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Thought Processes in Problem Solving

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THOUGHT PROCESSES IN PROBLEM SOLVING

Written by
George Louris

A Thesis Submitted to the Faculty of Graduate School of Loyola University in Partial Fulfillment of the Requirements for the Degree of Master of Arts

February 1960
PREFACE

The first impetus for this thesis came from the course of Physiological Psychology given by Fr. Herr in the second semester of the school year 1957-58. The final planning of this study was based on the results of the two previous pilot studies done by the writer.

The study represents an attempt to investigate experimentally, human thought processes. Statements, findings, and suggestions of other similar studies are presented.

The writer considered a number of theories referring to thought processes but his experimental design is not based on any of the theories. Some of the problems concerning the thought processes were investigated but no claims were made that the problems have been solved. However it is considered that some further information and scientific knowledge has been provided which, it is hoped, will provide impetus for farther investigations of this type.

The writer's efforts were directed toward investigating the differences existing between certain types of normal human thought processes. Such differences were expected to be found in the various categories of mental content, the methods used, and the successive periods in solving of problems.

The scientist places more confidence on data from experimental studies than from mere speculations. Therefore, the writer tried to find experimentally the significance of differences between the processes, and then to
speculate as to the meaning of the differences.

Thought or mental process was here taken as one aspect of human behavior and as such it was hoped that the present study will contribute to the development of better methods for learning or teaching and for predicting or controlling human behavior.

A problem-solving situation was used in this study. The behavior of the subject was observed as he was working on its solution. The task of the study then was to devise an experiment by which to get serially related samples of behavior from each subject while solving the problem and then to analyze the observed behavior and to relate the introspections to the observed behavior wherever possible.

Within the scope, thus outlined, the thesis is divided into five sections: First the statement of the problem and its theoretical aspects; secondly a review of the related literature; thirdly a description of the method and experimental procedure; fourthly an analysis of results, and finally a summary with conclusions drawn.
ACKNOWLEDGEMENTS

The writer wishes to express his gratitude to Fr. Herr, Chairman of the Department of Psychology, for his encouragement and advice in planning and carrying out the research.

The writer also wishes to express his indebtedness to Dr. Marx, a professor in the Department of Psychology at Loyola University, who supervised the plans for gathering data and who provided helpful counsel in the planning of the design of the present study.
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CHAPTER I

INTRODUCTION

Thinking and thought processes are here considered one aspect of human behavior. They occur in response to an inner need, or to a problem arising in the external world. In other words, they serve in the adjustment of the organism to its environment, internal or external.

To describe thinking is not an easy matter. The difficulties that one encounters in doing this have given rise to numerous problems. These difficulties are due to the rapidity and automatic occurrence of brain activity, to the inability of the person fully to introspect as he is thinking, and finally to the inability to retrospect on absolutely everything that went on, as he was thinking. Studies on thinking may be based in a greater or lesser degree on inferences from observed phenomena. These latter afford indirect evidence for this study. Vinacke says that "We may identify the thought readily in its presence or absence, in its clearness or vagueness and in other ways. Nevertheless, when we seek to describe the thought itself, difficulties arise."¹

It was the purpose of this study to make a small contribution to the existing knowledge on thinking and mental processes by providing indirect

evidences on (1) the differences that exist between the process of acting-out and that of non-acting-out, in the problem solving situation; and (2) the differences existing in thought processes when simple and complex materials are used in the problems.

The most urgent need in the present experimental investigation, is not so much to obtain a quantitative answer to the question; "how many persons solved each problem, how many failed, etc.," but to get an understanding of the existing differences between the mental processes in the various tasks performed under the several conditions.

It was assumed that (1) the mechanisms of acting-out and that of non-acting-out on the solution of the problems would differ only by chance; and (2) the thought processes differ only by chance, if the problem is on the one hand simple, by reason of the kinds of material used, and if, on the other hand, it is complex.

By the term "acting-out solution" is meant some movement or action which is relevant to the concrete or practical situation and which occurs along with and as an aid or adjunct to the thought processes; in other words, it is the special case in which thinking is accompanied by doing something or otherwise manipulating the test materials.

By the term "non-acting-out solution" is meant an abstract, theoretical, or strictly intellectual solution which is not accompanied by any overt doing, or manipulation of materials.

