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Kinesthetic Versus Visual Retroactive Inhibition

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KINESTHETIC VERSUS VISUAL

RETROACTIVE INHIBITION

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CHAPTER I

A THEORY OF FORGETTING

Introduction

The passage of time is often considered as the cause of forgetting (8, p. 217). This is clearly depicted in the classical experiment by Ebbinghaus (13, p. 52). He memorized many lists of nonsense syllables. Some of these lists were relearned twenty minutes after he had memorized them to the point of one perfect repetition. Other lists were relearned a day after, some two days later, some six days later, and so on. He found that approximately forty-seven per cent was forgotten in twenty minutes, sixty-six per cent in one day, seventy-two per cent in two days, seventy-five per cent in six days, and seventy-nine per cent in thirty-one days. Several studies since then have also indicated that memory of previous experiences grows fainter with a lapse of time.

It is by no means certain, however, that lapse of time as such, causes forgetting. According to Woodworth (13, p. 52) only the processes that go on in time are important, since time is not a force or agency. In other words, time may be an important factor in forgetting merely because of the activities which occur in time.

The present study is designed to investigate those processes in time which affect recall. In attempting to do this, several studies concerning the effects of interpolated activities on forgetting will be explored in the next section. Future sections will be devoted to an application of these findings to a specific theory of forgetting.

The Effects of Interpolated Activities on Learning

Numerous experiments have shown that forgetting is decreased when the original learning is followed by a period of inactivity. The pioneer study in this area was done in 1924, by Jenkins and Dallenbach (3). They demonstrated that varying periods of sleep, immediately preceded by a period of learning, facilitated recall of the learned material. Corresponding periods of waking activity seemed to interfere with and retard recall of the learned material. These findings have been verified in later research by Minami and Dallenbach (7). They placed cockroaches in a state of tonic immobility after the cockroaches had learned to avoid a shaded area in a learning box. Another group which learned the same response was subjected to interpolated activities. Comparison of the two groups definitely indicated a superior retention by the inactive group.

Using human subjects, Van Ormer (12) and Houlahan (2) have also been successful in demonstrating that induced inactivity following acquisition retards the rate of forgetting. In the investigation by Houlahan, one thousand school children, separated into equated groups, studied twenty-five verbs and then recalled all they could after twenty-one minutes and after twenty-four hours. The experimental group studied a list of nouns for seven minutes of the interval. Some of the experimental group studied the nouns immediately after studying the verbs, others studied the nouns following a rest of four minutes, and still others following a rest of eight minutes. Thus, the interpolated learning came at different intervals following acquisition. The control group sang familiar songs during the entire twenty-one minute period.

The lowest retention score within the experimental group was for interpolated study immediately after learning. Retention after twenty-four hours showed little loss for the control group, but a large loss for the experimental group. In both groups the longer the rest period between learning and interpolated study, the higher the retention score.

Van Ormer's subjects learned lists of syllables either in the morning or just at bedtime and relearned them after intervals of waking or sleep. Retention was much improved after sleep, especially with the eight-hour interval.

These findings, which are supported by a large body of evidence, will be discussed in the following section in terms of their relationship to an "interference" theory of forgetting and a "perseveration" theory of learning.

The Nature of Interference

If practicing one act makes another more difficult to perform, the increased difficulty is attributed to "interference" (13, p. 223). The effects of interference are demonstrated in a study by Bergstrom (13, p. 224). He used a pack of eighty cards, eight of a kind, to be sorted into ten piles, the location of each pile being designated by a sample card. Two different arrangements of the piles were prescribed, and the pack was sorted alternately according to the two arrangements. When the interval between sortings was only three seconds, interference was very noticable, but as the interval increased the effect rapidly decreased, and in twenty-four hours had vanished altogether.

A similar card-sorting experiment was conducted by Culler (13, p. 225). The cards were sorted into two sets of pigeonholes labled with sample cards. The two sets of pigeonholes, A and B, demanded different arrangements of the cards. One group sorted alternately in the two arrangements, another group sorted four times by the arrangement before changing, and a control group sorted throughout by the same arrangement. A rest period of thirty seconds was taken between trials.

The results of this study indicate that there is a genuine interference between the two performances. In comparing the control group with the two interference groups, it is apparent that the control group, except on the last day when it apparently reached its peak, shows improvement throughout each day's work. In the interference groups the first sorting each day was usually the quickest, however, as soon as the contrary performance was introduced the work became slower.

