

DOI: 10.7596/taksad.v7i3.1707

Citation: Yunyk, D., Yunyk, I., Yunyk, T., Burnazova, V., & Kotova, L. (2018). Memory of Subjects of Communication: The Structural and Functional Components. *Journal of History Culture and Art Research*, 7(3), 469-479. doi:<http://dx.doi.org/10.7596/taksad.v7i3.1707>

Memory of Subjects of Communication: The Structural and Functional Components

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Abstract

The essence of psychological theories of memory is highlighted in the article. It is proved that the memory of subjects of communication has a three-component structure: the sensory register, short-term and long-term memory. The specifics of the work of psychological mechanisms of each of its structural and functional components are revealed. Physical signs of new information items that are valuable to communication subjects, are transmitted to processing and preservation, and invaluable and unrecognized – are sent to the sensory register buffer. Two directions of movement of the signs of information units in the short-term memory – incoming and outgoing – are considered. Through the incoming direction, psychological mechanisms supply valuable signs of information units for parallel or sequential processing, integration into a holistic image and encoding, and through the outgoing – direct them to reproduction or to long-term memory for storage. In long-term memory, they activate the appropriate and inappropriate codes and represent their semantic concepts for both recognizing the signs of new information units and for reproducing memorized information in order to enrich, modify, consolidate or implement it.

Keywords: Subjects of communication, Psychological mechanisms, Sensory register, Short-term memory, Long-term memory.

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Introduction

The rapid development of communicative space in the era of postmodernism requires modern science to reveal the mechanisms of holistic perception, quality memorization and accurate reproduction of information. Subjects of communication do not simply capture its features at the sensory-perceptual level, but also compare these features in their imagination with previously remembered. Today's realities require the development of effective methods of purposeful training of specialists in communicative activities, taking into account the current achievements of psychological science. That is why the study of psychological mechanisms of the work of structural and functional components of memory of subjects of communication acquires the special relevance, because the quality of remembering the desired information and the accuracy of its reproduction in the conditions of professional activity depends on them.

Methodology

The purpose of this article is to highlight the psychological mechanisms of the work of structural and functional components of memory of communication subjects. To achieve this goal, it was necessary to solve the following tasks:

- 1) To carry out a literary review of the problem under study;
- 2) To consider the structure of the memory of subjects of communication, taking into account modern psychological research;
- 3) To reveal the specifics of the work of each structural and functional component of memory of subjects of communication;
- 4) To find out the main reasons for the manifestation of interference at the level of work of psychological mechanisms of each structural and functional component of memory of subjects of communication;
- 5) To substantiate the conclusions and perspective directions of further consideration of the chosen problem.

To achieve the goal, *methods* were used that were consistent with the nature of the phenomenon studied and were adequate to the task, namely:

- Analysis of scientific literature within the studied problem;
- Modeling the content of the initial provisions of psychological research in the theory and methodology of professional activity of subjects of communication;
- Generalization of the results obtained in the process of diagnosing the success of the professional activities of the subjects of communication.

The theoretical basis of the research are ideas about: the relationship of intellectual development of the subjects of communication and the success of their professional activities (L. Vyhotskyi, M. Levitov, O. Leontiev and others); the role of the cognitive sphere of the subjects of communication in the process of formation of imaginary images (L. Vekker, O. Konopkin, S. Freid and others); features of functioning of the functional system of the brain (R. Atkinson, T. Hrechenko, I. Pavlov and others); the classification of scientific theories of memory (S. Kysil, K. Levin, B. Skinner and others); the influence of stressors on the success of the professional activity of the subjects of communication (L. Kytaiev-Smyk, Ya. Reikovskiy, H. Selie and others).

Results and Discussion

The process of memorization of professional information by subjects for the formation of an imaginary

program of communicative activity was a classical subject of research of scientists in the field of psychology and pedagogy. In the conditions of the scientific development of various models and concepts of memory there were new approaches to the solution of this problem.