It is clearly seen from the explanation of these two terms, that, these two processes--the acting-out and the non-acting-out solution--were
distinguished from each other in terms of the relationships which exist between the organism and the external or internal world. The other two variables, the simpleness and the complexity of the tasks, were distinguished on the basis of the material used for evoking the thought processes.

Thus the words "acting-out" or "non-acting-out" are to be taken as including any and all mechanisms or behavior factors which may have furthered the reaching of the solution to the particular problem.

The terms "mental" and "thought processes" are intended to convey the notions of all internal, dynamic, regulative systems, by which a person responds to his internal and external environments. Gardner Murphy uses the term in this sense in his book on Personality.¹ In brief, thought processes are here considered, for purposes of experimentation only, to be both the internal regulators of action, and the numerous ways in which a person, now called the thinker, attempts to or actually does manipulate his internal and external world.

CHAPTER II

REVIEW OF LITERATURE

The problem of thought processes is an old one. It has always been basic to psychology, whether it be that of the primitive modes of thought or of the most complicated and elaborated system of logic.

Thought and its processes are not something which did not exist before this research and which were suddenly discovered and thus began to exist. It was an object of study even in the ancient times. Hellenic poetry reveals, since the homeric period, the stages in the drama of gradual understanding of man about himself. This understanding gradually unfolded and did away with the fallacious theories of magic and sorcery, which had prevailed in the pre-Homeric period.

The words Homer uses (dynamics, menos, atheneos, etc.) in his Iliad and Odyssey are indicative of certain specific functions, and certain specific experiences. Homer prepared the way for the later Hellenic philosophers, but he differed with them in his views on human thought (Noos). Homer attributed man's powers to the gods from whom he received them as a natural and fitting donation. The later Hellenes philosophers (Aristotle, Plato, 

Socrates, etc.) conceived man as possessing his own soul, with mental and spiritual acts due in some to the influence of external forces. Bruno Snell, referring to Heraclitus' ideas, says "Heraclitus ascribes to the psyche a logos capable of extending and adding to itself of its own accord; the soul is regarded as a sort of base, from which certain developments are possible." ¹

Hellenic philosophy from which the development of modern knowledge in the western world is traced, reached its culmination in the monumental works of those remarkable men, Plato and Aristotle. The fifth century B.C., began to deal more objectively and definitely with problems of knowing, in addition to those of reality and theology.

Hellenic psychologists formulated theories of mental processes in terms of logical systematization based on introspection and not on direct empirical evidence. In Aristotle's conception mental processes can be interpreted as inner motions which persist after the initial stimulation through the senses has ceased.²

Theorizing about thinking prevailed for many centuries. It was not long after the year 1900 that a form of experimentation on thought processes was started by several investigators. The subjects were asked to describe their experience, not to explain it. These are the famous auto-introspective or retrospective reports which were made by the Wuersburgers and others. What


the person does actually in such reports is about the same as when he reports
what he sees in an actual scene or event.

A number of excellent books, articles, and monographs, have been written
on the various aspects of the psychology of thinking but in spite of this
fact thinking is one of the areas that enjoys a small part of the interest of
contemporary psychologists. An inventory of the tables of content of various
psychological books and especially of texts, will provide enough evidence of
this fact. The popular Outline of General Psychology by Fryer and Henry,
for example, devotes only sixteen pages of its 299 pages to thinking.\(^1\) If the
reader agrees that investigations on thinking and its processes contribute to
the prediction and controlling of human behavior, then psychological
endeavors should be made to uncover or minimize the difficulties involved in
this area of research.

Traditionally the mental thought process has been regarded as a
characteristic that differentiates man from other creatures.\(^2\) It is an
endowment of human beings, that enables them to live in higher levels, by
understanding, discovering, and creating ideas, systems and relations and by
developing the ability to adjust to new situations. The thought process is a
conscious state of mind, a mental uneasiness which refers to a thing not
present and not directly or concretely sensed, such as beliefs and

\(^1\)D. Fryer and R. E. Henry, An Outline of General Psychology (Barnes &

\(^2\)L. R. Floyd, Psychology of Life, New edition (Rush, Scott, Foreman
Company, New York, 1941).
abstractions. These in turn rest upon facts, evidence, or testimony. As a process or operation, thinking aims toward arriving at truths or knowledge, beliefs or conclusions.