The relationship between these results and the findings of the authors cited in Section II is fairly obvious. In both instances activities interpolated immediately after learning seem to retard recall. Similar findings of closely related studies (3) have been interpreted as showing that forgetting is not so much a matter of the decay of old impressions as it is a matter of the interference of the old by the new.

Impairment of recall by mental activity interpolated between learning and recall is often referred to as "retroactive inhibition." An examination of its relationship to "perseveration" is necessary at this point.

In all of the studies cited previously, interpolated activities presented immediately after the original learning seemed to impair retention as if it prevented the memory trace from being properly established. Since increased inactivity immediately after learning allows the memory trace to become better established, there is evidence which indicates that even though the overt learning process has come to an end, it is by no means certain that the whole process of forming the trace is finished. The physiological processes which are intensely active during learning, quite possibly do not lapse instantly into quiescence, but perseverate for a short time at least, and during the after-activity continue to strengthen and consolidate the traces (13, p. 227). Such a phenomenon would support the author's contention that rest immediately after learning favors perseveration and allows for full consolidation of the traces, while strenuous mental activity just at this time cuts short the after-learning and leaves the traces weak.

A functional account of perseveration can be found in the work by Hebb (1). His work in neurophysiology indicates that a repeated stimulation of specific receptors will lead slowly to the formation of an "assembly" of association-area cells which can act briefly as a closed system after stimulation has ceased. This prolongs the time during which the structural changes of learning can occur and tends to induce lasting cellular changes which allow permanent memory to occur.

In interpreting the findings of the studies referred to earlier, the evidence of Hebb suggests that activities interpolated after learning interfered with learning because excitation of the neural circuits involved in the original learning was not prolonged enough to cause the cellular changes necessary for the learning to become permanent.

It is especially obvious that interference depends greatly upon recency when the card sorting investigation by Culler is examined. At the beginning of each day's work the effect of previous practice is strongly in evidence, and the first trial shows little interference holding over from the day before. During each day's work the interference effect is so strong as to mask further improvement that is being made, and that will be revealed by the work of the following day.

Various investigations (6) have shown that there is also a relation between the degree of forgetting and the similarity of the interpolated activity to that involved in the original learning. These findings and their relationship to the locus of forgetting will be discussed in the next section.

The Locus of Forgetting

In 1935, Nagge (9) found that if the original list of nonsense syllables was presented to the eye and the interpolated list to the ear, or the reverse, retroactive inhibition was not as great as when both activities involved the same visual or auditory pathways. A comparison of retention scores between the conditions where the interpolated learning was sensorially dissociated from the original learning activity and where the learning activities were mediated by a common sense avenue, indicated that there was a reliable difference.

In terms of a perseveration theory of learning, the findings of Nagge could be interpreted as an indication that forgetting was greater when the interpolated activity involved the use of the same sense modality, because the neural activity in both cases was concentrated in the same area of the brain. When the interpolated activity involved the use of a different sense modality, the neural activity was concentrated in a different area of the brain. As a result there was less interference or disruption of the reverberating circuits activated by the original learning task, thereby permitting an improved retention.

A similar, more recent study is interpreted in a like manner. Using Lashley's evidence (4, 5) that memory traces of discriminative habits based on brightness and pattern are localized within the visual projection area, Thompson and Bryant (11) hypothesized that activity will produce forgetting only if it is of such a nature as to affect the visual cortex.

They found that placing a group of ten rats in a dark room after learning a visual discrimination task, brought about a superior retention of the task in comparison to a group of ten rats which were placed in a lighted room after learning the same task. This is even more convincing in view of the fact that the subjects which were placed in the dark room were more active than those placed in the lighted room. These results strongly support their hypothesis that activity of the relevant receptor interferes with memory, and are interpretable in a perseveration frame of reference.

The purpose of the present paper is to supplement the works of Thompson and Bryant, and Nagge by extending these older studies to a different sense modality. Specifically, the author hypothesizes that forgetting is greatest when the interpolated learning task involves the use of the same receptor utilized in the original learning task. The second chapter will describe the method used to test this specific hypothesis. Chapter III will report the results, and Chapter IV will be devoted to a discussion and summary of these findings.

CHAPTER II

METHOD

Subjects

The Ss were twenty-eight volunteer male students from Fort Hays Kansas State College.

