THE EFFECT OF TWO SITUATIONAL VARIABLES ON CREATIVE PROBLEM SOLVING ABILITIES

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THE EFFECT OF TWO SITUATIONAL VARIABLES ON CREATIVE PROBLEM SOLVING ABILITIES

by

William J. Pieper

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The limited number of creative problem solvers and the importance of developing creative solutions makes the effective usage of creative problem solving abilities an important problem. The purpose of this study is to determine the effect of two situational variables, the availability of task relevent visual stimuli, and the level of general body tension, on creative problem solving abilities.

The subjects were tested in three different simulated office situations. Testing was done with three forms of a test battery composed of four of Guilford's tests: Object Synthesis, Alternate Uses, Utility Test and Apparatus Test. All have significant loadings on stable factors. The experimental design was a 3x3x3 Greaco-Latin Square of Simulated Office Situations, Test Forms, and Testing Sessions. The analysis of variance performed on the data separates the within and between components so that the three main effects were within subject effects and the two and three factor interactions

were mixed effects and were analyzed separately for their between and within components.

The results showed that situational conditions do effect creative problem solving abilities and that the most effective usage of these abilities is obtained when task relevant visual stimuli are available and the person can select the preferred level of general body tension.

Approved: J H Wakeley
Committee Chairman

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Thesis Committee:
John H. Wakeley, Chairman
Abram M. Barch
Donald M. Johnson

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William J. Pieper

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INTRODUCTION

Developing creative problem solutions is an important part of the functions of people in the sciences and industry. Because of the increasing need for persons with creative problem solving abilities, much effort has been directed at identifying these traits or abilities. Most of the principal studies have involved highly creative people in the physical sciences and arts and have treated creative ability as an absolute. No attempts have been made in these studies to develop methods of measuring differential amounts of creativity or standardizing criteria. Typical of these studies is that of Ann Roe (1951), who studied eminent scientists. Another study of this type but with a slight variation is that of McKinnon (1961), who studied architects by comparing groups rated as creative to those not rated as creative. While the findings of these various studies are interesting, they are seldom directly comparable because different methods of investigation and different criterion of creativity are used. The development of reliable measures and techniques to be used in studying changes in the expression of creative problem solving traits or abilities is lacking.

A different approach to the study of these abilities is that of J. P. Guilford. The factor analytic approach has produced tests which are reliable and load on factors which have been repeated in several studies. These factors include Originality, Ideational Fluency, Spontaneous Flexability, Sensitivity to Problems, and Redefinition. These factors are repeated in Guilford (1953), Guilford et al (1954), Wilson et al (1954), Hertzka et al (1954), and Kettner et al (1956). The subjects used in these studies were not selected for their creative ability; hence, the tests can measure differential levels of the abilities. The validity of the tests has been demonstrated in at least one study of scientists, Mullins (1960), by significant correlations with the independent criteria of supervisor ratings and number of publications.

The bulk of the studies of creativity have involved eminent scientists; however, scientists are not the only people concerned with creative problem solving.

Developing creative solutions to problems is an important part of the functions of management personnel at all levels. Because of the limited number of creative problem solvers, it is important that industry make the most effective possible use of the problem

solving abilities of their management personnel--particularly people involved in solving problems of materials selection, production methods and scheduling, packaging for shipping and handling, etc. Problems of these types and other complex problems typically are not solved in a day. Many alternative solutions must be tried and often new solutions must be proposed which satisfy the requirements of the present problems by combining the characteristics of previous solutions to different problems. The problem facing industry is to provide conditions in the immediate work situation which enhance the expression of creative problem solving abilities.

No studies have been found in the area of creativity which involve the manipulation of such situational variables. However, work has been done involving aided vs. unaided recall in the area of learning. The aided recall has been in the form of relevant visual stimuli. Recall is also facilitated by recalling whatever was learned in the same situation and under the same conditions as when the learning occurred. Prompting with stimuli relevant to the content of the learned material has been effective in facilitating recall. Therefore a problem solving situation which contains content relevant stimuli should suggest more solutions than a situation without such stimuli.

