A Study of the Three Phase Concept of Memory: Its Musical Implications

Author(s): P. Thomas Tallarico

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ARTICLE OF INTEREST

A STUDY OF THE THREE PHASE CONCEPT OF MEMORY: ITS MUSICAL IMPLICATIONS

p. thomas tallarico

This study presents important findings related to a description of a recent theory of memory which has grown out of the current interest in memory research. Evidence has been cited which attempts to substantiate this theory and is followed by speculation as to the musical implications of the three-phase concept of memory.

The music educator faced with the problem of preparing students to memorize or more effectively retain a musical composition constantly searches for an efficient means of accomplishing the task. Many questions arise as a result of this search. The elementary vocal teacher must ask, for example, whether memory span is increased during the rote process if a

new song is presented at the beginning of the period and then repeated twenty minutes later. Is it possible that a twenty-four hour period between presentations will result in less forgetting? Does the style or character of the musical stimulus which immediately follows a new composition affect the amount of retention? Obviously, these questions are of a very practical nature and point toward a need for a greater awareness of recent developments in memory research.

One who attempts a study of human memory is immediately impressed by the current increase in experimentation investigating the nature of the memory process. In 1966 McGaugh indicated that "in the last decade and particularly during the last few years, interest in the nature of the processes underlying learning and memory has surged dramatically."[1] Adams points out that "Research on memory has taken large steps in recent years, and our present understanding has reached heights beyond all expectation . . . ."[2] This dramatic growth of research is an inescapable fact of modern experimental psychology which has added new and respectable dimensions to the scientific understanding of the concept of memory. It would appear that it is now imperative for the music educator to systematically examine this expanding body of knowledge and determine its possible application to the teaching of music.

The results of this research assume even greater significance when the following statement by Deutsch concerning memory is considered: "We know that time alters the stability of memory, and this alteration presumably reflects in some way the underlying physical processes. Many theories have been advanced to explain these changes, but only recently have discoveries been made that permit us to test the validity of theories."[3] Deutsch's remarks indicate that we have entered a period in which previously held notions concerning the memory process may be unable to withstand the results of modern experimentation. In addition, recent research has resulted in the formulation of new theories of memory—theories which may have important musical implications.

One aspect of the memory process which has received a great deal of consideration has been whether or not the storage of information involves more than one type of memory. Present evidence seems to indicate that there may be validity in the position that different memories do exist. From this has emerged a theory which assumes that the retention or storage of information may involve three different memories. This theory, a three-phase concept of memory, has recently gained support from some authorities in the field of memory research. It is important to ask whether or not this concept is of value for those involved in areas of music education which require the memorization of musical material. The purpose of the following study is to determine the musical implication of the three-

phase concept of memory. Important findings are first presented which are related to a description and possible substantiation of this concept.

Important Findings Related to a Description of the Three-Phase Concept of Memory

In order to gain greater insight into the nature of the three-phase concept of memory it is important to note the present status of our knowledge concerning certain processes involved in human memory. Norman has provided a brief account of the extent of this knowledge and has indicated that there is now general agreement concerning a number of essential features of human memory.[4] For example, many authorities concur with the concept that at the initial stage "a visual or auditory signal is transformed into a sensory representation by the appropriate sense organs. Then, a sensory storage system maintains an image of that signal for a short time after the physical signal ends."[5] Reitman explains that information first enters the system through the senses and remains in a sensory register for a fraction of a second. This information is then passed on to the next process or lost through a very rapid decay.[6]

It is with the next process, the one with which this study is directly concerned, that some degree of controversy still exists. According to Brierley, the next process involves the retention or storage of information which comes from the sensory register or sensory storage system.[7] Is the information or material retained in one memory system or do several different types of memory exist? One explanation, the unitary theory of memory, assumes that there is but one type of memory. In contrast to this concept is the one which assumes that two different types of memory exist. This dual conception of memory makes a distinction between what is referred to as "short-term memory" (STM) and "long-term memory" (LTM). (Other writers refer to STM as "recent," "immediate,"[8] "primary,"[9] "short-term" or "dynamic" phase, while LTM is also called "secondary," "permanent," or "consolidated" phase.[10]) Some psychologists believe that material may at first be retained in the STM and then subsequently transferred to the LTM, which differs from STM in various ways.

