THE PAVLOVIAN THEORY OF HYPNOSIS: AN EVALUATION*

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EXPOSITION

PAVLOV'S theory of hypnosis is, perhaps, the first theory of hypnosis to be essentially derived from physiological experiments. Arising out of his experiments with dogs, the theory hopes to explain the hypnotic phenomena in human beings.

While engaged in experiments on delayed conditioning, Pavlov noticed that some dogs develop a state of drowsiness after the onset of the CS and lasting until the unconditioned stimulus is given; such states of drowsiness were also observed in animals who had been used for conditioning experiments which started some time after the animal was fastened to its stand. By the repetition of an already extinguished stimulus or the repetition of a negative stimulus established during differential conditioning, drowsiness could also be aroused. Repetition of an indifferent stimulus in a continuous monotonous manner was also observed to produce the same reaction. A sufficiently prolonged continuation of any of the above operations led to deep sleep.

Pavlov called this a state of inhibition between wakefulness and sleep. He called this a state of inhibition for reasons which shall be clear later. The most obvious reason, however, was that it could be produced by the repetition of a stimulus which has acquired inhibitory property.

The following quotation from Pavlov indicates the relation between sleep and inhibition:

> "Internal inhibition† and sleep are one and the same process . . . *inhibition* is a partial, fragmentary, strictly localized sleep confined within definite boundaries under the influence of the opposing process: that of excitation; sleep, on the contrary, is an inhibition which has spread over a great section of the cerebrum, over the entire hemisphere and even into the underlying midbrain." (Pavlov, 1928.)

Thus, sleep and internal inhibition are similar, but not identical.

The phases between wakefulness and sleep are called hypnotic phases by Pavlov. There can be obtained gradual intermediate states of inhibition (hypnosis) ranged from those hardly differing from wakefulness to states tending to deep sleep. These states differ in their intensity and extensity of inhibition in the cerebral cortex (Ivanov-Smolensky, 1952, p. 112). As the application of the inhibitory stimulus continues, inhibition begins to spread; unless otherwise directed by verbal suggestions of the hypnotist, gradually the motor areas of the cortex come under inhibition and catalepsy and paralysis

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† For those less familiar with Pavlov's system, internal inhibition is an active, elaborated conditioned inhibition: extinction is an example. In contrast, external inhibition is a passive unconditioned inhibition. A very loud tone abolishes the conditioned reflex: this can be explained by external inhibition. Both have the same neurological basis.

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may be observed. When inhibition also spreads to the sensory areas and in fact covers the whole cortex, normal sleep develops.

Pavlov noted interesting changes as the state of inhibition deepened. In the first stage of hypnosis (in the animal) both the weak and the strong stimuli act exactly alike in eliciting the CR (Conditioned Response). This is called a state of equalization. Then comes a stage where the weak stimulus is effective, but the strong stimulus is either not at all effective or has a very weak effect. This state is aptly described as the paradoxical phase. In the third stage, called the ultra paradoxical phase, only the previously elaborated inhibitory agents have a positive effect. Finally, a state of complete inhibition characterizing sleep develops. Pavlov seems to imply that the above-mentioned states develop in the same sequence always. Ivanov-Smolensky mentions experiments where this order is not always maintained.

