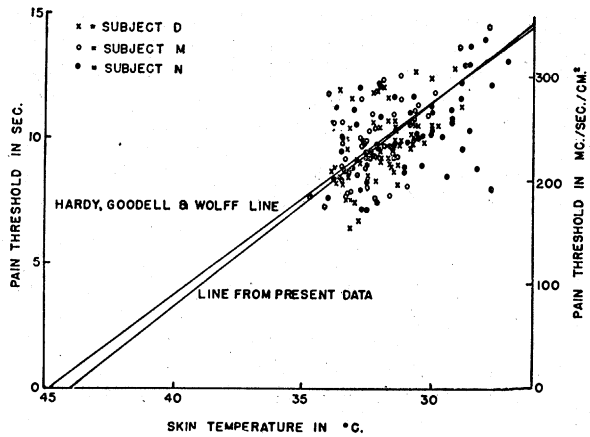

FIG. 1.

The present report derives from an investigation of the temporal variation of various sensory thresholds, in which skin temperature was measured as a control for pain threshold. The resultant data are comparable to those of Hardy, Goodell, and Wolff, except that the range of the present data is smaller than theirs, because no attempt was made to produce major changes in skin temperature artificially.

At 7 P. M. daily for 45 consecutive days pain thresholds were measured on each of three subjects. Measurement was performed on an apparatus designed after that of Hardy *et al.*, but with a different technique.

The radiant intensity was set at 275 mc/sec/cm² each time and was applied to the forearm on a blackened circular area 1.8 cm in diameter. The threshold was measured in terms of the number of seconds that the radiation had to be applied before the subject reported burning pain.

Just before application of the stimulus, skin temperature at the blackened spot was taken by means of a thermistor (1 V6 11) and a GR type 150 impedance bridge; resistance was translated into degrees centigrade by means of a calibration curve.

Correlation coefficients between threshold and temperature were −.70, −.61, and −.72 for the three subjects, and all were highly significant statistically (better than the .1% level). The data were plotted (Fig. 1), and a least square straight line was fitted to the data in a manner comparable to that in Fig. 1 of Hardy, Goodell, and Wolff. Extrapolation from this line provides a striking confirmation of their "zero point," since our data yield a value of 44.1° C in comparison with their report of 44.9° C. The agreement is all the more remarkable because Hardy, Goodell, and Wolff—

1) Used threshold for pricking pain, whereas we used that for burning pain;

2) Used the Hardy-Wolff-Goodell method, and we used a very simple temporal measure;

3) Used a temperature range of over 20° C, whereas we used one less than half as large; and the variability of our data was even larger than theirs.

The present experiments provide further confirmation of Hardy, Goodell, and Wolff's conclusion:

Buettner and Henriques and Moritz have shown that reversible tissue damage in the skin of the forearm and upper leg of humans is produced at the critical temperatures of 44° C to 45° C. In the above experiments threshold pain has been elicited when the skin temperature has been raised to roughly this same level, irrespective of the initial level of skin temperature. From these two independent observations the close relation between tissue damage and noxious stimulation can be inferred, thus significantly supporting the concept that the adequate stimulus for pain is tissue injury.

Reference

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Time Distortion in Hypnosis and Nonmotor Learning

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By "time distortion" is meant a marked difference between the seeming duration of a time interval and its actual duration, as measured by the clock. In previous communications on this subject (*1, 2*), evidence was presented which indicated that the following statements are probably true:

1) In especially trained subjects, time sense can be deliberately altered to a predetermined degree by hypnotic suggestion. Such subjects can have an amount of subjective experience under these conditions that is more nearly commensurate with the subjective time involved than with the world time. This activity, although seeming to proceed at a natural rate as far as the subject is concerned, actually takes place with great rapidity relative to world time.

2) Retrospect falsification or elaboration does not enter into the subject's reports.

3) The continuity of these experiences during distorted time is good.

4) Thought, under time distortion, although apparently proceeding at a normal rate from the subject's point of view, can take place with extreme rapidity relative to world time. Such thought may be superior, in certain respects, to waking thought.

Thus, apparently, *time* can be given to the hypnotized subject, and he can use this time for various mental activities.