Some evidence, again from the area of learning, suggests that the level of physical activity could affect mental functions. Bills (1927), Courts (1939), and Shaw (1956) using a hand dynamometer showed that certain amounts of pressure facilitate mental functioning. Bourne (1955) and Meyer (1958) showed that induced tension acting as a drive facilitates mental functioning. Some of the studies, Courts (1939) and Shaw (1956), demonstrate that tension above a certain level can be disruptive and interfere with mental functions. One study Block, (1936), found no consistent relationship between amount of tension and performance. The subjects who did best on one day with a strong squeeze on the dynamometer might do better on another day with little or no pressure. This seems to indicate that a subject would do better with the opportunity to choose a satisfactory level of tension for the present task. Changes in body tension can be affected by changes in posture as well as squeezing a dynamometer.

A practical problem worth studying and one on which we have no information in the area of creativity is the effect of situational variables on creative problem solving abilities.

PURPOSE

The purpose of this study is to investigate the effects of two situational variables--the availability of relevant visual stimuli and the level of general body tension on creative problem solving as measured by tests of ideational fluency.

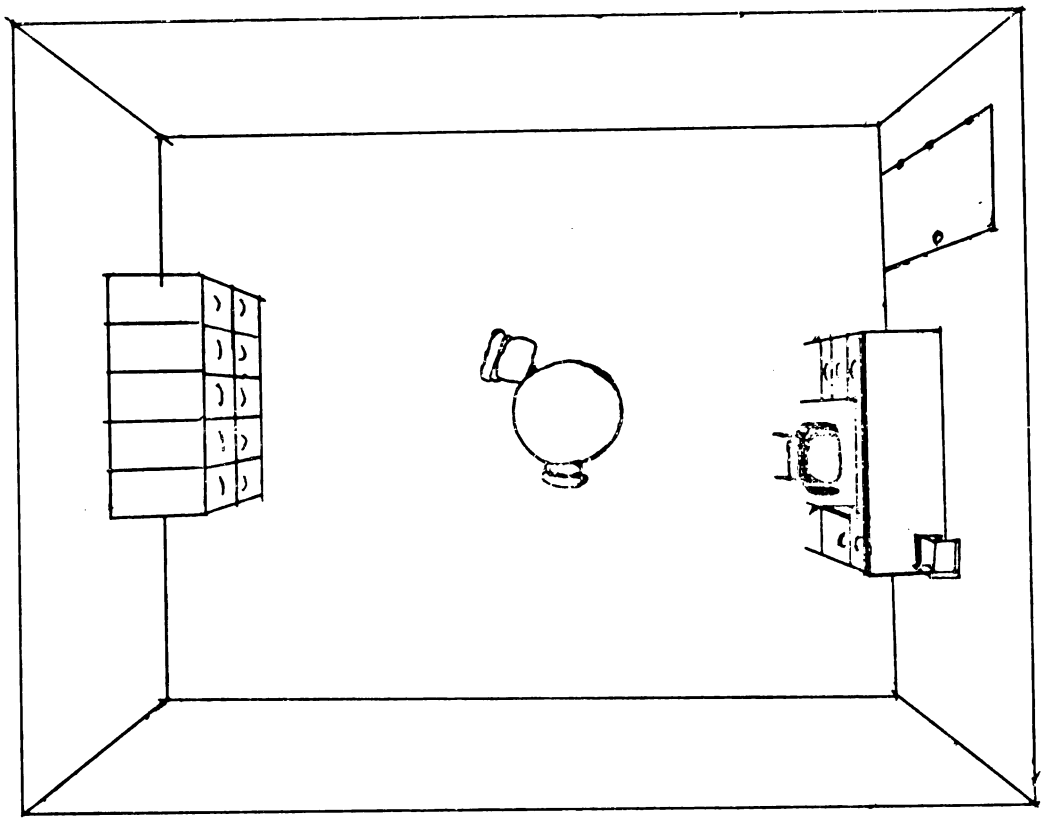
METHOD

In studying the effects of these variables, the approach was to first determine what situations should be used and how they should differ with respect to the availability of relevant visual stimuil and level of general body tension. The next decision involved the selection of the criterion measures and construction of the test batteries to be used. Lastly, the subjects were selected and the experimental design chosen. The situations are described below.

Three situations were used in the study. In two of the situations, fixed levels of general body tension were used, while in the third, the subject was free to pick his preferred level of body tension. For the two situations having fixed levels of body tension, relevant visual stimuli were not available; while for the tension choice situation, task relevant visual stimuli were available.