Recent findings are pointing to a third type of memory. Halstead and Rucker have concluded that memory appears to have three phases: The dynamic phase, the intermediate phase, and the permanent or consolidated phase.[11] In addition to the STM and LTM, as in the two-phase model, this three-phase concept of memory suggests an intermediate-term memory (ITM) which holds the material that is to be remembered while the STM is dissipating and LTM is forming.

Although it is not possible at present to describe each of these three

phases with precision, certain characteristics have emerged as a result of extensive experimentation. One point upon which all authorities agree is that the capacity of STM "is very small indeed."[12] This small or limited capacity, also known as the 'memory span,' has been defined as the "limitation in the amount of data which a subject can absorb in STM in a single, brief learning opportunity and then recall immediately."[13] The concept of memory span is significant for a theory of memory because it clearly defines a property of STM that does not seem to apply to the other phases of memory storage.

What happens to the information that is retained in this first phase of memory storage? Several opinions have been expressed in answer to this question and two of these are of great importance. According to one viewpoint the "material in STM decays rapidly so that it has essentially disappeared if 8 or 10 new items enter the memory afterward or 10-20 seconds elapse."[14] Although there is disagreement as to the interval of time of decay, it is assumed to be of very short duration. This theory, the theory of trace decay, states that the effect of time per se is the cause of forgetting and operates in much the same manner as the spontaneous decay of a radioactive substance.[15] (Trace or memory trace has been defined by Munn as "A term representing the neural modification inferred to underlie memory."[16]) Norman points out that an earlier concept of this theory of trace decay suggested that material in the STM fades away in time unless some effort is made to retain it by means of what is termed rehearsal.[17] Thus, according to trace decay theorists, if the material to be remembered is practiced (i.e. rehearsed) it will remain for a longer period of time in STM. Conversely, the decay theorist assumes that material that is not rehearsed will be lost as a result of time. This point has been disputed in recent years with the opposing position taken that time has little effect upon the material stored in STM. The opposing viewpoint assumes that interference and not time is the cause of the loss of material in STM.

Adams, after having reviewed recent literature on the matter of trace decay and interference, concluded that "There is no rapid decay in STM. The memory trace is stable as long as there are no interfering events, and in this sense the lable 'STM' is inapplicable. However, the material in STM, being at a low level of practice, is highly susceptible to interference. The interference comes from other verbal events which have similar sounds."[18] Evidence for this comes from the work of A. D. Baddeley who, in a series of three related experiments with verbal material, concluded that interference in STM was a result of acoustic similarity (words with similar sounds) rather than semantic similarity (words with similar meanings).[19]

A study of the second phase of memory storage (ITM) is a recent occur-

rence in the history of memory research. Halstead and Rucker have described various aspects of this intermediate phase and they indicated that it may have an independent life of its own which retains information during the time that the first phase (STM or dynamic phase) is dissipating and the third phase (LTM or consolidated phase) is still being formed. In addition, they have proposed that the three phases operate sequentially with the likelihood that there is some overlap between succeeding phases as one fades and the next grows. There is also the possibility that the intermediate and long-term phases may not depend upon each other for their existence. Furthermore, the intermediate-phase has a different rate of decay and growth than either the short-term or long-term phases of memory storage.[20] Wayne A. Wickelgren has elaborated on this aspect of ITM. After pointing out that the first phase of STM consolidates and decays very rapidly, he continues by saying that "It is quite reasonable to suppose that ITM requires a much longer consolidation time than STM . . . ."[21] (The term consolidation cannot, at present, be defined with precision. According to Hebb, however, consolidation or the consolidation process may involve either or both of the following: (1) a structural change in a neuron, or (2) a chemical change in a neuron. The time needed for such changes would be the consolidation period.[22]) The time which is required for each phase to consolidate ". . . may be a matter of hours or days for LTM."[23]

At this point there has not been any research into the capacity of the second phase of memory storage. Research into the capacity of LTM has shown that it is very large and unspecified. Unlike the study of STM the decay and/or interference characteristics, however, have been intensively studied in LTM over the past fifty years. It has been shown that this third phase of memory storage differs from the preceding ones in that LTM is a more permanent repository for information than either of the others.[24] The study of verbal interference in LTM has revealed that "At our present status of knowledge there seems good cause to assume different laws of interference for STM and LTM . . . ."[25] Work by Baddeley and Dale dealing with verbal interference during the long-term store have shown that LTM, unlike STM, is affected by words with similar meaning but not words which sound alike.[26]

Evidence in Favor of the Three-Phase Concept of Memory

There is much evidence indicating the existence of more than one type of memory. It has already been pointed out that a substantial difference exists between the STM and LTM capacities. The numerous verbal studies which deal with this quantitative difference suggest that it is one

reason for believing that there are at least two phases of memory storage. The study of the effect of different types of interference has been cited as additional evidence that there is more than one type of memory storage.