Inhibition, in the Pavlovian system, is a protective mechanism necessary for the survival of the organism. Excitation and inhibition are at opposite poles. When a nerve cell is stimulated beyond its physiological capacity, inhibition sets in. So also, when an extinguished CS (Conditioned Stimulus) is applied continuously, inhibition develops, protecting the cortical cells from "unnecessary" excitation. A partially decorticate animal develops a state of inhibition more quickly than a normal one, because its remaining cortical cells are liable to be more easily exhausted. Thus, the organism is protected from any stimulations that are not relevant for its survival. Sleep, the manifestation of complete cortical inhibition, is, therefore, a valuable protective mechanism. But how does Pavlov explain the state of hyper-suggestibility in hypnosis? The fact is: under hypnosis, there is a selective inhibition of certain parts of the cortex with points of excitation maintained by the suggestions of the hypnotist. It can best be described by quoting Pavlov: "What is suggestion and auto-suggestion? They are concentrated excitation of a definite stimulation, sensation or its trace, a representation, now in evoked emotion, i.e. excited from an internal connection, an association, excitation having been given a predominant, illegitimate and irrepressible significance . . . In hypnosis, we have a diminished positive tonus (in the cortex) as a consequence of irradiated inhibition. When on such a cortex a word or order of the hypnotizer is directed to a definite point the stimulus concentrates the excitatory process in the corresponding point and is immediately accompanied by negative induction, which causes it, without the slight opposition, to spread over the whole cortex; this is why the word or the order is completely isolated from all influences and is made an absolute, irrepressible, fatally-acting stimulus, even after the subject has returned to the waking state" (Pavlov, 1941, pp. 108–109).

Critique

Pavlov is not the only one who holds that hypnosis and sleep have some essentially common elements. Many past and contemporary investigators implied the existence of such a relationship.

Bechterew (1906) regarded hypnosis as a modification of normal sleep induced by suggestions under appropriate physiological conditions: "Hypnosis is nothing, but a modification of sleep." Schilder and Kauders (1927) also maintained in their monograph that hypnosis is a suggested sleep. They were confident that many of the phenomena in hypnosis could be explained by the psychology of sleep. Brown (1935) was of the same view, apparently resembling Pavlov's. Koster (1954) considered hypnosis as a special kind of sleep. None

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of the above investigators *equate* sleep with hypnosis. Barber (1956), however, has reported an experiment where he gave seven suggestions (usual suggestions acceptable in a light to medium depth of hypnosis) to subjects under light sleep and hypnosis. ". . . There were no significant differences between the subject's responses on the seven tests of suggestibility when the subjects were 'lightly sleeping' and after they had been subjected to hypnotic induction." If the degree of suggestibility is taken as an index of hypnotizability (as it is implied in most of the scales to measure hypnotizability), it would appear that light sleep and hypnosis, within the limitations of the reported study, are not significantly different.

Most Russian studies are biased to the Pavlovian standpoint on hypnosis. Assuming that hypnosis is a state of inhibition, Strelchuk (1953) shows how the hysterics, who have a weak second signalling system, can be more easily hypnotized by verbal suggestions; while the psychasthenics, with a weak first signalling system, are more susceptible to hypnosis through rhythmic, photic or dermal (especially thermal) stimuli. Evidently he does not question Pavlov's view on hypnosis. Korotkin and Suslova (1955) similarly mention that verbal suggestions affect subjects differently, the difference being most noticeable in post-hypnotic suggestion. The type of signalling system, they think, may explain some of these cases.

A field of controversy has been the possibility of establishing or "recalling" CRs during hypnosis. If hypnosis is a state of inhibition, it is argued, previously established CRs should disappear or new CRs should be difficult to form during hypnosis. Arguing, apparently, in this strain, Scott (1930) concluded that hypnosis is not a state of inhibition resembling sleep, because CRs were formed more easily under hypnosis in his experiment. But he did not make sure that the subject was in a really deep state of hypnosis most approximate to sleep, so far as inhibition was concerned. Most of the studies which show a facilitation of conditioning under hypnosis are liable to the following criticism: first, the techniques of many of these studies are faulty; the depth of hypnosis has not always been ascertained or mentioned. Where a mention has been made of the depth of hypnosis, adequate checks do not seem to have been made as to whether the same depth has been maintained throughout the experiment or in every session of the experiment. Only a very deep state of hypnosis can be expected to decrease conditionability, because after all, inhibition is partial in hypnosis. Secondly, it may be argued that with a lesser depth of hypnosis, it is only natural that conditioning would be facilitated. It is well known that attitudes interfere with human conditioning (Razran, 1936, 1939). Under hypnosis, when the subject is less critical of what is happening, conditioning may be hoped to be facilitated. Why a really deep state of inhibition is needed to hamper conditioning is shown by two drug experiments.