Situation A

This office was a mild sensory deprivation situation. It was set up in a room about 8 by 14 feet, Figure 1 shows an overhead view. The wall on the right of the door was covered by a set of closets and shelves.



A bed was attached to these shelves and protruded into the room across the short dimension. One of the closet doors on the right hand wall between the bed and entrance was open. A small fluorescent light was attached to the side of the door away from the bed. A small table and chair for use by the experimenter were also located behind the open closet door. The table and chair could not be seen by a subject lying on the bed. Boxes and chairs were stacked along the left wall and were covered by a gray drop cloth, so that no objects or shapes were visible to subjects. The walls and ceiling were a mat

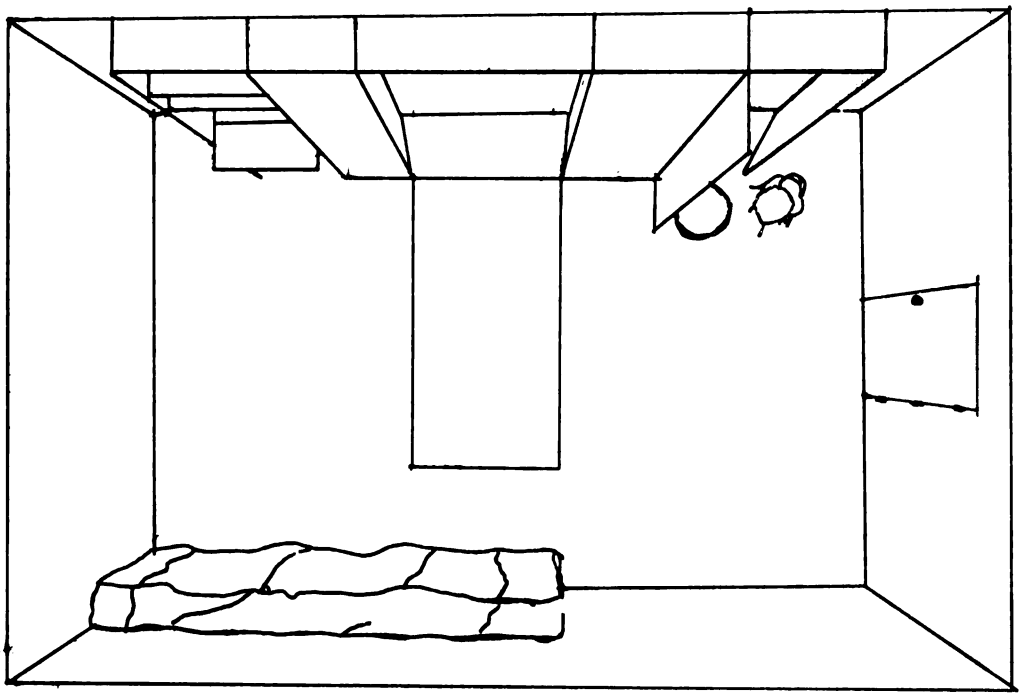
gray and the only illumination in the room was provided by the small fluorescent light on the back of the closet door. The room was in semi-darkness at all times so that the visual pattern was quite monotonous.

The only stimuli available to the subject in this situation were his own memories. Any interference to the production of ideas in the form of irrelevant stimuli had to come from within the subject. Although there were no external stimuli which could provide cues for a new idea, there were also none which could distract or mislead the subject.

The subject's movement was restricted, in this situation, to lying on his back on the bed. This situation should facilitate the production of ideas for those people who prefer low body tension during problem solving activities. This situation was quite novel, as this company and most others do not provide similar conditions for their employees.

Situation B

This situation was more like a normal office. It was set up in a room 12 by 12 feet, Figure 2 below shows an overhead view. To the left of the door was a desk and a non-swivel desk chair with arms. The desk faced the wall and there was an empty in-out basket on one corner. In the middle of the room, behind the desk



and chair, was a circular table with chairs to be used by the experimenter. On the wall opposite the door were some filing cabinets which could not be seen by the subject. The walls of the room were multicolored and the room was well lighted by fluorescent ceiling lights. The wall which the subject faced was bare and the only objects visible to him were the wall and the desk with its in-out box.