According to the associative memory theory, which was created in the XVII century and developed especially in the XVIII – XIX centuries, the memorization of the professional information by the subjects of communicative activity is due to the construction of meaningful logical lines in the imaginary program of actions. According to W. James, H. Ebbinghaus, G. Spencer and other scholars, the basis for creating such lines is provided by associations, which are conventionally divided into two types: simple and complex. Associations by contiguity, similarity and contrast are classified as simple. The first (adjacent associations) create logical lines of interconnected information components in time or space. The second (similarity associations) combine these components by the interconnectedness of their identical features, which make it possible to remember (recreate) others while mentioning one of them. The third (associations by contrast) reflect the opposite properties of the specified components for their comparison. To the complex type of associations, scholars include those that are aimed at knowledge of the content of information components. They combine two phenomena, which in reality interact with each other: part and whole, genus and species, cause and effect, and so on.

It should be noted that it is the interaction of associations of any kind that forms the basis for memorizing professional information by subjects for the formation of an imaginary program of communicative activity. However, the interpretation of the content of their memory as a «stimulus – response» type impose limitations on a deep understanding of the mnemonic processes, since the concept of an external connection of permanent psychological elements was put forward, which led the subjects to the passive management of their own cognitive sphere. The disadvantages of this approach became more and more apparent at the end of the XIX century, and therefore the theory of gestalt came to replace the associative theory of memory. For her, the initial concept and at the same time the main principle, on the basis of which the mechanisms for managing the process of memorizing the necessary information were revealed, were not associations of primary elements, but their integral organization – «gestalt». According to gestalt theory, the demanding state of subjects of communicative activity causes them to set an appropriate attitude to recognize and perceive signs of information, as well as to further memorize and reproduce it. V. Keller, K. Levin, E. Rubin and other scientists have proved that the usual memorization of information is not just a repetition of it, but, first of all, the reconstruction of imaginary images that emphasizes the dynamic nature of mnemonic processes. According to their beliefs, the algorithm of remembering any information is as follows:

- Its separation into components;
- Allocation of the leading component in the general information structure for memorization;
- Installing a sequence of information components for memorization;
- Integration of memorized information components into an integral system, isomorphic to the structures of perception.

The coverage of the mechanisms for managing the process of memorizing professional information by subjects for the formation of an imaginary program of communicative activity, taking into account the features of external stimulation, was carried out on the basis of behavioristic memory theory. I. Pavlov, B. Skinner, J. Watson and other scholars attached great importance to the reinforcement of the memory of professional information due to its repetition. They paid a lot of attention to studying the memory of subjects in the process of learning. Of course, learning and memorizing are closely interrelated, but it should be noted that learning is not only the process of memorizing of information, but also the development of

professional skills in subjects of communicative activity.

However, beyond the attention of supporters of the behavioral memory theory, a qualitative analysis of the activity of subjects of communicative activity remained, which led to the emergence of a new activity theory of memory in the middle of the XX century. L. Vyhotskyi, M. Levitov, O. Leontiev and other scientists linked the processes of memorizing any information with the conscious thinking of the individual, which provides the connection and continuity of new knowledge with the earlier learned. Confirmation of the probability of the proposed ideas can be traced in the studies by S. Freud, where it is stated that in order to ensure the quality of such a connection and continuity, all information that is at the disposal of the subjects, must be processed, that is, process of aggregation or distortion takes place. Aggregation is directed against vague traces in memory (such traces of previously learned information that have not yet lost the ability to cause affections and to withstand aggregation), and they are exposed to it without strain. These processes continue for a long time, during which the content of the retained information is affected by new perceived information.

Thus, according to the activity theory of memory, the memorization of the professional information by the subjects of communicative activity is due to the movement of two processes of opposite orientation, which provide:

- Preservation of all the signs of information in the form in which they were perceived;
- Maintenance of the newly formed forms of information signs, which they took in the further phases of their development.

In the middle of the XXth century, scientists returned to the two-component memory concept (L. Brodbent, L. Zankov, L. Miller, and others), which resulted in the creation of a new memory theory called «information-cybernetic». Particular importance in it was given to the work of the short-term memory of subjects or «short-term storage», where the processing of perceived information takes part. According to this theory, all cognitive processes that provide memorization of information are controlled by subjects, that is: subjects can control information flows in their own short-term memory and enter them in action upon request.