Sterling and Miller (1941) tried to condition cats under four progressive stages of anaesthesia. Although a small number of cats showed decreased conditioning in the first level (23 per cent.), only on the fourth level was conditioning not possible for any of the cats. Thus it really required a deep level of anaesthesia (and so, inhibition) to abolish conditioning. Headlee and Kellog (1941) found that conditioning proceeded at a lower level, but by no means disappeared under doses of nembutal.

There are quite a few Russian studies showing that conditioning or some other functions suffer under hypnosis. All of them used somnambulistic hypnosis. Maiorov (1950) has found that sensory chronaxie is lengthened during somnambulistic hypnosis; inability to do simple additions, anaesthesia

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and absence of blinking were also observed. He concludes that these are due to an irradiation of inhibition and dissociation—both characteristic of hypnosis. Korotkin and Suslova (1951) report that in the somnambulistic phase, CRs sometimes cannot be established; differentiation is equally impossible; and if CRs can be established at all, they are slowly acquired and have a longer latency. The same authors in another paper (1953) report the disappearance of previously established CRs under somnambulistic hypnosis. In a stage of lesser trance depth, such CRs do appear. Korotkin and Suslova also found that by giving a hypnotic suggestion to inhibit UCS (Unconditioned Stimulus), the CS was inhibited along with the UCS. They explain this in terms of irradiation of inhibition (1955c). The same authors have shown, as did Maiorov, how simple counting and additions become full of errors when worked out under hypnosis. The subjects were given equivalent addition and counting tasks in the state of wakefulness and during somnambulistic hypnosis. They performed definitely worse in hypnosis.* The authors conclude from this that under somnambulistic hypnosis higher nervous activities are affected by inhibition. The carrying out of post hypnotic suggestions is also explained by them in terms of inhibition (1955a, b). All the experiments mentioned above are consistent with Pavlov's view.

The EEG has been used in several studies to settle the issue whether hypnosis is a state of wakefulness or of sleep. Before we consider some of them, let us point out the basic fallacy that may vitiate such attempts to settle the question. The method of many EEG studies has been to obtain records from the same subject, during sleep, hypnosis and wakefulness. When they find that the brain waves under hypnosis resemble those of wakefulness more than they do those of sleep, the usual conclusion has been that hypnosis is not sleep. This neither supports nor opposes the Pavlovian concept of hypnotic phases as intermediate states of inhibition between wakefulness and sleep. It has never been claimed by Pavlov or Pavlovians that hypnosis *is* sleep. In fact, in a great many ways, they are considered different. Even under the deepest possible level of hypnosis, a contact is maintained between the subject and the hypnotist. There are still some cortical points which are "awake". In this sense, the cortex is only partially inhibited. In sleep, even under light sleep tending to a deep one, the whole cortex is under a state of inhibition. The inhibition is perhaps only less intense during light sleep. Attempt at communication hampers development of sleep, while possibility of communication is an essential characteristic of hypnosis. So, if sleep may be visualized to vary in a dimension of intensity of complete cortical inhibition, hypnosis cannot be described in such a dimension. The intensity of inhibition in those cortical areas inhibited under hypnosis may be as great as that found in deep sleep. But still there would be certain cortical points outside that area: some of those points may be under acute excitation by the verbal suggestion of the operator. Seen from this angle, hypnosis and sleep appear to lie in orthogonal dimensions.

We do not know, then, whether the partial wakefulness of the cortex during hypnosis creates a special problem in comparing the EEG records obtained in sleep and hypnosis with a view towards settling the original issue posed earlier.

* There are many studies on learning and memory during hypnosis which report either no deterioration or an improvement of these functions. Weitzenhoffer (1953) has written a good review of them, so we need not review them here. Because even such well-written books, like Hull's (1933) or Weitzenhoffer's, do not contain any reference to Russian or other studies supporting Pavlov's view, we thought it appropriate to bring these evidences to light. This has been adopted as almost a general policy throughout the present paper.