It is important for investigators to realize that the training of a subject for time distortion generally has required 3–20 hr, exclusive of his training as a hypnotic subject per se. Training was generally carried out on consecutive days, the average session lasting one hour. With sufficient effort and the proper technique, the phenomenon can probably be produced to varying degrees in the majority of hypnotic subjects.

In discussing time distortion in hypnosis, world time is solar, or clock, time, and personal time is sub-

jective, or experiential, time. Estimated personal time is the estimate, by the subject, of an interval of his experiential time. Suggested personal time is a time interval that is suggested to the subject under hypnosis. Allotted time is the time, in world time, that is allotted to a task by the experimenter. A completed activity is one that progresses to the fulfillment of certain stipulated or implied conditions (none of them concerning time), at which point it reaches completion. An incomplete or continuous activity is one that does not progress to such a limit. Distorted subjective time during hallucinated activity as experienced by subjects in these and similar experiments is sometimes referred to as special time, or special trance time.

In this paper, presentation time is the time in seconds required to present verbally to the subject the material to be learned. The term "study period" connotes the time allowed the subject for the study of the material presented, and thus does not include presentation time. Its onset was indicated by the signal "Now," or "Take."

The purpose of this study was to compare two methods of learning nonsense material. In one, the subject employed certain learning techniques while awake; in the other, he employed the same techniques in the hallucinated world, under conditions of time distortion, while in the trance state.

The subject was a 22-year-old, single, male graduate student in psychology. He was cooperative and intelligent and an excellent hypnotic subject. He had had considerable experience with the experimental use of nonsense syllables, and had been trained in time distortion. Two series of 150 paired nonsense letter-groups of 3 letters each were used. Some of these were syllables; others were consonant groups. Each pair was printed with blue crayon, in large type, on a $3'' \times 5''$ card thus: CGJ—QXH. The series were of comparable difficulty.

The task was to learn to give correctly, within 3 sec, the second group in the pair, in response to the verbal presentation of the first group by the experimenter. At each daily session, 5 pairs from one series of letter-groups were learned by the subject while awake, and 5 pairs from the other series while he was in the trance state. Twenty-four hr later he was tested for retention and relearning. Waking and trance tasks were assigned in alternate order on successive days.

Learning. At each session there was an initial basic study period, followed by successive runs through the 5 cards.

1. Awake

a) Basic study period: The subject sat at a table with pencil and paper at hand, and was instructed to print out each letter-group-pair 5 times, saying them over to himself and forming associations while doing so. He was to start printing immediately after the presentation of a given pair. The experimenter, in a period of 10 sec, then read the first pair of letter-groups to him thus: "CGJ, dash, QXH—CGJ, dash, QXH—Now." The "Now" marked the end of the 10 sec, and was the starting signal for the subject to print the material 5 times. As he printed, he said the letters to himself and tried to form associations. When this was finished, the pair on the next card was presented in the same way. The average time taken by the printing was 26.5 sec, making a total average time of 36.5 sec.

b) Runs: On completion of the above, the runs were begun, each preceded by a shuffling of the cards. The subject sat with his eyes closed. The experimenter read aloud the first group of one of the pairs, and the subject immediately stated the second group if he could. At the end of 3 sec, the experimenter said, "Take," whereupon the subject opened his eyes and looked at the card. Then followed a 5-sec study period, during which he repeated the letters, and formed associations, but did no printing. This period was terminated by the presentation of the first letter-group of the next pair. Subsequent runs followed immediately and continued until all the responses were correct. The maximum number of runs required was four.

It is thus evident that a run constituted both a test of performance and an opportunity for learning or for reinforcement.

2. Trance State

A moderately deep trance state was induced by suggestions of sleep.

It is important to point out that the following suggestions and instructions pertain to the subject's experience in the hallucinated world only. This world, incidentally, is very real to him, and it is in this, rather than in the physical one, that he carried out his trance study in distorted time, including the (purely hallucinated) printing. Throughout, he remained motionless, with his eyes closed.

a) Basic study period: The following suggestions were given to the subject:

> You're now going to learn some nonsense letter-groups. You will have ample time between signals to learn them solidly. [This reference to "ample time" was understood by the trained subject to refer to his "special time."] As I give you a pair, you will print it out five times, exactly as you did while awake, saying the letters to yourself and forming associations as you do so. After that you may print them some more, or say the letters over to yourself many times more in order to take advantage of repetition, or form unusual associations, or adopt any other method of learning that you wish. This activity will impress the material upon your memory. It is important that you take as much of your special trance time as is necessary. You will not hurry, and it will be easy to learn them and to recall them later.