It should be noted that the initial provisions of the information and cybernetic theory of memory today constitute the methodological basis of many theoretical and experimental studies in the field of psychology and pedagogy. Instead, further efforts of scientists are aimed at studying the memory of subjects in aspects of disclosure of its structure and operational composition, that is, the disclosure of the means of managing memory, rather than the study of its system as an isolated abstract substance. The replacement of the traditional object of research and the transition to the study of processes of perception, processing, preservation and reproduction of information directed scientists to study memory in terms of its structural differentiation at specific functional levels and the time of preservation of information. R. Atkinson, S. Kisil, S. Marinova, D. Norman, I. Hoffman and other scientists came to the conclusion that the memory of subjects has a three-component structure: the sensory register; short-term and long-term memory.

Psychological mechanisms of the operation of the sensory memory register

The perception of information by the subjects of communication is due to the coordinated work of mechanisms of the sensory register of their memory. The perception of any information begins with the arbitrary or involuntary delimitation of it into separate units, which are represented by certain features. These features physically affect the external sensory receptors (visual, auditory, tactile, olfactory or taste). When the effects on these receptors disappear, their «echoic trace» is stored in the initial form (image) only for 200-400 milliseconds, after which it «breaks down». Influencing the receptor of a certain modality

in the sensory register, the physical characteristics of the signs of new information units «turn» into the corresponding «states» of the central nervous system that are isomorphic to the specific features of the signs of new information units. Establishing the correspondence between the physical parameters of the signs of new information units and the state of the central nervous system is due to the work of long-term memory, which stores the traces of previously perceived signs of information units in encoded semantic concepts. Psychological mechanisms of memory of subjects of communication provide recognition of the signs of new information units in the process of their perception due to the fact that they:

- Activate the generated codes in long-term memory, semantic concepts of which contain signs of previously perceived analogous or similar informational units;
- Represent the formed codes in long-term memory, semantic concepts of which contain signs of previously perceived analogous or similar information units and transfer them to short-term memory;
- Decode formed codes in short-term memory, semantic concepts of which contain signs of previously perceived analogous or similar informational units and transfer them to the sensory register of memory of communication subjects for comparison (as a result of such a comparison, the recognition of signs of new information units takes place, i.e. they acquire semantic content).

It should be noted that one of the peculiarities of work of psychological mechanisms of the sensory register of memory of the subjects of communication is their ability only to short-term maintenance of a clear image of the signs of newly-discovered information units. The effect of the received next portion of the signs of information units can change or even completely erase the previous image of previously perceived signs of information units. However, the semantic organization of their sequence for further perception by the subjects of communication is characterized not only by the short-term maintenance of a clear image, but also the use of semantic ties. It is thanks to semantic ties that, in the presence of at least a short time, signs of new information units can be available for identification. The selection of «valuable» information is carried out through the management of the process of perception by attention. One of the first decisions taken by the subjects of communication relates to which receptor it is directed to (visual, auditory, tactile, olfactory or taste). The definition of a sequence of signs of new information units for perception occurs by subjects of communication, both by voluntary and involuntary attention directed to the relevant objects. According to the semantic homogeneity of the signs of new information units, analysis of their structure is carried out spontaneously (automatically), and in heterogeneity – arbitrarily. It is the identification of heterogeneous signs of new information units forcing subjects of communication to use cognitive efforts to further analyze their parameters. Psychological mechanisms of the sensory register of their memory leave out of sight or eliminate unidentified signs of new information units and less valuable for them units, that is, they are sent to the sensory register buffer. Recognized signs of newly-discovered information units and «valuable» for the subjects of communication signs are directed to the next structural and functional component (in short-term memory) for further processing. Given the absolute identity of the signs of newly perceived information units and signs of the represented semantic concepts of long-term memory, the psychological mechanisms of this register can immediately transfer first units (newly perceived) to long-term memory, bypassing the short-term memory.