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With this orientation, let us consider some relevant EEG studies. Just before going into the literature on hypnosis and EEG we may mention here an experiment showing how Pavlov's concept of cortical inhibition is demonstrable electroencephalographically. Morrell and Ross (1953) and Morrell (1956) could show that whenever any of the three types of inhibitions (manifested during extinction, delayed and differential conditioning) were induced, a delay in cortical conduction was occurring. They used conditioning of cortical alpha rhythm for their CR.

Darrow, Henry, Brenman, and Converse (1950), in two studies, find a significant difference between states of wakefulness and hypnosis by using EEG. "Analysis of available double speed (monopolar) EEG records obtained on 11 fair to good hypnotic subjects shows, with only one exception, an increase of average in phase peak to peak correspondence between waves in occipital and motor areas." The increment for the hypnotic state was significant below 1 per cent. level. The "records from some of the same subjects while going to sleep show a similar increase in frontal-motor parallelism during drowsiness or early phases of sleep". Hypnosis was, thus, significantly different from wakefulness and only resembled sleep in the early stages. Lundholm and Löwenbach (1942–43) studied the changes in alpha activity under hypnotic suggestions of blindness and deafness. They found that alpha activity was present only when there was an actual absence of stimulation. When blindness was suggested and a light held in front of the subject's eyes, the alpha rhythm disappeared; they reappeared only when the light was actually removed. This shows that physiological modifications, at least in the cortical level, if any, are not made by hypnotic suggestions. The same conclusions could be derived from a study of hypnotic anaesthesia and analgesia (Brown and Vogel, 1938). If a light is held before the closed eyes of the sleeper, perhaps the alpha waves would not disappear, if they were present. But under suggested hypnotic blindness, in the same conditions, they did disappear. From this it would be erroneous to conclude that hypnosis is not a state of inhibition resembling sleep. For during sleep, if it were possible to keep the eyes open without awakening the subject as is done under hypnosis, it is probable that holding a light before the open eyes of the sleeper would block the alpha activity. Furthermore, under hypnosis, suggestion may be able to inhibit only the *perception* (interpretation of sensation) rather than the physiological outcomes of sensation. A dissociation between sensory and association areas may be the most likely neurological explanation.

Barker and Burgwin (1948, 1949) made a new approach to the problem by distinguishing hypnosis from sleep and hypnotic sleep. They found that when trance was induced without any mention of "sleep", "relax", etc., the brain wave patterns did not resemble sleep at all. But when the subject was asked to relax, his attention narrowed down and suggestions of sleep were given. "Sleep indistinguishable electroencephalographically from normal sleep in various stages" could be produced and terminated. "We have repeatedly observed that suggestions which minimize sensory stimuli and ensure maximal muscle relaxation are associated with changes in the brain wave patterns towards that of sleep." It may be remarked that most induction methods use relaxation and suggestions of narrowing down of attention. So it can only be asked whether the brain wave patterns characteristic of sleep do not disappear when communication is attempted with the subject. Sleep, according to these authors, "is characterized by the absence of active relationship with the environment". If the operator's suggestions can be accepted as a part of the environment,

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hypnosis cannot, perhaps, be described in identical terms. Dynes (1947) seems to have overlooked this. He obtained EEG records continuously from subjects during the induction of hypnosis and perhaps implicitly argued that as the subject passes from wakefulness to hypnosis the EEG records would progressively resemble those of sleep. This was, obviously, not found; he does not even mention whether the subject was taken to a somnambulistic stage.

Summarizing the researches in this field, Chartok and Kramraz (1955) arrive at the conclusion that EEG studies are not yet in agreement about electroencephalographic similarity between sleep and hypnosis. They also report an experiment done by them on good hypnotic subjects. Again, only in some subjects did brain waves resembling those during sleep appear. An absence of operator- and subject-contact could allow the sleep pattern to be retained in some.