During the last 13 runs the above suggestions were given verbatim. Prior to that, the same ideas were presented, but the wording was varied slightly at times.

Immediately after giving the suggestions, the actual presentation of the material was begun. The subject sat at a table with his eyes closed, and the letter-

groups were read to him exactly as in the waking state. Then, at the starting signal, he began his trance study, using distorted time. At the end of only 5 sec allotted time, the amount being unknown to the subject, the experimenter gave the termination signal ("Now, blank"), indicating to the subject that he was to stop all mental activity and make his mind a blank. The next pair was then presented. Thus the presentation time was 10 sec, and the hallucinated activity lasted 5 sec.

b) Runs: During the runs, the technique was identical with that used in the waking state, except that the subject, in the 5-sec study period, closed his eyes again and, using distorted time, practiced much as he had during the basic study period for the trance state.

Retention test and relearning. Here the subject was awake throughout. There was of course no basic study period. Runs were assigned until the responses were all correct. The technique was identical with that already described for runs in the waking state. This testing was generally done 24 hr after the original learning, but in some instances several days intervened.

Tables 1–3 show the subject's performance.

TABLE 1

PROGRESS IN LEARNING

Study period	Waking				Trance state			
	I* (Sec)	II† (Pairs)	III‡ (Pairs)	IV§ (%)	I* (Sec)	II† (Pairs)	III‡ (Pairs)	IV§ (%)
Basic	26.5	150	62	41.3	5	150	89	59.3
First run	5	88	54	61.4	5	61	51	83.6
Second run	5	34	25	73.5	5	10	8	80
Third run	5	9	5	55.5	5	2	2	100
Fourth run	5	4	4	100				

* Av duration of study period.
† Total number of unlearned pairs studied during the 30 study periods of a given designation.
‡ Total number of pairs learned in the 30 periods of a given designation.
§ Percentage learned of the total unlearned pairs presented during the 30 periods of a given designation.

TABLE 2

AVERAGE LEARNING TIME

Av learning time per letter-group	Waking (sec)	Trance state (sec)
Including presentation time	41.0	17.4
Not including presentation time	31.0	7.4

TABLE 3

RETENTION AND RELEARNING

	After waking learning	After trance learning
Retention	24%	28%
Av relearning time per letter-group-pair	7.6 sec	6.1 sec

The subject stated that trance study in distorted time seemed easier than waking study. Not only did he have more time for associations, which in addition came more easily, but he had the benefit of rote practice. He always had plenty of time, and felt that he had really learned the material by the end of the study period, even if he didn't always remember it. He did not hurry, and all activity seemed to him to proceed at the normal or customary rate. Although each study period lasted only 5 sec, it seemed to him to be 4 or 5 min.

Those interested in these findings should read the previous reports (*1, 2*) for an understanding of time distortion in hypnosis and its implications. It should be mentioned here, however, that the tasks involving trance study, as described above, fall into the category of completed activities, since they proceed to a specified point—i.e., the learning of the letter-groups. The allotted time was 5 sec. No specific interval of suggested personal time was used, but the subject was told that he would have all the time he needed. The estimated personal time was 4 or 5 min.

The average learning time per letter-group-pair, including the time required for presentation of the material, was 41.0 sec in the waking series, and 17.4 in the trance series. If the presentation time of 10 sec is not included, the times are 31.0 sec and 7.4 sec, respectively.

The results certainly indicate that the study in the trance state in distorted time was more effective than that in the waking state. Further investigation will be necessary to determine the relative significance, in this apparent facilitation of the learning process, of such factors as increased motivation and better concentration on the one hand, and of true "utilization" of special trance time on the other. We believe that the latter is of considerable importance and that the allotted time could probably have been cut down from 5 to 3 sec or less without materially altering the results.

References

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