Psychological mechanisms of work of short-term memory

In this structural and functional component of the memory of the subjects of communication there are two directions of movement of the signs of information units, which can be named as incoming and outgoing.

Incoming flow of signs of information units has the following sources: sensory register and long-term memory. It is these sources that provide valuable for the subjects of communication signs of information units from perceived images on the output of the sensory register and from the represented semantic

concepts at the output from the long-term memory for the formation of copies. Psychological mechanisms of short-term memory of the subjects of communication process the signs of newly-received information units, synthesize them in a holistic image and encode. Instead, short-term memory is characterized by limited capacity. Its volume in subjects of communication aged from 16 to 50 years can contain at the same time 7-9 signs of information units perceived from the outside by the visual, auditory, tactile, olfactory or taste receptors. Processing features of newly-discovered information units in short-term memory is a time-wrapped process. Psychological mechanisms of short-term memory of the subjects of communication carry out parallel processing of well-known and easily differentiated signs of newly-received information units. Less familiar and hardly differentiated traits are processed sequentially. However, with the parallel processing of signs of newly-discovered information units, each of them can be processed sequentially. The sequence of processing such signs is generated automatically when:

- Signs of newly discovered information units are connected by the same values;
- Signs of newly discovered information units cause the same reactions of the subjects of communication;
- Signs of newly discovered information units are often used by the subjects of communication in the process of professional activity.

If the same signs of newly discovered information units cause a different reaction in communication subjects, then the psychological mechanisms of short-term memory in the process of their processing are forced to use a controlled search for the effective synthesis of these features in a holistic image (determining the priority of the signs of newly-received information units for sequential processing and their synthesis into a holistic image was researched by scientists within gestalt psychology, known as the «genesis of gestalt»). In order to create a new holistic image, the signs of newly-discovered information units in the short-term memory of communication subjects are complemented by discovered properties (content qualities, color display, emotional completeness, etc.) in other representational semantic concepts of long-term memory. Psychological mechanisms of this structural and functional component of their memory carry the integration of the enriched features of newly-received informational units into a holistic image with its subsequent coding. The coding process is carried out automatically or arbitrarily by the subjects of communication. Automated processes occur when the signs of newly discovered information units are closely related to the signs of information units representing the corresponding semantic concepts. Otherwise, the allocation of signs of newly discovered information units is carried out in the mode of controlled search, which requires from the subjects of communication arbitrary focus on these features. Automatic coding processes take place in parallel and independently of each other, while controlled processes are carried out only within the limits of the specified restriction and more often lead to mutual relaxation.

It should be noted that at the beginning of the cognitive action, not all signs of each newly-received information unit are available to the subjects of communication for processing and subsequent coding. Its structure gradually acquires the required form. The more attributes of one information unit are used for processing and the smaller they are, the more time it takes to encode. The process of coding heterogeneous features of information units requires their careful analysis, which requires additional time and cognitive efforts of the subjects of communication. According to the variability in the characteristics of the information units and in the presence of a time deficit for their processing, the probability of qualitative coding of these features is reduced. If the initial stage of coding the signs of newly received information units is distinguished by their «description», then the final one – by the transfer of the newly created code to long-term memory. It is the final stage of coding the signs of newly-discovered information units that leads to the emergence of another information flow – the outgoing one.

Psychological mechanisms of short-term memory of the subjects of communication provide the passage of

the initial flow of signs of information units, which has two directions of movement:

the first one – directs processed and encoded signs of information units to long-term memory;

the second – directs the processed and decoded signs of information units for reproduction (realization).

Psychological mechanisms of work of long-term memory

Long-term memory of the subjects of communication is a storage of extensive capacity. In it the signs of information units are stored not in the form of sensory influences, but in modal independent forms (codes), which are represented both for recognizing the signs of new information units, and for reproduction of stored information in order to enrich, modify, consolidate or implement it. The effectiveness of the psychological mechanisms of this structural and functional component of memory is determined by the availability of the generated codes for the activation and subsequent representation of their semantic concepts. The length of the process of activating the necessary codes and the subsequent representation of their semantic concepts depends on:

- Ease of recognition of signs of semantic concepts in the generated code;
- Ease of localization of the generated code;
- Stability of the shape of the trace in long-term memory;
- The nature of ordering of the generated code.

