certain duration—in these studies, 0.5 sec). The second part of the analyzer classifies the units of speech in terms of their duration in sec, and gives their frequency distribution. The third part records the number of interruptions and classifies them according to which participant in the interview interrupts and which one stops speaking after the interruption. The fourth part is a tape recorder on which the units of speech are recorded. Two complete units, including the four parts described above, are provided for each of the participants in an interview.

The speech of the two persons in the interview is picked up by unidirectional microphones (cardioid type) whose output is fed into speech amplifiers (Fig. 1). The gain of the amplifiers is adjusted so that the imput of the two microphones will not interfere with each other. The output of the amplifiers is rectified and taken through a clipping circuit which maintains the voltage below a certain limiting level. The output of the speech amplifier, after having gone through the clipping circuit, is fed to an adjustable time delay relay[1] (time delay *A* on diagram) which does not drop out unless the pause in speech is at least 0.5 sec.

Thus when the subject begins to speak the relay pulls on, energizes an electromagnetic counter, and starts an electric timer. When the subject stops speaking *and only after the minimum pause mentioned above has elapsed,* the counter completes the counting of one unit and the

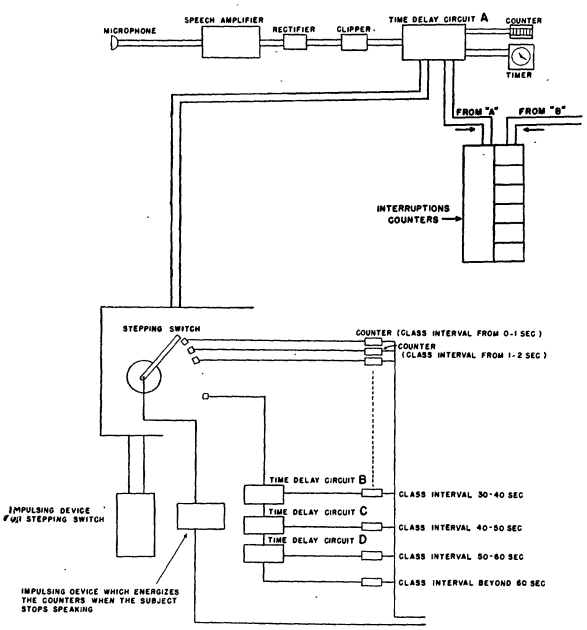

FIG. 1.

timer stops. If the minimum pause does not elapse, the counter does not complete the count and the timer goes on timing whatever follows as one period, until the minimum pause occurs. At the end of the whole interview the counter will show the total number of units of speech and the timer will show the total time in speech.

The total time in silence is obtained by subtracting the total time in speech from the total duration of the interview. The time delay relay also energizes a pen, which leaves a trace of every period of speech on a paper tape, pulled by a synchronous motor, so that each period of speech can be recorded and studied separately, if desired. Two identical channels including microphone, amplifier, rectifier, clipper circuit, time delay relay, counter, and timer are provided; one for the subject, one for the interviewer.

For the study of variability an apparatus was devised which at the end of the interview shows automatically, on a series of counters, the frequency distribution of the

[1] Certain types of time-delay circuits, like the multivibrator ("flip-flop") type, which is used at present in the apparatus described, eliminate the necessity of using rectifiers and clipper circuit. This type of time-delay circuit was designed and built for us by Hanopol and MacLeod, Charlestown, Massachusetts.

durations of the units of speech. (This is the second part of the complete unit.)

This apparatus consists essentially of (1) a timer which provides a short pulse every second; (2) a stepping relay (or stepping switch); (3) a series of time delay relays, (time delay circuits *B*, *C*, and *D* on diagram); (4) a series of electromagnetic counters.

Every time the subject begins to speak the stepping switch begins to move from contact to contact, in steps of 1 sec, under the control of the impulses emanating each second from the timer, and keeps moving as long as the subject speaks. When the subject stops speaking an impulse goes through the wiper of the stepping switch to a counter, which records that unit of speech as one belonging to a class interval of a fixed duration. The wiper returns to zero and is ready to move up for another unit.

For practical purposes it was convenient to limit the stepping switch to 30 steps. If any period of speech lasts longer than 30 sec, it will be classified in a larger class interval in the following way:

When the wiper of the stepping switch arrives at the 30th contact it energizes a time delay relay circuit, which in turn energizes a counter which will record a halt in the subject's speaking between 30 and 40 sec after zero time. If the subject speaks beyond 40 sec, another time delay circuit will energize another counter which records a halt between 40 and 50 sec, and so on. The last counter will record all the periods of speech which lasted beyond 1 min.

For the study of interruptions a switching and computing system was built which automatically counts the interruptions and classifies them into the following six categories:

1.	A	begins	to	speak,	B interrupts,	A stops
2.	A	"	"	"	B "	B stops
3.	A	"	"	"	B "	both stop
4.	B	"	"	"	A "	A stops
5.	B	"	"	"	A "	B stops
6.	B	"	"	"	A "	both stop

One of the great advantages of this analyzer is that it can be used in the study of any phenomenon distributed in time. It can automatically determine the number of occurrences in a given time, the total duration of a series of individual occurrences, and the frequency distribution of the durations of the events studied. From the frequency distribution the standard deviation can be readily calculated.

In our present work we are adapting this apparatus to the study of speech (verbal activity) as it occurs in the interview situation and in free association during psychotherapy. In studying free association we record the patients' verbal productions on a wire recorder and then play the record back into one of the channels of the automatic speech analyzer.

References

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Increasing the Efficiency of the Laying Hen

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Work has been under way for many years on increasing the efficiency of the hen by increasing the number and size of eggs, and by reducing losses in the laying houses due to disease. In a long-term attack on this problem and using a unique method of measuring gains, we are able to state that the efficiency of the individual hen, measured by the increase in average weight of eggs per hen per year, has risen by 75.4% since 1923. If the decline in losses is taken into account, the increase in efficiency is 106.8%. This increase has been gained through the consistent use of the family method of breeding—an adaptation of Mendelian principles to the peculiarities of quantitative characters. So far as we are able to learn, no other method of breeding has been developed capable of making so much improvement in efficiency.

References 2–5 give results of the application of this method of breeding in other instances. It has been used by poultry breeders of Massachusetts and vicinity with so much success that poultry breeders in all sections of the United States and Canada are adopting it. The method is effective because each pair of parents is judged by the qualities of all their children. Pairs whose children rate highest in the qualities desired by the breeder are given an opportunity to have more children. Meanwhile, a new generation of parents is selected from members of families with the highest ratings. But of this new generation of parents, only those few whose children rate the highest are retained. This process, repeated generation after generation on a sufficiently large scale, has thus far promoted a constantly rising average of those qualities which the breeder seeks to improve.

The improvement in the efficiency of the laying hen made through consistent use of the family method of breeding suggests that when it is applied to other farm animals and to food plants, similar gains in efficiency will result.

The poultry plant at Mount Hope Farm was begun in 1917. Work on improving the efficiency of the hen began in 1918 with the assembling of the best stock available at that time. Once the assembling of stock was completed, the flock was closed and no other stock added. As it was not necessary for the work to be self-supporting, or to provide a livelihood for a farm family, the work could proceed without the handicaps that confront many poultry breeders. Thus it has been possible to use a method of measuring gains which most poultry breeders have not found feasible.

This method, established in 1923, consists in setting aside entire families of full sisters, which are all held—good, bad, and indifferent—for 15 months after the first hatch is placed in the laying houses. Beginning in 1927, these families have come from parents hatched the previous season. These parents are, therefore, not progeny-