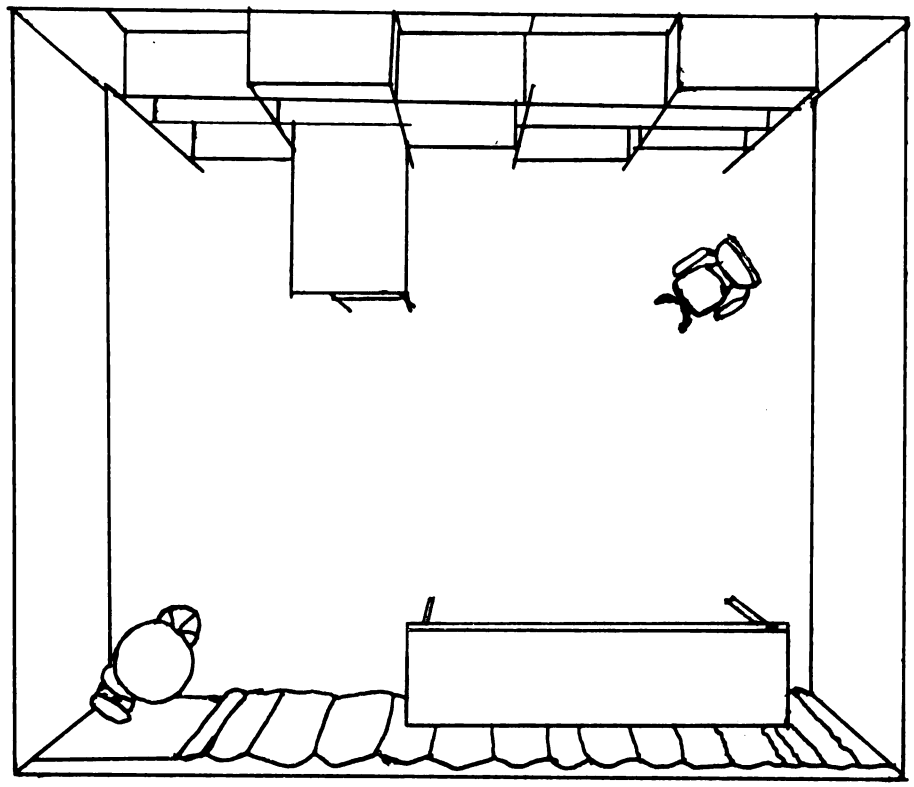
The stimulus pattern of this room was a great deal different than that of Situation A. However, the visual pattern was still quite monotonous for the subject and he had to rely mostly on internal

relevant stimuli to aid him in the production of ideas for solutions to the problems given in the test. Any interference had to be internal. Except for the shapes, materials, and colors of the objects visible to the subject, there were no external cues to aid him if interference occurred.

The subject's movement was restricted in this situation to sitting in the chair at the desk. His general body tension, however, is higher than that of Situation A because he must sit erect. This well known situation could enhance the production of ideas for the subjects because of their practice in and familiarity with the condtions.

Situation C

This situation was the novel office or "extra-stimulus" situation. It was set up in a room about 10 by 10 feet, Figure 3 below shows an overhead view. Relevant visual stimuli were placed on the large table to the right of the door. Along the wall opposite the door was a set of walnut modular storage units and shelves including a desk. Some of the stimulus pictures were placed on these shelves and could be seen by the subjects. A swivel chair with casters was also in the room. The wall to the left of the door, opposite the door, and ceiling were white and the walls were made of



plaster. The wall to the right of the door was covered with gray drapes. Stimulus pictures were attached to the walls on both the left and right of the door. The room was well lighted with fluorescent ceiling lights. A small round table with a chair for use by the experimenter were in the doorway to the room.

The visual pattern of this room was quite varied. The pictures placed around the room contained visual stimuli relevant to the production of ideas for solutions to the test problems. Not all pictures contained stimuli

relevant to all problems. In some instances, a given picture might interfere with the production of ideas for a specific problem, since it would not contain stimuli relevant to the problem. The criteria for selecting the stimulus pictures will be explained later in this section. If a subject realized that a picture was interfering, he could glance around at others until he found one which gave him some new ideas. Cues to solutions to some of the problems were also available in the materials, construction, and shapes of the furniture in the room.

The subject's movements were not restricted in this situation, he was free to walk around, stand, sit, or lie down. The subject could choose the level of body tension he most prefered for this day and situation, or which best fit his behavior pattern. This situation was not entirely different from most offices in that there was space in which the person could pace or could turn in his chair or could lean back and put his feet on the desk. The freedom to change the level of body tension and the availability of the relevant visual stimuli could enhance the production of ideas.