Vinacke describes thought processes as "internal dynamic, regulative systems"; and on another page as "personalized or shaped by the selective and regulative systems which are established during the learning process."

According to Wertheimer:

Thinking consists in envisaging, realizing, structural features and structural requirements; proceeding in accordance with, and determined by, these requirements; thereby changing the situation in the direction of structural improvements, which involves:
that gaps, trouble regions, disturbances, superficialities, etc. be viewed and dealt with structurally;
that inner structural relations, fitting or not fitting, be sought among such disturbances and the given situation as a whole and among its various parts;
that there be operations of structural grouping and segregation of centering, etc;
that operations be viewed and treated in their structural place, role, dynamic meaning, including realization of the changes which this involves.

From the biological point of view Vinacke says that thinking may be regarded as the activity of nervous centers, particularly the higher centers of the brain." But this view, if exclusive, would obviously be a materialistic one.

Thought process "in the elementary form" as H. Pieron states, "represents nothing more than the successive evocation, by the action of mnemonic machinery, of sensory impressions revived with relative incompleteness - images...."¹ This is a sensistic view. The views which follow seem to be more philosophically neutral.

An idealistic definition of thought process is given by B. Blanshard. He says that thought is "that activity of mind which aims directly at truth."²

Wilhelm Stekel holds that, thinking "is a polyphony, a stream of which only the surface is visible" and that "the final thought-product is a compromise which condenses the representations of the various strivings, struggling for expression."³

Freud⁴ states that thinking takes place on basis of two principles; the principle of pleasure and the principle of reality, which are in constant struggle. The reality principle, he says, prevails mostly in the normal thinking.

Burtt,⁵ tried to describe right thinking and to discriminate it from the wrong thinking. He says, that the possibility for the distinction between

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right and wrong thinking is given by judgments concerned about reality. The following statement presents the way he distinguishes and defines right and wrong thinking:

If it follows a method calculated normally to yield correct judgments it is right thinking; if it fails to do so it is wrong thinking. It must be remembered, of course, that sometimes factors upset our calculations which could not be foreseen in advance, and that often the time available for reflection is insufficient to permit the best solution that would otherwise be possible. In the light of these considerations, right thinking may be provisionally defined as reasoning which proceeds in the manner most likely under the circumstances to reach correctness in the judgments with which it is concerned.

The various theories that developed in relation to thought and its processes, such as the theory of traditional logic, the theory of associationism, the dynamic theory, etc., are all explaining thought process from a certain viewpoint. Traditional logic theory, for example, holds that ideas, opinions, and conclusions are the result of consideration of previous ones; to this associationism adds the chain phenomenon, or the sum of elements and their transformation. Dynamic theory on the other hand states that mental processes are a dynamic interplay of events. Its main characteristics are (a) productivity and not mere reproductivity, (b) problem-solving, (c) restructuring and recentering, (d) experience and action, (e) insight, and (f) internal motivation. Each of these theories had been supported and criticized in the past by many psychologists and philosophers. The associationistic theory, for example, had been severely criticized on theoretical grounds and also on the basis of some elaborate experiments using

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introspection. The first experimental attack on association as producing thought was made by J. H. Watt and N. Ach who were inspired by Kupfe's theory and ideas and other workers in the Wuerzburg School. Their studies were based on a "systematic experimental self-observation" technique. Their conclusions were that Determining Tendencies (Ach) which spring from the task (Watt) are the mechanism or factors to account for the sequence of the thinking process; or that something exists in thought which is not reducible to sense images (Buhler, Ach, Messer).

It is clear from all these descriptions of thought process, that diversity has existed among psychologists and their theories on the problem of what thought is, since the time of Hellenic philosophers. In spite of all the efforts made, no entirely satisfactory answer has been formulated.

Whatever the nature of thought process is, it seems well understood, that, for the majority of human beings it serves for the better understanding of the processes of creativity, discovery and invention that occur in the minds of the discoverers and inventors.

The evocation of thought process is done by means of symbols such as concepts, images, experiences, etc., which were used in the present study as categories of mental content. These symbols have overlapping and interweaving areas.  