One important source of physiological evidence indicating that there may be a qualitative difference between STM and LTM comes from the study of loss of memory for events immediately preceding a head injury. Although research dealing with this phenomenon had occurred as early as 1885,[27] the most important study was made by Russel and Nathan in 1946.[28] In a survey of over 1,000 cases of head injury they found that more than 700 of the individuals in the study had forgotten events that occurred just before their injuries (up to 30 minutes before), while only 133 patients had forgotten events occurring earlier than 30 minutes before the accident. This suggested to the authors that the storage of recent events (i.e., STM) involves a process which is more susceptible to interference than the storage of memories of more remote events (i.e. LTM).

A considerable amount of evidence implying at least two types of memory storage has accumulated as a result of experiments which study the effects of various drugs upon memory. Injections of the antibiotic, puromycin, have been given to laboratory animals in numerous experiments over the past few years. These studies have generally shown that puromycin intefers with LTM but not with STM.[29]

Evidence for an additional intermediate phase of memory has been provided by Halstead and Rucker. In their investigation of the previously referred to survey made by Russell and Nathan involving over 1,000 head injured patients it was pointed out that some patients were able to recall details of the circumstances of their injury if they were questioned within a few minutes of the accident. Half an hour later, however, they appeared to have forgotten completely what had occurred. Halstead and Rucker argue that since the loss of LTM implies disruption of STM, it seems as though their memory must have been stored in some other form just after the injury. It is believed that this other form is the intermediate phase or ITM which holds information during the time when the STM is dissipating and the LTM is being formed.[30] E. R. John cites as evidence for the existence of an intermediate-term phase (which he refers to as temporary holding phase) the fact that other studies have shown that electroconvulsive shock (ECS) does not 'erase' the memory of a learned act. Instead, these studies revealed that when subjects received ECS immediately after a learned act, retention is perfect one hour later with a gradual decay of performance to complete amnesia by 24 hours. In other words, LTM does not form. "This evidence indicates the existence of a temporary holding phase, capable of mediating retrieval for periods up to one day, but insufficient for permanent storage . . . . Apparently, ECS interferes with the mechanism which

eventually mediates permanent storage, but a different mechanism is responsible for holding the memory during the period before long-term storage is accomplished."[31]

In 1963 Kamin reported on the results of an experiment that two authorities later cited as evidence for an intermediate phase of memory storage. Six groups of rats with 10 rats in each group were taught to avoid punishment (buzzer and shock) in a shuttlebox apparatus. In the original training period the rats were trained to a criterion of three consecutive avoidances. Each group was then tested at intervals of 1 minute, 30 minutes, 1 hour, 6 hours, 24 hours or 20 days to determine how much they had retained of the original avoidance training. Kamin found that the amount retained at first declined with time but then increased. The four groups of rats which were tested at intervals of 1 minute, 30 minutes, 24 hours and 20 days after learning showed good retention on the 25 relearning trials. In contrast, however, the two groups which were tested one hour and six hours after the original learning showed a sharp drop in performance. This period of poor retention, sometimes called the "Kamin effect," has been experimentally substantiated by a number of other investigations.[32] Halstead and Rucker have studied the results of Kamin's work and they are of the opinion that these results support the three-phase concept of memory. They have attributed the "Kamin effect" to the unequal rates of decay and growth of the intermediate and LTM process. The work of Kamin as well as some of the other previously mentioned evidence has led Halstead and Rucker to postulate the following about the three-phase concept of memory:

"Apparently the intermediate phase of memory (strong at 30 minutes) fades and if the consolidated phase of memory does not become established rapidly, there is a period (at 3 to 6 hours) when a memory gap occurs . . . . Retention of memory, then appears to have three phases; the dynamic phase, the intermediate phase, and, the permanent or consolidated phase."[33]