Stimuli

The stimulus pictures used in Situation C were full page pictures taken from popular business magazines

such as FORTUNE. The ads used were those which survived two screenings. The first criteria was that the pictures contain no product names, company names, meaningful words, pictures of persons, or pictures of objects being used by people. The second screening criteria was that the ads not contain uses or products of specific objects used in any test problems. An example of a picture which survived both screenings is shown in Figure 4 below. The important characterisic of this picture is that categories of objects are shown. Each of these categories has certain characteristics which can be compared to the characteristics of objects used in the test problems. These characteristics could suggest alternate uses and ways to synthesize objects. The stimulus pictures were not intended to provide solutions to the test problems but to aid in the production of ideas for possible solutions.

FIGURE 4.--Acceptable stimulus picture.

Figure 5 below is an example of a picture which was not used. Even if the people were not in the picture, it still would not be used because the principal object in the picture is a nail which was an object used in a test item and a specific use is shown for the object, providing a direct solution to a test problem. Only pictures showing categories or characteristics of objects were used as stimulus pictures.

FIGURE 5.--Unacceptable stimulus picture.

Tests

The measures of creative problem solving used in the study are three forms of a test battery composed of four of Guilford's tests; Unusual Uses, Apparatus Test, Objective Synthesis, and Utility Test (formerly Brick Uses). Each of the tests chosen had significant factor loadings on at least one twice-repeated factor found in the studies mentioned earlier in the introduction. The factors found and the significant loadings of the tests are shown below in Table 1.

TABLE 1.--Factor loadings of four of Guilford's tests.

FACTORS	TESTS			
	Unusual Uses	Apparatus Test	Object Synthesis	Utility Test
Ideational Fluency	.47			.64
Originality	.46		.40	
Spontaneous Flexibility	.52			.49
Redefinition			.31	
Sensitivity to Problem	.43	.59		

Three forms of the test battery are used because of the desirability of testing each subject in each of the three situations. Therefore, the tests had to have sufficiently high reliabilities to be split into three alternate forms. The lower bound of the reliabilities of the original tests estimated from communalities are: Unusual Uses .80, Apparatus Test .71, Object Synthesis .72, and Utility Test .66. These lower bound estimates are sufficiently high to permit the construction of the three forms of the test battery, given that subtest scores are not used in the analysis. Each form of the test battery contains 19 items and is composed of 8 items of Object Synthesis, 7 items of Apparatus Test, 1 item of Utility Test, and 3 items of Unusual Uses.

J. P. Guilford supplied the original tests and information on how to divide the tests to obtain 3 alternate forms of each test having somewhat different means but equal variances. Every third item of the original tests was used in the alternate forms of the test battery so that Form I contained the 1st, 4th, 7th, 10th, etc. items from the original tests and Form II contained the 2nd, 5th, 8th, 11th, etc. items from the original tests and Form III contained the 3rd, 6th, 9th, 12th, etc. items from the original tests.

Subjects

The subjects used were a random sample of foremen and other first level management personnel employed in the home office and two manufacturing plants of an international furniture manufacturing company. The 36 subjects were all males ranging in age between the mid-twenties and late forties.

Experimental Design

The number of situations and test forms used, and the need to test each subject in the three situations required a design which would counterbalance the effects of practice and include provision for evaluating the three forms of the test battery.

The conditions are satisfied by the Lindquist Type V design, taken from Lindquist (1953). The design is a 3x3x3 Greaco-Latin square and prescribes a method for assigning groups of subjects to conditions and forms, in a way which counterbalanced the effects of practice and required three testing sessions. Each of the groups of subjects took only three of the possible twenty-seven treatment combinations as shown in Table 2 below.

TABLE 2.--Order of the treatment combinations for each of the 9 groups of subjects.

	SESSIONS					
	1.		2.		3.	
Group	Situation	Form	Situation	Form	Situation	Form
1	A	I	B	II	C	III
2	B	III	C	I	A	II
3	C	II	A	III	B	I
4	C	III	A	I	B	II
5	A	II	B	III	C	I
6	B	I	C	II	A	III
7	B	II	C	III	A	I
8	C	I	A	II	B	III
9	A	III	B	I	C	II

This design is an analysis of variance design in which the main effects are within subject effects. The double and triple interactions are mixed effects, having both between and within components. The separation of the between and within effects gives this design a great deal of power for relatively small numbers of subjects.