In concluding this section, we only mean to reiterate our standpoint outlined at the beginning of the section: we do not know whether the partial wakefulness of the cortex during hypnosis may account for all the difference between EEG records obtained under sleep, wakefulness and hypnosis.

An Experimental Support

It has been mentioned before that Pavlov's dogs could develop states of drowsiness under monotonous stimulation. On subsequent occasions, the dogs became drowsy in an increasingly shorter time. Thus, at last, a dog may develop drowsiness as soon as it is brought into the laboratory or fastened to its stand. Two distinct points could be noticed: (*i*) a state of drowsiness (as a result of inhibition) can be produced by laboratory techniques; (*ii*) with subsequent practice, the development of such a state may appear as a conditioned response to the environment of the laboratory itself.

These two findings are from studies on dogs. Can these be obtained with human subjects? What, if any, is the relation between the speed of development of such a state and the depth of hypnosis attainable for a certain subject? The experiment to be reported was designed to answer these questions.

During an experiment on hypnosis and conditioning, it was discovered that some subjects could not be made to wake up easily after hypnosis and some of them became so drowsy during an experiment on eyelid conditioning that they had to be reminded frequently to keep their eyes open. One subject showed this trend so strikingly that it could not be overlooked. He was hypnotized, but could not be awakened in the usual manner (counting slowly up to 15 and asking the subject to wake up at the end of the counting). Commands, persuasions, mild shaking, could not wake him. After some shouting and severe shaking, the subject finally woke up slowly. E (experimenter) assumed that the subject had fallen asleep; but upon asking the subject, he said that he was listening to all the persuasions of E to awaken him, but just could not pull himself out of that state. During the conditioning experiment, he began to feel so extremely drowsy that he could not keep his eyes open, and the experiment had to be discontinued. Later, he reported that in spite of his best attempts, he could not keep his eyes open. This case, an extreme of similar cases, led to the experiment to be described below.

Method

Four subjects, whom we shall call OF, RA, ST and MA, were used. RA was the case described above. OF and RA had high scores in hypnosis: RA had the highest possible score, 6: OF had a score of 5; ST and MA scored

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low in hypnosis: 1 and 2 respectively. The lowest possible score was 0 and the highest was 6.

The following device was used to produce inhibition. In a sound-proof room, usually used as a conditioning laboratory, S was asked to sit comfortably in a dentist type chair. He had, in front of him, a booth with a little red light (·5 watt) in the centre. He was instructed to keep looking at the red light all through the experiment. A continuous pure tone of 1,110 cs. per second, an intensity of 10 decibels above the subject's auditory threshold, was transmitted to the pair of earphones which the subject was wearing. The tone was regularly discontinued for ·5 second in every 30 seconds. S had been asked to blink when he perceived this break in the tone. S was wearing a pair of spectacles with plain lenses; on the lens for the right eye, a tiny photoelectric cell was mounted and was connected to an appropriate apparatus, and then to a tracing pen. Besides this pen, there was another pen acting as an event marker. Both the pens were parts of a recording milliammeter. Thus every time a break in the tone was made, the event marker traced an elevated curve for ·5 seconds and if the subject blinked, the other pen traced a rather sharp rise. E had a switch which, when pressed, would discontinue the tone for ·5 seconds, after which the tone would resume automatically. E with all the apparatus was in one part of the room, separated from S by a one-way screen.

S was not told about the purpose of the experiment. He was told that he is expected to sit relaxed and to blink to the break in the tone.

Since the experiment was of an exploratory nature, a rigid common procedure could not be fixed from the beginning. It was only broadly decided that the experiment should be carried on for 20 minutes and if an S did not miss a single chance to blink to the break in the tone during that period, the session should come to an end. If S began to show signs of drowsiness and failed to blink, the session was to continue until he did not blink to 10 successive breaks. He was to be taken out of the laboratory, given ten minutes of performance on the pursuit rotor and again brought back for the next session. In this way, the experiment was to continue until S did not blink to the first break in the tone.