Musical Implications

In 1940 Grace Rubin-Rabson was in the process of making a thorough study into the psychology of memorizing piano music. The results of this experiment are interesting when considered in light of the three-phase concept of memory. One of the questions that she had tried to answer concerned whether or not there were any significant differences in retention when material was memorized by means of a method referred to as massed practice as opposed to memorizing material by the distributed practice method. In order to solve this problem nine experienced pianists were

selected as subjects and subsequently divided into three groups of three each (group I, II, and III). Each group memorized nine, eight-measure excerpts utilizing three methods (A,B,C). For all three methods the objectives were for the subject to have one smooth memorized performance by the right hand alone, one by the left hand alone, and one smooth memorized performance utilizing both hands. Method A was described as massed practice and included ten trials for the right hand, ten for the left, and ten trials for both hands. Method B was described as a form of distributed practice in which the subject had five trials or practice periods for the right hand, five for the left, and five for both hands. One hour later five additional trials were completed. Method C was also described as a form of distributed practice in which twenty-four hours separated each of the five trials. Each excerpt was studied and intensively analyzed before any practice at the keyboard. After a two-week period the subjects were tested for the amount of retention of the material. At that time there was no preliminary study and the amount of retention was measured in terms of the number of trials the subjects needed in order to play one smooth memorized performance with both hands.[34]

According to the results of the experiment, significant differences occurred between methods when the material to be memorized was tested for retention two weeks later. The total number of trials required when the memorized material was tested for retention at that time was as follows:

(1) Method A resulted in a total number of 250 relearning trials (combined scores of all 3 groups).
(2) Method B resulted in a total number of 198 relearning trials (combined scores of all 3 groups).
(3) Method C resulted in a total number of 193 relearning trials (combined scores of all 3 groups).[35]

Rubin-Rabson had shown, then, that distributed practice periods (methods B and C) resulted in greater retention of musical material than did the massed method (method A). Lundin pointed out that these results were in agreement "with most work done in other fields of learning, where the method of distributed practice is usually more effective."[36] These findings lead to many interesting questions. One might ask, for example, why it is that a delay of twenty-four hours between trials showed only slightly better retention than a delay of one hour between trials? Why, too, do delays of twenty-four hours and one hour between trials result in considerably better retention than when the material is presented by the massed method? Rubin-Rabson, quite obviously, had considered these questions and she indicated that experiments utilizing non-musical material had found certain optimum rest intervals or periods of delay in presentation of material. What might the relationship be between the

three-phase concept of memory and the fact that Rubin-Rabson observed the greatest retention when there was a twenty-four hour delay between presentations of musical material? Bjork and Wickelgren offer some help in explaining this fact in terms of the three-phase concept of memory. Bjork has recently made a summarization of existing research on the effects of spacing or the distribution of presentations in the study of memory. He first points out what was apparently a well-established fact in 1940. He states that the results of existing research show that "In general, performance is significantly better following spaced repetition of an item than performance following massed repetitions of an item."[37] In addition, ". . . there is a limit to the improvements in performance with spacing; as the interval between two repetitions of an item is increased, performance improves to a point and then declines."[38]

Wickelgren has examined these facts and has tried to show how they might be explained in terms of STM, ITM and LTM. It is his feeling that ". . . the advantages of spaced presentation appear when ITM is beginning to play a much larger role in memory performance."[39] Furthermore, as previously noted, he assumes that ITM requires a much longer time to form than does STM. It has also been noted that, in addition to a specific consolidation time, there is also a specific decay rate for each phase of memory storage. For example, with verbal material the consolidation period for STM might be one tenth of a second after presentation. Immediately after consolidation the decay rate might go to zero within the next ten minutes. Finally, LTM might require a number of days to consolidate. Wickelgren argues that ITM may be sustained or improved with spaced or distributed presentations if the second presentation occurs after the first had time to consolidate. He also feels that the best time for this presentation is approximately at the time consolidation of the first presentation is complete or almost complete. The reason for this is that ITM does decay after consolidation. Using the example above, when the verbal material to be retained was first presented it would require ten seconds in which to consolidate. If the material to be retained was again presented at precisely 10 seconds after the first presentation (or shortly before this), one would expect, according to Wickelgren, improvement in ITM performance. The material might be retained for a longer period of time and the likelihood of its going into LTM might improve. If, however, the material to be retained was presented a second time at precisely 40 seconds after the first presentation, we might expect, according to Bjork and Wickelgren, poor retention.[40]