PROCEDURE

Studies done in industrial situations, as this one was, are especially vulnerable to the effects of uncontrolled variables. In order to minimize the possibilty of this occurrence a number of precautionary procedures were followed.

Each subject was tested at the same time of the day on three consecutive Wednesdays, and was provided with a schedule of the dates and times he was to appear in each Situation. This allowed the subjects to plan the testing time into their work schedules and reduced the interruption of the subject's normal job activities. It also helped to control for the differences in motivation which could have occurred if testing were done on different days of the week or three consecutive days.

Three experimenters were used and rotated to a different situation for each testing session. The order of rotation prevented any experimenter from appearing in any situation or testing any group of subjects more than once.

In order to keep the conditions of test administration constant, tests were administered orally and the subject's responses were recorded by the

experimenter. This procedure originated in Situation A where the level of illumination and posture of the subject prevented him from reading and writing.

Testing was done in all three situations on each of the three days. Three groups were tested in each of the situations. The session time was 45 minutes per subject. Five minutes was allowed for a subject to arrive and depart the situation and 35 minutes for testing. When the subject arrived for his session, he was told to make himself comfortable by removing his coat and tie if he desired and was wearing one, and where he was to lie down or sit. The preliminary instructions were read to each subject including the special instruction for the present testing situation. The instructions and copies of the three forms of the test battery can be found in the Appendix to this report. After the subject's questions were answered and the subject reported he was ready, the experimenter began the testing. A set of instructions was read before each subtest was given and any questions were answered. See the Appendix for the complete instructions and the three forms of the test battery.

First the subject was given a list of 15 meaningful words to learn. This task served as a warm-up for the subjects and provided some time for adapting to the situation.

Next the subject was given forty-five seconds, for each of the eight pairs of object synthesis items, to produce the name of an object which could be made by combining the objects in each pair.

The subject was next given the names of seven common implements and in forty-five seconds was to give two improvements for each of the implements.

The forth section of the test required the subject to give as many uses as he could for a common object. The time allowed was five minutes.

In the next to the last section, the subject was asked to give six alternate uses for each of three common objects. The six uses were to be given in one and one-half minutes.

In the sixth and last section, the subject was given two minutes to recall as many of the 15 words which he learned in the first section as he could remember.

Scoring

The answer sheets were coded by Session, Situation, Form, and the group to which the subject belonged. After all testing was completed the answer sheets were scored, using the guidelines and lists of responses supplied by Guilford. The scores for each of the subtests were summed to get the total score for each answer

sheet. Each subject received one score per session which were used in the analysis of variance.

This description of the scoring is not complete and is included only to give the reader some idea of the criterion used. The original tests and scoring guides cannot be reproduced in this report but can be obtained from J. P. Guilford at the University of Southern California.

The Object Synthesis scores were obtained by giving one point for each acceptable new object. An acceptable object is one which could conceivably be made by combining the two stimulus objects. The new object must have a function or characteristic different than either of the two stimulus objects.

Example:

Stimulus objects----coat hanger--rock

Responses

Pendulum----acceptable

Club or hammer----acceptable

Weapon----unacceptable--either of the objects alone could be used as a weapon.

If the acceptability of an object was questionable, its acceptability was determined by consensus of the three experimenters.

In scoring the Apparatus Test, one point was given for each stated improvement. An improvement was not given a point if; (a) it was a duplicate of a previous improvement given, although an extension of an improvement was acceptable if it contained a new idea; (b) it was absurd, ie., improvements which were in opposition to the intended function of the object; (c) it was incomplete so that the type of improvement was unclear. Improvements which had already been made and were public knowledge were not acceptable.

One point was given for each class of uses mentioned for the Utility Test item. Each class is usually defined by a characteristic of the object. If more than one use in any class was mentioned, only the first use was given a score.

Example:

Uses of a Brick

Uses--Build a house
Pound nails
Build a garage
Build a wall
Throw it at an animal
Paper weight
Anchor

Score----1 point for each use as a building material, pounding tool, weapon, and a weight.