Results

A summary of the results are to be found in the accompanying table. It will be seen that OF could not blink 30 seconds after the 4th session started and RA fell into a state of drowsiness as soon as the 2nd session began. In fact, he later reported that he felt sleepy as soon as he entered the laboratory for the 3rd session. Both of these subjects were seen sitting in the chair, with their heads drooping and eyes closed, after they had stopped blinking. RA was snoring

Table

Subjects	Hypnotism Score	Trials* and Minutes after which Blinking Stopped				
ST ..	1	Did not stop.				
MA ..	2	Did not stop.				
		Sessions				
		i	ii	iii	iv	
OF ..	5	12	10	3	1	(trials)
		6	5	1·5	·5	(minutes)
RA ..	6	12	0	0	–	(trials)
		6	0	0	–	(minutes)

* Every time a break in the tone occurs is called a trial; each trial occurring once in every ·5 minute (30 seconds).

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audibly in the third session. In contrast, ST reported having felt only bored. MA felt sleepy, but said that he did not think that he would have really fallen asleep had the experiment continued longer.

Discussion

The results need little discussion. Our first objective was to show that a state of drowsiness, analogous to the one observed in Pavlov's dogs, could be produced in human subjects. Perhaps we can say that we have been able to demonstrate it unequivocally. We have further shown that in those in whom this state of drowsiness developed, it began to take a shorter time with practice, so much so that the mere sight of the laboratory environment initiated it—our subject RA developed drowsiness in less than 30 seconds. Pavlov had also noticed similar phenomena in his dogs. To support hypnosis as a state of inhibition, we find that the two subjects who did not develop such a state scored low in hypnosis—indeed, they are to be classed as unhypnotizable if we were to classify dichotomously. (A person scores two if he does not accept any of the five hypnotic suggestions, apart from the post-hypnotic suggestions, but feels relaxed, heavy and slightly drowsy; a score of one is given when he feels just relaxed.) A correspondence can also be noted between the hypnotic scores and the reaction to the experiments:

ST Hypnosis score: 1, felt bored.
MA Hypnosis score: 2, felt sleepy.
OF Hypnosis score: 5, found sleeping after 30 seconds.
RA Hypnosis score: 6, found snoring.

The number of cases is too small to apply any statistical technique to demonstrate a relationship. It would, however, be permissible to expect a positive correlation between depth of hypnosis attained and the speed of the development of this state of drowsiness under monotonous stimulation. We also found indications of a positive relation between the depth of hypnosis and the speed of conditioning to the monotonous environment of the laboratory which produces the state of drowsiness. Does it imply that a correlation between hypnotizability and conditionability exists? We consider it a likely hypothesis.

We have been calling the experimentally produced state under which the subject could not keep his eyes open to be able to blink a state of drowsiness. This is clearly a superficial nomenclature. If we follow the Pavlovian terminology, it can best be described as a state of experimentally produced inhibition intermediate between wakefulness and sleep. This is a learned state inasmuch as it is amenable to improvement with practice. If a correlation is found between this and hypnosis, and is interpreted as meaning a basic similarity between the two, hypnosis may be defined as a learned state of inhibition and hypnotizability an ability to learn to develop inhibition.

Summary

A brief exposition of Pavlov's conception of hypnosis as a state of inhibition intermediate between wakefulness and sleep was made. Evidence mainly supporting this view was presented. Some relevant EEG studies were examined. Some of them appeared to have disproved the identity between sleep and hypnosis. This was not regarded as evidence against the Pavlovian view of hypnosis. A small experiment carried out by the author was described. It demonstrated the possibility of the development of a state of inhibition (drowsiness) in human subjects by monotonous application of sound and light stimuli in a generally monotonous laboratory condition. Pavlov had demonstrated similar phenomena on dogs. The results of the experiment also suggested that such a development of inhibition improves with practice and may be correlated positively with an increasing degree of hypnotizability.

On the whole, it is felt that there is enough evidence to make out a case for supporting Pavlov's view of hypnosis as a state of partial or selective inhibition.

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