Psychological mechanisms of long-term memory of the subjects of communication use the most energy resources to recognize the semantic concepts of the generated codes, since this is one of the most vulnerable features of the activity of this structural and functional component of the memory. The duration of the search for the required codes is determined by the ease of the association of their features with the physical characteristics of the new information units. When false (inappropriate) codes are activated, processes in the sensory register and short-term memory of the subjects of communication are slowed down, as psychological mechanisms are forced to search for other (alternative) variants. The activation of several codes also reduces the time both for comparing their signs with the signs of new information units, as well as for reproduction of stored information in order to enrich, modify, consolidate or implement it. The development of the trace engram in the long-term memory of the subjects of communication is carried out in two stages, namely:

- In the first stage, an unstable form of the trace is formed, which can be kept in the long-term memory for no more than several hours;
- In the second stage it becomes a stable form, which does not change for a long time.

The unstable form of the trace is also formed due to the use of structural or associative links in the process of coding the signs of information units, and the persistent form – in the process of coding semantic units. The use of associative and structural links as reinforcements during their controlled coding increases the stability of the shape of the trace. However, the formation of a stronger trace is facilitated by the pure process of encoding the signs of information units. It is achieved when the psychological mechanisms of the subjects of communication at any moment direct attention to only one of their signs, and also make the maximum use of existing strong associations. This precludes the need to look for new features in information units.

Interference of signs of information units

The effect of interference manifests itself in various forms and arises from the reasons of the trace change

or its weakening in any structural and functional component of the memory of the subjects of communication. The manifestation of the interference at the level of work of the psychological mechanisms of the sensory register of memory of the subjects of communication takes place provided:

- Lack of interest in information that weakens their attention;
- Difficulty of awareness operations of signs of information units by increasing their number in the circumstances of the time deficit;
- Perception of the signs of the following information units;
- The absence in the short-term memory of the relevant semantic concepts (represented from long-term memory), necessary for the integration of perceived signs of information units into a holistic image;
- Excessive action of stressors during the perception of signs of new information units.

The manifestation of interference at the level of work of psychological mechanisms of short-term memory of the subjects of communication is a consequence of the difficulty of self-tuning the mnemonic system. Thanks to self-tuning and self-correction, short-term memory tends to persistence and overcoming interference, which is primarily provided by long-term memory, which acts as the basic structure of the mnemonic system. The specificity of the manifestation of interference both in the sensory register and in the short-term memory of the subjects of communication is also due to the fact that the processing of the signs of information units at different functional levels of memory requires its corresponding set of automated mnemonic operations, imaginary models and codes. It is their absence in the mnemonic system of the subjects of communication that leads to the difficulty of self-tuning the memory and increasing the level of interference. Interference of the signs of information units in the process of processing and integration into a holistic image is associated with the complexity of their structuring. The reasons for such a complication are:

- Limited volume of short-term memory of subjects of communication;
- Lack in the memory of the subjects of communication of adequate operations structuring such features of information units;
- Time deficit for parallel or sequential processing of perceived features of information units and their integration into a holistic image;
- Excessive action of stressors during the processing of perceived signs of information units, their integration into a holistic image and coding.