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The categorization of the mental content for the present study, is a formal one. It is based on equivalence rather than identity of response. The categories were constructed on the basis of the discritica or the attribute properties of class members. The reader may not find the categorization the same as others or he may have objections to it. This is possible, perhaps very natural; because categories generally exist as abstractions and not as discoveries of really existing things. Consequently it might be said, that there exists nearly an infinitude of ways of grouping events of discriminable properties.

Thinking can be studied by direct methods such as introspections and observations or by indirect inference from observed behavior. It is amazing sometimes, how much observation of another person can help to detect elements of mental content or modes of attack. It is mainly on account of the rapidity of thought and its uniqueness in each individual, that observations are difficult. In spite of this, many opportunities are provided for generalities and clues which help to confirm introspections.


2. J. C. Colemn, Facial Expressions of Emotions: Psychology Monographs (1949) 296 and

CHAPTER III

METHOD AND PROCEDURE OF THE EXPERIMENT

The subjects used in this study were people from different professions. The group consisted of forty-six subjects, twenty-six of which were male and twenty female. Their average age was 24.3 years, with a range from 17 to 43 years. The full scale intelligence quotients obtained (Wechsler-Bellevue for adolescents and adults test) was from 110 to 140. The majority of the subjects fell between 19 and 22 years of age, while their I.Q. was between 120 and 130. The range in educational level was from High School graduate to Ph. D. candidate. Each subject was tested individually.

The materials used were four cardboards of identical material, rectangular in form $14\frac{1}{2} \times 4$" in size, white in background, on which were written blueblack letters. One scrambled word or group of letters was written in capital letters on each cardboard. The size of the letters was $1\frac{1}{2} \times 1"$, the distance between them $1"$, and between the edges of the cardboard and the letters $1\frac{1}{4}"$. The thickness of all the lines of the letters was the same, namely $1/8"$.

Preliminary experimentation showed that difficulty in unscrambling a word and time spent were positively related to the number of letters in the word, and to the size of the category, such as, school, home, art, science, etc., from which the words were taken. On the basis of these findings, it
was decided to use two pairs of words. The two pairs differed in difficulty and/or number of letters. These pairs were table-chair, teacher-library. The members of each pair had the same number of letters, were assumed to be about of the same level of difficulty.

As to the time spent for unscrambling the word, it was decided to limit such time as much as possible without any detrimental effect on the results. On the basis of the preliminary experimentation, the six-letter word was chosen as the average level of difficulty. The five-letter pair used thus fell in the below average level, while the seven-letter pair fell in the above average level. Common words used in the environmental areas of home and school were utilized. This was told to the subjects in the instructions. The reasons for utilizing common words and informing the subjects were to provide an opportunity for the subject to solve the problem within the time limits of fifteen minutes, and also to adjust the task so that the purpose of the present study could be fulfilled. This purpose was to study the process of thought and not the time spent.

Two points were kept constantly in mind as the scrambling of the four words was done; first to present a group of letters and not a meaningful word, and second, to avoid clues which would direct the subject to the answer or mislead him.

The testing procedure consisted of four tests; the task in each test was to unscramble one word. The two tests using the five-letter words were presumed to be the simple task and were designed to test the mental process using a simple task. The remaining two tests of seven-letter words were used
to test the mental process using a complex task. Each task, simple or complex, was performed twice with a different word used each time; once to test the acting-out thought process, and the other time to test the non-acting-out thought process.

A counterbalancing technique in relation to the order of stimulus presentation was used to cancel out the probably influence of practice effect. This technique involved planned alternation of tests.

The subjects were instructed to unscramble the word or put the letters in such an order to make a meaningful word out of it. The instructions were different for each test. The differences between them were four: (1) for the simple tasks, one in acting-out and one in non-acting-out processes, to look for a word that referred to home, (2) for the complex tasks, in acting-out and non-acting-out processes, to look for a word that referred to school, (3) for the tasks in acting-out processes, simple and complex, to use paper and pencil for the arrangement of the letters, and (4) for the tasks in the non-acting-out processes, simple and complex, to rearrange the letters in their mind thinking silently to themselves. The written instructions were read by the testee to rule out probably influence of the tester's accent.

As soon as the subject had finished reading the instructions, he was presented with the cardboard containing the scrambled word. It was placed before him, and was kept there to the end of the test, to provide possible help to the subject's memory, as he was reporting his introspections.