Using Wickelgren's arguments, then, it may be possible to explain the results of Rubin-Rabson's experiment. Since her experiment used musical rather than verbal stimuli, is it not possible that presenting the material

twenty-four hours after the first presentation might represent the point in time at which the ITM had consolidated? According to Wickelgren, this would result in improved performance. This is precisely what seems to have occurred since method C resulted in fewer trials when relearning was attempted. Method B, which presented the musical stimulus one hour after the first presentation, was nearly as effective as method C. It is possible that the one hour period might represent the point at which intermediate-term memory was almost completely consolidated. Method A, on the other hand, resulted in the greatest number of relearning trials at the end of the two week period indicating the poorest retention. Wickelgren explains the method of massed presentation in terms of STM. His feeling is that "Since the STM trace consolidates and decays rapidly, one expects optimal STM from massed presentation."[41] The results of Rubin-Rabson's experiments seem to substantiate this since the data revealed that the material to be memorized to perfection by the right and left hands alone required significantly fewer trials when the massed practice method was used. In light of this, then, is it not possible, since the massed method resulted in (1) faster retention at the initial presentations, and (2) poorest retention after two weeks, that the experiment was dealing with STM using Method A?

A study of the three-phase concept also suggests that it would be worthwhile to reconstruct existing experiments which have been cited as evidence that there are indeed three phases of memory. The previously described study by Kamin provides one example of this. Halstead and Rucker felt that Kamin's results supported the three-phase concept of memory. It was their opinion that the "Kamin effect" was actually the unequal rates of decay and growth of the ITM and LTM process. It would be interesting to determine whether or not the same results which Kamin found might be substantiated by devising a similar experiment using musical stimuli. Furthermore, differences in the retention of melodic, chordal, and rhythmic patterns might be studied to determine whether or not the "Kamin effect" occurred. (It is encouraging to note that a similar effect has already been observed in a pilot study utilizing melodic patterns.[42])

An examination of research related to the three-phase concept of memory has shown that original experiments, experiments designed to study the three-phases of memory using musical stimuli, were lacking. Other areas of research have extensively studied STM and LTM. Musical experiments should be devised which try to substantiate some of the existing facts. The intermediate-term phase of memory storage, however, has not been studied as extensively and there are very few indications as to how this might be done. Wickelgren has provided one method for studying this

second phase and the possibility exists that his suggestions might be of value in determining how to devise similar musical experiments. His suggestions for studying ITM are as follows:

"Studying ITM independently of STM is simple: just make use of the fact that ITM decays much more slowly than STM. Do not use immediate retention tests. Do use a variety of longer retention intervals on the order of minutes and hours. At least the first 20 seconds of the retention interval should be filled with rehearsal preventing activity to eliminate the STM traces, but it is also highly desirable to do all one can to minimize rehearsal throughout the entire span of any retention interval. Finally, . . ., ITM often requires numerous presentations to build up to a substantial level. . . ., all verbal learning tasks with filled (rehearsal-preventing) retention intervals of minutes or hours are studying verbal ITM."[43]

A study of the three-phase concept of memory also suggests that a greater efficiency in teaching might be possible when considering those aspects of music instruction which rely upon memorization of musical material to a great degree. For example, an entirely new technique for choral rehearsal procedure might be possible. Wickelgren's investigation of distributed or spaced presentations of material led to an important assumption. The assumption was that when material to be retained is distributed so that the second presentation comes at a time when the ITM is formed, or nearly formed, it results in sustained or improved memory during this second phase. It seems highly probable that if those specific points in time could be determined it might result in a more efficient means for retaining musical material. As an example of this, one might present a new composition with additional presentations near the end of the rehearsal period. This may be precisely the time at which, as Wickelgren has suggested, the intermediate phase of memory storage might be improved. Additional presentations at critical points (perhaps twenty-four hours later) could also be made. This would lead to a more efficient means of placing the material into LTM. Obviously, as has already been suggested, extensive experimentation is needed as a means of determining what these points in time might be.