In scoring the responses to the Alternate Uses section, 1 point was given for each acceptable use mentioned for which the object or any part of the object could be used. An acceptable use is one which must be possible, different from the stated use or class of uses in which the stated use falls, and concise as opposed to general or vague. Also an acceptable response includes uses pertaining to any interpretation of the objects given, eg., a shoe is part of a brake as well as being footwear. Lists of the most common responses were provided with the tests and were used as scoring guides.

RESULTS

The means and variances for the three forms of the battery based on 36 subjects are shown in Table 3 below.

TABLE 3.--Means and variances of the three forms of the test battery.

FORM	MEAN SCORE*	VARIANCE**
I	24.2	43.80
II	26.5	43.62
III	25.8	40.08

*The t-test for the differences between means is not significant.

**None of the F ratios (I-II, I-III, or II-III) are significant.

The reliability of the three forms was determined by a correlation of the subjects scores. The correlations are shown in Table 4 below.

TABLE 4.--Reliability coefficients of the three forms of the battery.

	FORMS		
	I	II	III
I		.61	.69
II			.65

The results of the analysis of variance is shown in Table 5 below.

TABLE 5.--Source table for the analysis of variance.

SOURCE	df	SS	MS	F
Between Subjects	35	3370.86	139	
Sit. x Forms	2	278.91	139.45	1.33
Sit. x Sessions	2	168.13	84.06	
Forms x Sessions	2	79.41	39.70	
Sit. x For. x Ses.	2	6.90	3.45	
Error	27	2837.51	105.09	

TABLE 5.--Continued.

SOURCE	df	SS	MS	F
Within Subjects	72	1162.00		
Situations	2	147.36	73.68	6.89**
Forms	2	144.91	72.45	6.78**
Sessions	2	112.30	56.15	5.25**
Sit. x Forms	2	79.19	39.59	3.70*
Sit. x Sessions	2	11.91	5.95	
Forms x Sessions	2	15.58	7.79	
Sit. x For. x Ses.	6	73.26	12.21	
Error	54	577.49	10.69	
Total	107	4532.86		

*Significant at the .05 level

**Significant at the .01 level

The Means for the three sessions of testing are:

Session 1 23.9

Session 2 26.1

Session 3 26.8

The subjects are naive test takers and the increasing means show the typical effects of practice.

The Means for the three situations are:

Situation A	24.1
Situation B	25.8
Situation C	26.97

The means show increases for the more normal office and the addition of relevant visual stimuli.

DISCUSSION

The significance of the situations indicates that the two situational variables, the availability of relevant visual stimuli and level of general body tension effect creative problem solving. Greatest facilitation of creative problem solving abilities is achieved in the situation providing relevant visual stimuli and choice of the preferred level of general body tension.

The effects demonstrated in this study, although significant, may well be an underestimate of the potential effects. First, the tasks used in this study are novel tasks for the subjects as opposed to job oriented tasks. The subjects were not recalling previously learned associations or problem solutions as they would be with job oriented problems. Second, the relevant visual stimuli used in an actual work situation would be task specific. How relevant the visual stimuli used in this study are to the tasks is indeterminate. The more relevant the stimuli used, the less the interference caused by irrelevant stimuli. Third, the subjects spent very little time in the experimental situations and consequently had little opportunity to adapt to the situations. The subjects

have had almost no experience in an office having conditions similar to Situation C or A so they cannot take full advantage of the conditions. Given more experience in selecting a preferred level of body tension and using self generated relevant visual stimuli, the increase in the production of ideas could be well above that shown in this study.

For the subjects in this study who were foremen, about one-fourth, there is an alternative explanation of the results. Situation C is the normal situation for foremen, so the more normal the situation, the greater the facilitation of creative problem solving abilities. If this were true, the subjects should feel anxious and uneasy in Situations A and B. Informal discussions with the subjects did not indicate that there were any feelings of uneasiness on the part of the subjects for any situation.

One of the uses of the experimental design of this study is to evaluate the effects of treatments by counterbalancing the effects of order and criterion differences, when the interactions can be assumed to be zero. These assumptions could not be met a priori so advantage could not be taken of this aspect of the design. However, the results show that these assumptions could well have been justified. If such an assumption were made, it would result in a reduction

of the error term used to test the main effects, thereby, increasing the importance of the findings.