A stop watch was used to measure the time the subject spent in reading the instructions and also in doing the task. In terms of this time and the
introspections, the counting of frequencies was made for the successive periods and methods.

Two techniques were used for the collection of the data (1) observation and (2) introspection. The observation was done by the writer and experimenter, as the subject was doing the task. He kept track by taking notes of any facial reaction, manipulations of materials, emotional responses, and movements of various parts of the body. Preliminary experimental studies on the present problem and theories of many authors indicated that such movements or reactions were indicative of some categories of mental content, methods, or successive periods.

After the subject had finished the task, he introspected: (1) by giving a written report in an unlimited and nonrestricted way, that led him to a free flow in describing his mental processes; and (2) by answering a structured, formalized, and oral questionnaire while the tester took notes on his answers.

The subject's report aimed at obtaining reproductions of his performance, after it was completed, in order that elucidation of what occurred could be obtained. The advantage of this process was that the subject could better relate his performance to the whole problem.

The purpose of combining introspection and observation techniques was to obtain the advantages of each one of these techniques and allow the one to supplement the other.

The final steps for the collection of the data were the analysis of the introspections and observations for each subject and their classification. The study of books and articles, plus the preliminary experimentation by the
writer, revealed that mental processes can be studied in terms of categories of mental content, methods used, and successive periods or steps.

Categories of mental content are simple, irreducible, dynamic and inter-independent elements.¹ The categories used in the present study were concepts, images, feelings and/or emotions, past experience, relations, and comparisons.

By methods is meant the ways in which the thinker solved the problem, or the modes of attack. Four of them were used in the present study: trial and error, insight, analysis, and synthesis.

Thought processes pertaining to the solution of the problem were studied in a sequence of three clearly recognizable and fairly well defined successive periods or steps: (1) preparation; (2) performance; and (3) solution. A comparison of these steps with those distinguished by Dewey² shows some similarities. The first period, preparation, includes Dewey's two first steps, that is the "occurrence of difficulty" and the "definition of difficulty". The second period, performance, includes what Dewey calls "occurrence of a suggested explanation or possible solution" and "rational elaboration of the idea". The third period, solution, includes Dewey's last step, that is, "corroboration of an idea and formation of a concluding belief". This use of successive periods aids in studying accurately the continuity and dynamic interplay of elements of mental content, and also in analyzing the free

² John Dewey, How to Think (Boston, Heath, 1933).
interchange between modes of attack.

Experimental arrangements, based on the pilot studies, were made so that all necessary aspects were open to observation; which would lead to the use of either of the modes of attack, or categories.

In regard to the meaning and determination of the six categories, the four methods, and three steps Vinacke's definitions and explanations were followed. Preliminary experimentation was also used for finding the methods and successive periods. It appeared that the subjects could not recall the number of trials made, even in acting-out processes in cases where they could not write down every trial. It was decided then that the examiner would use the time spent on the task, in addition to the introspection and observation methods in order to count the frequencies for the methods of trial and error and insight, and for the successive periods. On the basis of the observations made in the pilot study, the average time spent for each trial was determined to be ten seconds. This time was taken as a unit to count the frequencies for the successive periods and the two methods. Time less than ten seconds was counted one frequency.

In the preliminary study there had to be made clear distinctions between two of the methods, namely, that of insight and that of trial and error. It was found that a good cutting point between them could be set at two trials. Thus if more than two trials were used, the method was called trial and error

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rather than insight. This distinction was then used in the interpretation of data.

In regard to the various techniques used by the experimenter in the study, namely observation, written introspection, and the subject's answers to the questionnaire, each yielded a certain number of frequencies for each of the six categories, the four methods, and three steps. Only one number of frequencies was used for each category, method, or step. This number could come from any of the above mentioned three techniques, but it was the one with the most frequencies, provided that the items in the small numbers were included in that of the largest number. The items that were not included were added to it. This can be illustrated by the following example: The obtained frequencies for the subject B, in the category of feelings and/or emotions, were three from the observation, two from the written introspection, and four from the questionnaire. The number four here is the largest frequency and was yielded by the technique of questionnaire. Two more frequencies were added to this number, one for the disappointment which was reported in the written introspection, and one for the anxiety that was obtained by observation; both these two frequencies were not included in the number four. Consequently the number of frequencies obtained by pooling all sources of information, for the category of feelings and/or emotions, for the subject B, was six.