The manifestation of interference at the level of work of the psychological mechanisms of long-term memory of the subjects of communication is most often due to excessive action of stressors during the reproduction (realization) of stored information. That is why the manifestation of interference in this structural and functional component of memory is associated with the immunity of subjects. This psychic property (immunity) promotes concerted work of psychological mechanisms of long-term memory of subjects of communication in the conditions of negative influence of various stressors without the inclusion of reserve forces of an organism. The immunity is determined by the integration of the motivational, volitional, intellectual and emotional qualities of the subjects of communication taking into account the psychophysiological features of their nervous system. Its main determinants are:

- Level of excitation, which depends on the individual characteristics of the emotional reactivity of the subjects of communication;
- Features of the nervous system of subjects of communication (strength, plasticity, balance, speed, etc.);

- Socio-psychological properties of the person, acquired in the process of communicative activity;
- Development of the intelligence of the subjects of communication;
- The level of complexity of remembered information;
- The excessive effect of stressors when searching for codes for the activation and representation of their semantic concepts, both for recognizing the signs of new information units, and for reproducing stored information in order to enrich, modify, consolidate or implement it;
- Frequency of reproduction (realization) of the remembered information.

Conclusions

Summarizing the above-mentioned material regarding the coverage of the psychological mechanisms of the work of the structural and functional components of the memory of the subjects of communication, certain *conclusions* can be made.

1. The perception of any information begins with its arbitrary or involuntary delineation of the psychological mechanisms of the sensory register of memory of the subjects of communication into separate units, which are reflected by certain features. These signs physically affect the external receptors of their sensory register (visual, auditory, tactile, olfactory or taste). Its psychological mechanisms carry out a comparison of the signs of new information units with signs of activated and represented semantic concepts in long-term memory, which contain traces of signs of previously perceived similar or analogous information units, and thus provide recognition of signs of new information units.
2. The short-term effect of the signs of new information units on the external receptors of the sensory register of memory of the subjects of communication leads to physical effects that are sufficient for their recognition. The direction of psychological mechanisms for semantic connections between the signs of new information units and the signs of activated and represented semantic concepts in long-term memory enhances the efficiency of the operation of the sensory register of the memory of the subjects of communication.
3. Psychological mechanisms of the sensory register of memory of the subjects of communication classify the recognized features of new information units into two groups: valuable and invaluable. Signs of the first group (valuable) they direct to short-term memory for further processing, and the second group (invaluable), similarly as unrecognized, are rejected (sent to the sensory register buffer). Given the absolute identity of the signs of the newly discovered information units of the first group and the signs of the represented semantic concepts of long-term memory, the psychological mechanisms of this register can carry the signs of newly-received information units immediately to long-term memory without processing them in the short-term memory of the subjects of communication.
4. The number of signs used by the new information unit for its recognition and their sequence in this process affect the length of perception of new information. Different reactions of subjects of communication on the same signs of a new information unit make their psychological mechanisms use an additional search for the corresponding semantic concepts in long-term memory.
5. Psychological mechanisms of short-term memory of subjects of communication carry the movement of signs of information units in two opposite directions: incoming and outgoing. Through the incoming direction, they supply valuable signs of information units for parallel or sequential processing, integration into a holistic image and encoding, and through the outgoing – direct them to long-term memory or for reproduction (implementation).
6. Psychological mechanisms of short-term memory of the subjects of communication first process global

signs of new information units, and then – local. By focusing on the local features of new information units, the clarity of global features remains unchanged. However, its concentration on the last (global) signs reduces already insignificant expressiveness of the first (local) signs.

7. Psychological mechanisms of long-term memory of subjects of communication activate appropriate and inappropriate codes and represent their semantic concepts for both recognition of signs of new information units and for the reproduction of stored information in order to enrich, modify, consolidate or implement it. The length of the search for the required codes in the long-term memory of the subjects of communication is determined by the ease of the association of their signs with the physical characteristics of the new information units.

8. Psychological mechanisms of all structural and functional constituents of memory of the subjects of communication voluntarily seek to overcome the manifestation of interference due to self-tuning and self-correction of their work. Excessive action of stressors during the perception, processing and reproduction of information leads to the manifestation of interference at all structural and functional levels of memory of subjects of communication.

Prospects for further research. The above mentioned information does not pretend to exhaustively disclose chosen problem. It can serve as the basis for further coverage of the totality of the general theoretical positions regarding the psychological mechanisms of the work of the structural and functional components of the memory of the subjects of communication, because the issues of the influence of emotionogenic conditions on the process of activity of the phenomenon mentioned have remained unattended.

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