Procedure

The Ss were tested individually. After the S entered the experimental room, he was seated before a table. Fastened onto the table-top were two finger mazes, A and B. Both mazes were covered so that S could not see them when he entered the room.

Every S was told that the purpose of the experiment was to see if he could learn one of the mazes blindfolded to a criterion of two perfect successive trials. A three-inch wooden pencil without lead was used to trace the mazes. The experimenter guided S back to start box to begin each new trial.

After learning the first maze, half of the Ss, or Ss in Group I, were told to begin on the second maze and try to learn it to a criterion of two successive perfect trials. At the end of fifteen minutes Ss were stopped. The remaining Ss, or Ss in Group II, after learning the first maze, were asked to remove their blindfolds, and study the second maze for fifteen minutes so that at the end of that time S could trace the maze blindfolded without making a single mistake. In both broups, Ss were required to relearn the first maze immediately after the fifteen minute interpolated activity.

CHAPTER III

Results

On the relearning task the Ss who used the same sense modality in the original and interpolated learning made a combined total of 128 mistakes. Those Ss who did not use the same sense modality in learning the original and interpolated task made a combined total of 34 mistakes in relearning the first maze.

According to the Kolmogorov-Smirnov One-Sample Test (10) the maximum deviation between the two groups was found to be near .357. Statistical tables revealed that when the maximum deviation is equal to or greater than .349 with a sample of 14, the associated probability of occurrence (two-tailed) is near $p=.05$.

ABSTRACT

In this paper an attempt was made to show that forgettins is caused by interfering activities in time and not by time as such. To demonstrate this the many studies concerning the effects of interpolated activities on learning were investigated. These findings were interpreted in terms of an "interference" theory of forgetting and a "perseveration" theory of learning.

The many studies involving retroactive inhibition seem to support the idea of a perseverating action in the neural tissues of the brain even after the overt learning process has come to an end. When this perseverating activity is allowed to continue without interference, cellular changes occur thereby allowing memory to become permanent.

There is evidence presented also which suggests that forgetting is greatest when the interpolated activity and the original learning activity involve the use of the same receptor. Because the use of a specific receptor excites neural activity in a particular area of the brain, it was suggested that forgetting is greatest when a common sense modality is used in the original and interpolated learning, because the neural activity in both cases is concentrated in the same area of the brain. As a result forgetting is increased because of the interference, which prevents the memory trace from becoming established by disrupting the reverberating circuits.

CHAPTER IV

Discussion and Summary

Discussion

As expected, the results of this experiment are consistent with the previous findings of Thompson and Bryant, and Nagge. The primary importance of this study, however, was to supplement their work and use this information to elucidate the general problem of the nature and locus of forgetting.

Although previous research (6) has indicated a relationship between the degree of forgetting and the degree of similarity between learning tasks, the relationship has generally been attributed to other factors; mainly the passage of time. In terms of the present study, this relationship can be more clearly understood only if one accepts the assumption about the structural changes that make lasting memory possible. According to Hebb (1) this assumption has been made many times before, in one way or another, and repeatedly found unsatisfactory by learning theory critics. However, he also contends that because of added anatomical and physiological knowledge, this assumption is becoming more defensible and more fertile than in the past.

A similar criticism could be leveled toward the concept of reverberating circuits. To the extent that anatomical and physiological observations establish the possibility of reverberating after-effects of a sensory event, the present author regards such a process as the physiological basis of "transient" memory.

The greatest need for research in regard to this study seems to be in the area of neurophysiology. Studies such as the present one, however, even though not directly concerned with neurophysiology, provide another means by which the nature and locus of forgetting can be investigated.

Summary

The obtained results led to the following conclusions:

1. Forgetting is greatest when the initial learning task is followed by another learning task involving the use of the same sense modality. Such a conclusion is supported by evidence which indicates that the neural activity activated by the use of the receptor involved in the learning tasks is concentrated in the same area of the brain. According to the perseveration theory of learning expounded in this paper, such an interpolated learning task prevents the memory trace from becoming established by disrupting the reverberating circuits.

2. In light of the previous evidence favoring a transient type of memory, it would seem that there is a memory trace that is wholly a function of a pattern of neural activity, independent of any structural change.

3. Because the neural activity activated by various receptors is localized in specific parts of the brain, the author concludes that the entire brain is not involved in every learning process.

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