The process involved in memorizing choral music may be no different than that which is involved in memorizing piano music. If the retention of musical stimuli is the same as that which has been suggested by the literature pertaining to the three-phase concept of memory, then the above statement would be true. But when dealing with musical stimuli the problem is far more complex. This complexity may be explored by examining one aspect of what is involved in the memorization of piano music as opposed to the memorization of choral music. Rubin-Rabson points out that "The memorizing of piano music involves motor memory, logical

memory, and unfortunately, (from empirical observation) a memory for nonsense material as well."[44] Whether or not one agrees with this is not essential. What is essential is the fact that the memorization of choral music, unlike the memorization of piano music, generally also involves the retention of verbal material. Adams has said that although memory for different response classes such as motor behavior, verbal behavior, touch and smell has not been investigated, he feels that there is some evidence which indicates that motor retention and verbal retention may go through the same phases of memory storage. The difference may be in the laws which govern each phase. It is his opinion that the failure to retain certain motor responses might be explained by trace decay, while verbal forgetting is explained by interference.[45] What might this imply for the memorization of piano and choral music based upon what is thought to be true about three phases of memory storage? Assume, as Rubin-Rabson did, that "motor memory" is of some importance when attempting to memorize piano music. Assume, too, that Adams is correct in his opinion that the failure to retain certain motor responses is a result of trace decay. If this is true, then the material which immediately follows the initial presentation (or presentations) of a new piano composition might not interfere with how much of the music is retained. The forgetting that did occur would be attributed only to the passage of time. The material which immediately followed the first presentation (or presentations) of the new composition would not interfere with that which was being memorized.

However, if one assumes that the memorization of choral music is subject to the laws which govern verbal retention, the choice of the material which follows the initial presentation of the piece to be memorized would be of importance. Presumably, the material to be retained would, upon initial presentation, be in the STM store. According to the interference theory there will be less retention if the new material, as well as the material which immediately follows it, sound similar. One way that this might occur is if new choral music is immediately followed by music which is the same style. It might be advantageous, then, to follow the initial presentation of choral music which is to be memorized by a piece which is contrasting in style. Choral rehearsal procedures which consider this might result in greater efficiency in the retention of material.

Summary and Conclusions

An intensive examination of the important literature pertaining to the three-phase concept of memory has shown that only a rather general description of the concept has thus far emerged. An investigation of the characteristics of the three phases assumed to be involved in the memory

process indicates that STM and LTM have been studied in great detail for a considerable length of time. Most authorities have concluded that STM is a temporary storage device which can retain only a very limited amount of information. There is disagreement at present, however, as to what happens to information which is stored in this first phase. According to Norman, "Some authors claim that items decay with the passage of time; others claim that forgetting is a result of interference from the presentation of other material. Some postulate a mixture of both time decay and interference, and still a few others cannot quite make up their minds."[46] It should be pointed out, however, that verbal studies have shown that information stored in STM is highly susceptible to interference from verbal stimuli which sound alike. Studies investigating the nature of LTM reveal that it is a more permanent storage device which can retain unlimited amounts of information. In addition, information stored in LTM is highly susceptible to interference from verbal stimuli which are semantically similar. Presently, it is not possible to provide as detailed a description of the second phase of the memory process. Proponents of the three-phase concept of memory indicate that ITM may retain information during the time that the first phase is dissipating and the last phase is consolidating. Furthermore, it is believed that this second phase has a different rate of consolidation and decay than either the first or third phase. However, details of the effects of interference upon ITM as well as the details of the capacity of ITM have not yet been determined. The results of this study have shown that there is a definite need for additional experimentation designed to study ITM. In addition, the accumulated evidence indicating that there are three different memories is not conclusive. Much of the evidence which favors the three-phase concept is based upon a re-examination of existing studies in memory research. The fact that at least one authority has recently outlined how each phase may be studied offers hope that the concept may be more thoroughly investigated.

A study of the available information relating to the three-phase concept of memory suggests that there may be some value in re-examining musical experiments which were originally intended as a means of investigating other aspects of memory. The possibility exists that the results of some of those musical experiments may be explained according to the assumptions of the three-phase concept of memory. Furthermore, experiments which have been cited as evidence in favor of this concept may be reconstructed utilizing musical stimuli. The present lack of musical studies in this area indicates that it is important to try and musically substantiate the existing evidence. The results of this study also suggest that original musical experimentation designed to study the three-phase concept of memory may now be undertaken based upon proposed methods of study by

authorities on memory research. Finally, speculation as to the implications of the three-phase concept of memory has led to the assumption that it may be possible to achieve increased teaching efficiency in certain areas of music instruction which rely upon memorization of musical material to a great degree.

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