A statistical analysis, using the Chi-square technique was made of the results of the tabulation (see Table I). The results were expressed in terms of level of significance.
CHAPTER IV

ANALYSIS OF RESULTS AND DISCUSSION

At the beginning of this thesis it was stated that the problem of the present study was finding whether or not there was more than a chance difference existing within each of the groupings of the thought processes. The investigation for such difference was made in three areas or aspects of thought process: categories of mental content, methods used, and successive periods.

A statistical analysis and elaboration was made of the results of the tabulation, using the Chi-square technique. Two tables for each of the aspects of thought process were made, to test the two hypotheses. The differences within each of the groupings of mental processes (simple versus complex, and acting-out versus non-acting-out), were computed and the figures were expressed in levels of significance.

Both hypotheses were rejected in the area of categories of mental content, and successive periods; and neither was rejected in the area of methods used; that is, the obtained level of significance of differences between thought processes using complex and simple materials was .50 in the aspect of categories of mental content, and .75 in the aspect of successive periods. The obtained level of significance of differences between acting-out and non-acting-out thought processes was .60 in the area of categories of mental content, and .20 in the area of successive periods. In the area
of methods used, the obtained level of significance for the differences between both sets of thought processes, that is, between acting-out versus non-acting-out and simple versus complex, was found to be well beyond the .01, as seen in Table II. From the data in Table II, however, taken with the figures of Table I, it is seen that all methods were used more often in the complex trials; and that all of them, with the exception of INSIGHT, were used more often in the acting-out trials.

An extensive further investigation, of the differences existing within either of the sets of thought processes, was made by re-analyzing the data in the area of categories of mental content, using each time a different number and combination of categories. In spite of the fact that the number of categories was reduced to two, the level of significance remained insignificant, fluctuating between .05 to .95. The .05 level of significance was obtained only for the set of thought processes using simple and complex materials, on the basis of categories of relations and comparisons. All the other levels of significance were above .17.

The important points that were noticed in this extensive investigation were that:

1. The level of significance for the differences in both sets of thought processes in the area of methods used was found to be beyond the .01.
2. The differences between thought processes using simple and complex materials showed an increase in level of significance as the number of categories was decreased (.50 - .05). On the basis of the increase of the level of significance it seemed that the most significant categories
used were those of relations, comparisons, and images. It also seemed that the former, relations and comparisons, were more influential than the last category, images.

3. The differences between the level of significance for the acting-out and the non-acting-out thought processes showed a rather stable level, around .60.

4. A same-direction difference always existed between the two sets of thought processes, acting-out versus non-acting-out on the one hand, and simple versus complex on the other hand; and with the use of either combination of categories; the set using simple and complex materials was the favored one, as seen in Table II.

The decision that was made after the preliminary experimentation concerning the use of a combination of techniques, appeared once more justifiable. In spite of the fact that these techniques presented variation, they appeared to be complimentary to each other in many cases. Their use helped in the objectivity of the data. The utilization of both introspection and observation was something like a compromise with the rapidity and automation of thought process. It can not be claimed, by any means, that combination of methods solves the whole problem of thought rapidly; but it can be presented as a way to get more and better information. Thought process will continue to be difficult to analyse; as J. H. Robinson remarks: "Our thought moves with such incredible rapidity that it is almost impossible to arrest any specimen of it long enough to have a look at it."¹

Observation was used as a technique because of the three common functions it has with the experiment, namely, (1) the presentation of the problem in the beginning, (2) the use of the senses and instruments that facilitate the broadening of the basis for theorizing, and (3) the verification of hypotheses.

The writer, who was also the tester, tried to be as neutral as possible in regard to theory so as to avoid being biased by any one theory, knowing that this could lead to mistakes in observation. Bias toward a theory makes the observer observe the wrong things or miss the right ones.

On the basis of the observations on the subjects used, it might be said that (1) verbalization, whispering or spelling by heart, words or combinations of letters, facilitated thought and led to the solution of the problem, and (2) there were instances at which thought could not be expressed by words. These observations remind one of the controversies on imageless thought, and seem to prove that the thought may be an irreducible state or phenomenon. George Humphrey\(^1\) says that thought is "an irreducible fact of experience," and "it is not entirely homogeneous."