Although the results of the two methods of evaluating the equivalence of the forms of the test batteries seem contradictory, closer examination of the evidence shows that they are not. On the one hand, the analysis of variance shows a significant difference among the forms, while on the other hand, the t-tests for the difference among the means and the F-ratios are not significant. The significant results found in the analysis of variance may be due in large part to the interaction between situations and forms. Examining the means for forms by situation shows that the change in means is not always in the same direction or of the same magnitude. Form II shows almost no change in the mean score for the three situations. Form I shows almost no change in mean between Situation A and B but considerable difference between the means for Situations A and C, and B and C. Form III shows no difference in means for Situations B and C but considerable mean differences for A and B, and A and C.

The differences in the specific items on the forms could account for these observed means. It is possible that the visual stimuli placed in Situation C are more relevant to the items found on Form I than

than the items on either Form II or III. The items on Form II may be more familiar than the items on either Form I or III since almost no change occurs for the means of this form across the three Situations. Certainly the visual stimuli in Situation C did not have the same effect on the mean of Form II as on that for Form I.

It seems reasonable to conclude that the difference between forms found in the analysis of variance is due to the interaction between Situations and Forms since the independent analysis of the means and variances showed no significant differences.

Additional research is needed using actual office situations. By measuring the productivity of people in their present offices, then providing offices in which the subject can vary the amount of activity, postural body tension, and display task relevant visual stimuli; it will be possible to assess the potential gains in productivity for which these variables are responsible.

Summary

This study identifies two variables of the office situation which effect the production of ideas as measured by some of J. P. Guilford's tests. The results of the study show that people working in offices will be more effective problem solvers if they can select a

preferred level of body tension and task relevant visual stimuli are displayed in the situation. This suggests that a number of different types of body support devices and open visible storage and display facilities should be provided in the office situation.

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APPENDIX

Preliminary Instructions for Testing

This experiment will involve some tests of creativity. The test results will have no effect on your job nor will your employer know how you did on the tests. You are free to use any objects in the situation that will help you in giving answers to the questions. All the items will be given orally and you are asked to give your answers orally also. All the questions may be answered with short phrases instead of complete sentences. I will tell you when to begin each section after I have read the instructions to you. All the tests have a time limit so work as fast as you can and still maintain accuracy in your answers.

Situation A. I must ask that you remain lying on the couch for the entire experimental session.

Situation B. I must request that you do not move the chair away from the desk or stand until the experiment is over.

Situation C. You are free to move about during the experiment and you may use any of the objects around the room which will help you answer the questions given you.

Once the experiment has started ask questions only after the instructions for each section, no questions will be answered during the test. Remember the tests are tests of creativity and have a time limit so work as fast and as accurately as you feel you can. Are there any questions?

Form III

1. I will read a list of words through two times. After the second time through the list you will be asked to recall as many of the words as you can remember. You may recall them in any order you wish it need not be in the order in which they are presented to you.
KING, JUDGE, EVEN, LOSS, HURT, STAND, BLOCK, MOVE, DRAW, NOSE, RIVER, WATCH, OFFICE, GOOD, TRAVEL.
From the time I say go, you will have one minute to recall the words.

2. In this next section, you will be given the names of two objects. Your task is to think of something you could make by combining the two objects. You will have 45 seconds for each answer.

clamshells	--shoelace	cellopane	--candle
rubber band	--oak leaf	safety pin	--string
needle	--clothes pin	cork	--spring
rubber sponge	--screw	thread spool	--nail

3. You will be given the names of some implements which are familiar to everyone. Your task is to suggest two improvements for each of them. Your suggestions should be specific. A general improvement like, "the implement should be made more efficient" is not acceptable. Do not suggest an improvement which you know has already

acceptable. Do not suggest an improvement which you know has already been made. You will be given 45 seconds to give the two improvements for each implement.

TOASTER

REFRIGERATOR

VACUUM CLEANER

WINDSHIELD WIPER

DOORBELL

SAFETY RAZOR

AUTOMATIC PENCIL

4. In this test you will be given the name of a common object and you are to give as many uses as you can think of for that object. You will have five minutes in which to give your answers. List as many uses as you can think of for a BRICK.

5. Now you are to consider some common objects. Each object has a common use which will be stated. You are to give as many as six other uses for which the object or parts of the object could serve. You will have one and one half minutes to give the uses for each object.

SHOE (used as footwear)

BUTTON (used to fasten things)

KEY (used to open a lock)

6. You will now have two minutes in which to recall as many words as you can from the list you learned at the beginning of the test. You may give them in any order that you wish. Begin when I say GO.