Osward Kople,\(^2\) philosopher and pupil of Wundt in experimental psychology, and the father of the studies on thought and its processes, in his efforts to theorize on the various movements that accompany thought, states that movements (1) "from the purely psychological standpoint are simple illustrations


of the various types of action; voluntary, impulsive, or reflex," (2) they initiate and are initiated by emotions, and (3) they are determined to a large degree by the ideational contents.

In many cases it was observed that as the subject was proceeding in his report on the thought process, he stopped momentarily and then jumped to the next point because of inability to refer to that particular point. Probable explanations of this phenomenon are the existence of non-meaningful or disjunctive parts, small details, and above all the limited ability to follow the thought process that occurs very rapidly.

The introspections given by the subjects provided much reliable information. Their report, in spite of the unrestricted and free nature of the same, gave much less information than the questionnaire, and appeared to be in a personalized form. Every time the subject faced a difficulty (and this was often) in describing a thought process, a hurry-up feeling, with omissions was apparent. It seemed like an effort to repeat or copy the thought process with all its rapidity as it occurred. The questionnaire, in comparison to the other techniques, appeared to be the more objective and provided more information, albeit some answers not otherwise thought of may have been suggested by it.

Observations on the thought processes indicated that "acting-out" thought process does not appear, as was previously thought, to be easier or faster than the "non-acting-out" thought process; in which there would be the help of manipulation of material. Many times the subjects avoid the writing down
of trials, words they thought of, etc., because such writing interrupted their thought process, as they said; in other cases, they also said; this writing contributed both to a looseness of the series and also to connections of their ideas and thoughts.

On the basis of the experimental evidence, complete inaction did not appear to be characteristic of thought process. For a certain length of time, and without any other stimulation, language speech and muscular movements were minimized to the smallest possible degree. In actuality, movements continued to take place but they were too minute to be seen by the human eye unaided. The subjects felt a continuous movement in their physical constitution; they noticed it in a few cases as they were thinking, but the movements had no relation to their will. At other times, muscular movements, facial changes, and speech movements could be easily noticed by the observer. These movements were carriers, contributors, or manifestations to an outsider of the arrival of meanings in thought processes.
CHAPTER V

SUMMARY AND CONCLUSIONS

Once a psychologist seeks to understand human behavior, thought processes are to be of his special interest. Thought processes are one aspect of human behavior. Knowledge of that aspect provides the psychologist with the ability to predict and control behavior; it leads to the understanding and also to the solution of problems referring to communication, to formulation and promotion of interpersonal and intergroup relationships, and to the establishment of industrial and governmental systems.

A thought process occurs very rapidly and automatically and its study presents difficulties. Methods and techniques should be established for further investigations. In the present study it was proved that observations and introspections combined provide rather adequate information.

It is imperative that basic mental processes should be discovered through experimental studies, and differences among them should be identified. These differences should be studied on the basis of mental content or methods used.

It is equally imperative that it be not assumed that everyone else thinks the same way as we do; no two people think exactly the same way.

It was shown that the hypothesis of a chance difference between various kinds of thought processes studied in terms of content or successive periods could not be rejected but that when they are considered on the basis of
various methods used, chance could be rejected.

Observations indicated that (1) manipulation of materials at the same time as thought goes on, interrupts thought process, and (2) only minimization of movements occurs as thought goes on, especially during certain short periods.
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| METHODS               |            |              |                |              |
|                       |            |              |                |              |
| Trial/Error           | 997        | 993          | 682            | 912          |
| Insight               | 21         | 22           | 35             | 49           |
| Analysis              | 189        | 139          | 95             | 187          |
| Synthesis             | 313        | 293          | 185            | 305          |

| SUCCESSIVE PERIODS    |            |              |                |              |
|                       |            |              |                |              |
| Preparation           | 40         | 51           | 35             | 43           |
| Performance           | 1010       | 996          | 707            | 946          |
| Solution              | 90         | 96           | 88             | 98           |
# TABLE II

## LEVELS OF SIGNIFICANCE

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Heidbreder, E. "An Experimental Study of Thinking," *Arch. Psychology*, 1924, No. 73.


C. MONOGRAPHS


The thesis submitted by George Louris has been read and approved by three members of the Department of Psychology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Arts.

Date: Dec. 10, 1959
Signature of Adviser: