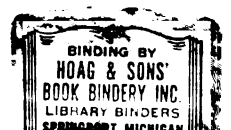
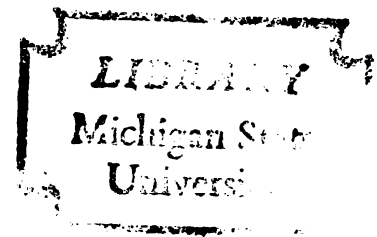




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DEVELOPMENTAL INFLUENCES
ON DIVERGENT THOUGHT

Thesis for the Degree of M. A.
MICHIGAN STATE UNIVERSITY
LEONARD PAUL SAWISCH
1974



ABSTRACT

DEVELOPMENTAL INFLUENCES ON DIVERGENT THOUGHT

By

Leonard Paul Sawisch

Results of previous studies manipulating stimulus presentation suggested that on a divergent thinking task (Unusual Uses for a Penny) subjects at Piaget's concrete operational level of cognitive development (5th grade) would show facilitated performance when stimulus presentation was concrete, while subjects at Piaget's formal operational level of cognitive development (college) would show facilitated performance when stimulus presentation was abstract.

Measures of flexibility and originality did not support the hypothesis, while the measure of subject fluency did, especially at the 5th grade level. Some procedural problems with originality indices are discussed, and a measure of specific response types is suggested as a more appropriate measure of subject performance for future studies in this area. In addition, a presentation gender interaction was found with a percentage of common responses index, suggesting a gender effect not discussed before, possibly due to task designs in previous studies.

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DEVELOPMENTAL INFLUENCES ON DIVERGENT THOUGHT

By

Leonard Paul Sawisch

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Psychology

1974

ACKNOWLEDGMENTS

I am pleased to express my appreciation to Dr. Donald M. Johnson, chairman of my committee, for his guidance and assistance in the preparation of this thesis.

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INTRODUCTION

Underlying Piaget's description of cognitive development is the increase in ability to think logically and eventually the increase in ability to think logically about abstract concepts. For example, while subjects at the concrete operational level of cognitive development have the ability to reverse operations, a necessary step in logical thought that promotes solutions to simple conservation tasks, this ability is somewhat limited to concrete applications. It is not until subjects reach the formal operational level of cognitive development that the immediate situation can be transcended and thought can be directed to more abstract applications (Piaget and Inhelder, 1969).

The value of any theory, of course, lies in its predictive ability. While knowing a subject's level of cognitive development provides a degree of predictability of subject performance on typical Piagetian tasks that involve a specific solution, or limited set of solutions (e.g., conservation and classification tasks), to what degree does this same information facilitate prediction of a subject's performance on tasks that do not have a specific solution, or set of solutions?

Though this question has not been directly investigated in the past, there are a few studies that in conjunction suggest an interesting relationship between cognitive level and ability to deal with abstractions. Goodnow (1969), using Unusual Uses tasks with kindergarten subjects, found that they made more original (non-standard) responses when allowed to manipulate the stimulus object, than when simply allowed to view it. Otte (1962), in studying the effects of verbal (word) and pictorial presentation of stimuli on concept attainment, asked subjects to explain how groups of three stimuli were alike. In a pilot study with 20 undergraduates, Otte found verbal presentation evoked significantly more responses (.01 level) than pictorial presentation, with the nature of the response sets differing significantly (.05 level) by mode of presentation. When the study was replicated with 80 4th grade subjects, however, significant differences in the opposite direction were found! Davidon (1952), in a similar study with college students, used four modes of stimulus presentation (short names, long names, line drawings, and photos), and found that both short names and long names elicited significantly more unique responses than did line drawings or photos (the influence on number of responses was unclear).

The relationship suggested is an interaction between level of cognitive development and level of abstractness

of stimulus presentation. A plausible Piagetian interpretation would be that subjects at the formal operational level of cognitive development perform best when given a more abstract stimulus presentation, while subjects at the concrete operational, or lower level of cognitive development perform best when given a more concrete stimulus presentation.

While both the Otte and Davidon studies used concept attainment tasks which do have a finite, though large, number of solutions, a more appropriate approach would be to use a clearly divergent task with a very concrete stimulus presentation (i.e., an actual, manipulable stimulus object) and an abstract stimulus presentation (i.e., a symbolic representation of the actual stimulus, or a verbal label for the stimulus). With subjects assumed to be at the formal operational level of cognitive development (e.g., college students), one would assume that performance would be most facilitated with an abstract presentation while with subjects assumed to be at the concrete operational level of cognitive development (e.g., 5th grade subjects) one would assume that performance would be most facilitated with a concrete presentation. Note that while a cognitive level by stimulus presentation interaction is predicted, direct comparison of 5th grade and college performance is not as important to the question as is comparison of performance

between presentations within each cognitive (or age) level.

A review of studies in the area of divergent thought, especially the works of Guilford and Torrance, suggest a number of possible divergent thinking tasks that allow for a great variety of solutions (Johnson, 1972). For this study, however, the Unusual Uses task, as designed by Guilford and modified by Torrance, has a number of advantages. First, the task itself is relatively easy, and so can be used with subjects of varying ages. The task is also brief enough to maintain the interest of younger subjects. More importantly, however, the task provides easily rated measures of three performance variables: fluency, flexibility, and originality (Torrance, 1974). The stimulus object used is a penny. Previously used by this author, this object elicits a wide range of responses, and normative data is available for both 5th grade and college subjects.

METHOD

Subjects

Thirty-six 5th grade subjects (18 males & 18 females) were drawn from two 5th grade classes at a lower middle-class grade school (Holt school system in Michigan), and thirty-six college subjects (18 males & 18 females) were volunteers from introductory psychology classes at Michigan State University.

Procedure

College subjects were randomly assigned to one of the two stimulus presentation conditions and then run in two groups (by presentation). The 5th grade subjects were run by classes, with each class assigned to one of the two presentation conditions. This division was necessary due to the difficulties in obtaining grade school subjects.

Each subject received an 8" by 11" paper with directions followed by twenty numbered spaces, and an envelope containing the stimulus object. The directions (identical for all subjects) were then read by the experimenter and any questions were answered.

Directions

"This is an Unusual Uses task. You are to list below as many unusual uses as you can think of for the object provided. By unusual we mean any use that is different from the common, everyday, or intended use of the object. In the envelope provided is the object you are to work with. Open the envelope, take out the object, and begin work. Remember, list as many Unusual Uses as you can think of for the object you have."

For the concrete presentation condition the envelope contained an actual penny; while for the abstract presentation the envelope contained a 3" by 5" card with the words 'a penny' typed in the center. (Review of the response sheets and verbal reports by subjects in the latter group indicated that no subjects responded to the actual index card rather than the words 'a penny'.) The envelope procedure was used to allow for identical directions with both stimulus presentation conditions, and to insure that, at least initially, subjects in the concrete group actually handled the penny. All subjects were allowed 10 minutes to complete the task.

Each subject's response sheet was rated for fluency, flexibility, and originality by two independent judges. Judges were trained on each scale using response sheets from an earlier study until a high degree of concordance between judges was obtained.

Fluency is the number of different responses produced. This is defined rather leniently in that elaboration of an idea or response may contain a number of uses. For

example, a subject responding with "A penny can be used in games, like spinning contests or pitching pennies" was rated as giving two responses: "spinning contest" and "pitching pennies". Unelaborated, "A penny can be used in games", the response was rated as a single response. The fluency index was the sum of the ratings by both judges.

Flexibility is the number of response set changes; every time a response falls into a different category from the response immediately before it, a point was given. A guideline list of categories, obtained from previous responses by 5th grade and college subjects to the penny item, is located in the Appendix. The flexibility index is the sum of the ratings by both judges, divided by the fluency index.

Originality of each response was rated on a seven-point scale, from "very common" (1), to "very unusual" (7). This type of rating scale has been used extensively in research at Michigan State University (Johnson and Kidder, 1972). A sample of the rating guide used is located in the Appendix. While it may be argued that a separate originality scale should be used for each grade level, it was not the intent of this study to make a cross-age comparison, but to simply look at changes within each grade level due to the experimental manipulation. The scale described above has given a good distribution of ratings for both 5th grade and college subjects in the

past, suggesting that it will be sensitive to changes within each cognitive level. Interestingly, the results of this study could influence the choice of separate rating scales in the future, if the researcher's intent is to make a cross-age comparison.

The originality index for each response is the sum of the ratings by both judges. Given that subjects tend to give a number of responses, there are many ways of using the originality ratings to assign an originality index for each subject. Traditionally, two approaches have been taken. The first is a simple count of the absolute number of original responses (i.e., responses rated "5" or higher). While this is the index used in the Goodnow (1969) and Davidon (1952) studies, it is a somewhat crude measure in that it can be influenced by a subject's fluency score (Johnson, 1972). The second approach controls for fluency by dividing the total of both judges' ratings by the fluency index, resulting in a mean originality index. This is the index used by Johnson and Kidder (1972), and the same index was computed for subjects in this study.

Two additional indices were also computed. Because the focus of this study was on performance per se, and not specifically on original output, for each subject the percentage of responses rated "5" or above (uncommon responses) was computed, as was the percentage of responses rated "3" or below (common responses). To allow

a clear distinction between the two measures, responses rated "4" were not considered (i.e., a "4" response may be one 'a bit better than a "3"' or one 'almost a "5"'). For clarity, for each subject the number of "1", "2", and "3" ratings were totaled, then divided by the total number of ratings to give a percentage of common responses. The same procedure was used to determine the percentage of unusual responses. Note that this procedure controls for effects due to subject fluency in the same manner as the mean originality index.

RESULTS

A correlational analysis of data was used separately for each of the five indices, with relation to cognitive level (5th grade or college), stimulus presentation (concrete or abstract), and gender, in view of the popular concern over possible sex differences. This procedure provides all the information provided by the classical analysis of variance ($F = (N-8) \frac{r^2}{1-R^2}$), and, in addition, it indicates the direction of effects and allows easy and direct comparisons of the magnitude of different effects, both within this study and across studies, as correlations are independent of sample size.

To facilitate understanding of the direction of effects, the following values have been assigned to maximize the number of positive correlations. For stimulus presentation, concrete is positive (+) and abstract is negative (-). For assumed cognitive level (age), 5th grade is positive (+) and college is negative (-). For gender, females are positive (+) and males are negative (-).

Fluency

The interjudge reliability for fluency ratings was .99. Table 1 contains the correlations and corresponding

TABLE 1
Correlations and corresponding F values
for the fluency index.

	Correlation	F value
Presentation (P)	.26*	5.28*
Age (A)	-.10	.76
Gender (G)	-.01	.01
PA	.28*	6.36*
PG	.00	.00
AG	-.08	.53
PAG	.21	3.42

*P<.05

Concrete Presentation = +

Abstract Presentation = -

5th Grade = +

College = -

Females = +

Males = -

F values for the fluency index. Stimulus presentation had a significant main effect on fluency ($r = .26$, $P < .05$), with a mean fluency index of 30.42 for concrete presentation and 24.17 for abstract presentation. There was also a significant presentation-age interaction ($r = .28$, $P < .05$). Figure 1 clarifies this interaction, indicating that the major effect was at the 5th grade level, with a mean fluency index of 32.67 for concrete presentation and only 19.56 for abstract presentation. At the college level, the abstract presentation was not significantly greater than concrete presentation (mean fluency indices of 28.78 and 28.17, respectively).

Flexibility

The interjudge reliability for flexibility ratings was .99. Table 2 contains the correlations and corresponding F values for the flexibility index. Age had a significant main effect on flexibility ($r = .35$, $P < .01$), with a mean flexibility index of .59 at the 5th grade level and .74 at the college level.

Originality

The interjudge reliability for originality ratings was .97. Table 3 contains the correlations and corresponding F values for the three originality indices. For mean originality, gender had a significant main effect ($r = .38$, $P < .01$), with a mean originality index of 3.71 for females and 3.13 for males.

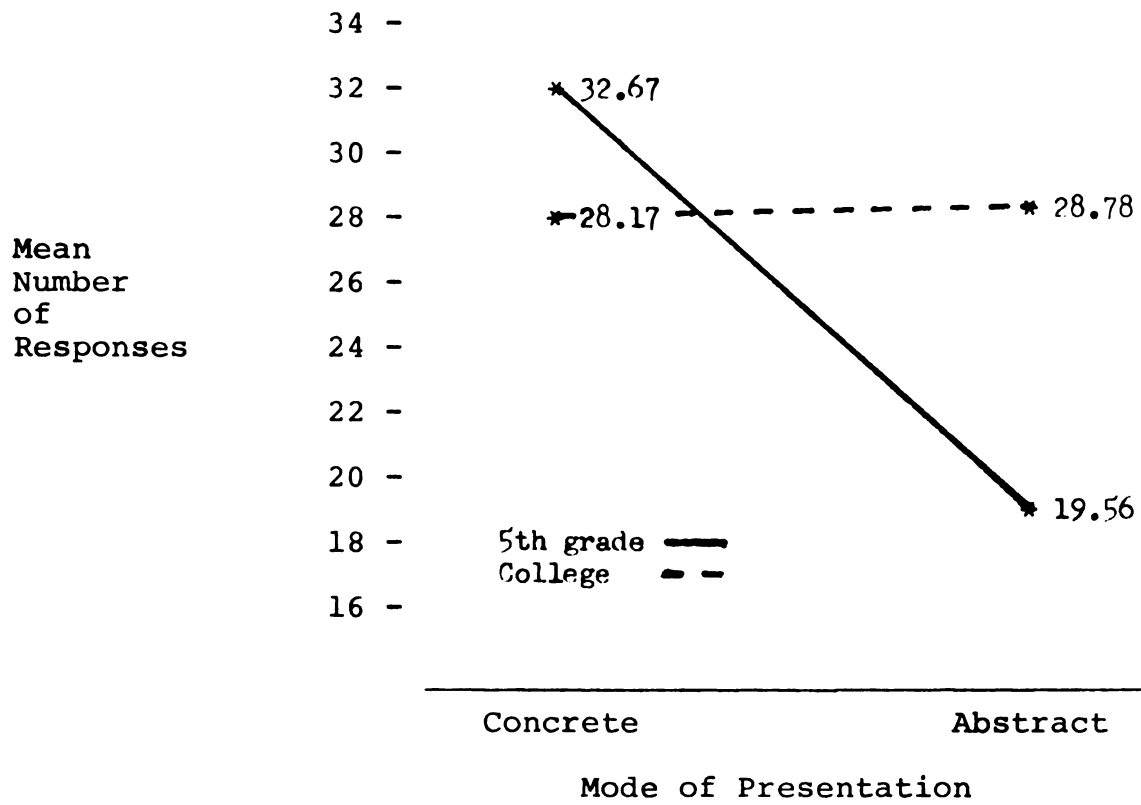


FIGURE 1. Presentation-age interaction for fluency.

TABLE 2

Correlations and corresponding F values
for the flexibility index.

	Correlation	F value
P	.01	.01
A	-.35**	9.60**
G	-.09	.68
PA	.04	.11
PG	.09	.65
AG	-.06	.31
PAG	-.14	1.59

**P < .01

TABLE 3

Correlations and corresponding F values for the mean originality index, the percentage of unusual responses index, and the percentage of common responses index.

	Mean Original		Percentage Unusual		Percentage Common	
	r	F value	r	F value	r	F value
P	-.01	.01	-.01	.02	.06	.33
A	.10	.87	.40**	16.53**	-.20	3.35
G	.38**	12.21**	.41**	17.11**	-.33**	9.51**
PA	-.10	.88	-.12	1.52	.19	3.04
PG	.18	2.72	.12	1.59	-.25*	5.28*
AG	.15	1.84	.14	2.05	-.19	1.42
PAG	-.03	.08	.05	.30	.05	.19

*P < .05

**P < .01

For percentage of unusual responses, both age and gender had significant main effects, ($r = .40$, $P < .01$; and $r = .41$, $P < .01$, respectively). The 5th grade subjects had a mean percentage of unusual responses of 36.08, while college subjects had a mean percentage of unusual responses of 20.22. Also, female subjects had a mean percentage of unusual responses of 36.22, while male subjects had a mean percentage of 20.08.

For percentage of common responses, however, there was no significant main effect due to age, only a significant main effect due to gender ($r = -.33$, $P < .01$), with a mean percentage of common responses of 59.06 for males and 42.95 for females. There was also a significant presentation-gender interaction ($r = -.25$, $P < .01$). Figure 2 clarifies this interaction. Females have a mean percentage of common responses of 38.45 with concrete presentation and 47.45 with abstract presentation, while males have a mean percentage of 66.56 with concrete presentation and 51.56 with abstract presentation.

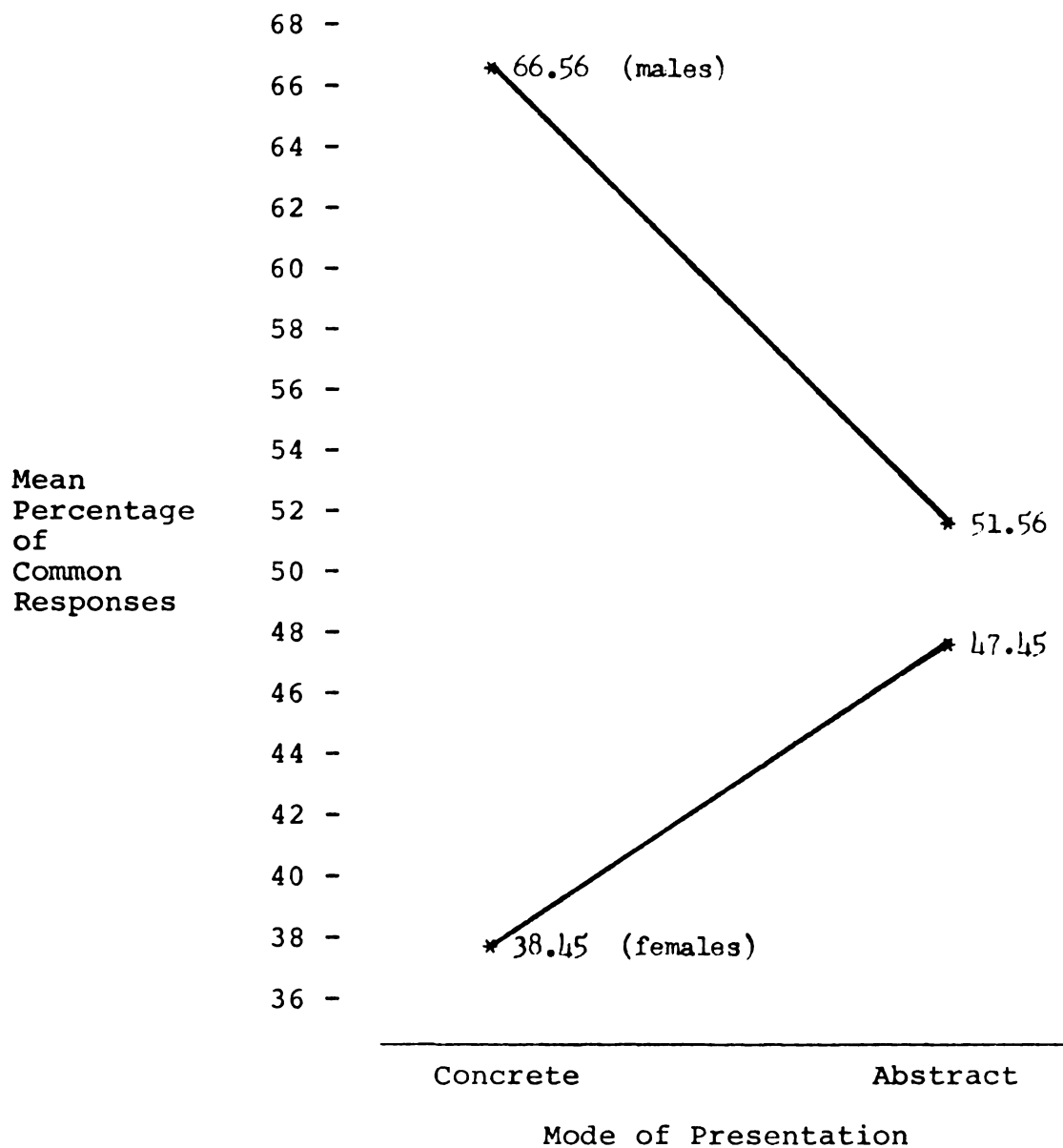


FIGURE 2. Presentation-gender interaction for percentage of common responses.

DISCUSSION

With a Piagetian overview of results from three published studies, it was predicted that subjects at the concrete operational level of cognitive development would show superior performance on a divergent thinking task when the stimulus was presented in a concrete manner, as opposed to an abstract manner. Similarly, it was assumed that subjects at the formal operational level of cognitive development would show superior performance when the stimulus was presented in an abstract manner, as opposed to a concrete manner. Performance was measured in three domains; fluency, flexibility, and originality, with three indices of originality being used.

The fluency data, to a degree, supports the hypothesis in that 5th grade subjects were more fluent with a concrete presentation than with an abstract presentation. College subjects, however, had nearly identical performance under both conditions (Review Figure 1). It is this lack of difference at the college level with the large difference at the 5th grade level that explains the appearance of a main effect by presentation for fluency.

The flexibility data does not support the original hypothesis, as no differences between stimulus

presentations were found within either age group. There was, however, a significant effect due to age, with college subjects more flexible than 5th grade subjects. This finding is consistent with the findings of other divergent thinking tasks as reported by Torrance (1974), where stimulus presentation is abstract for both age levels.

The three originality indices also fail to support the original hypothesis in that there were no differences due to presentation within each age level. The use of three indices of originality, however, does have some advantages. While all three indices indicate a gender effect (i.e., females have a higher mean originality, a higher percentage of unusual responses, and a lower percentage of common responses than males), consistent with data reported by Goodnow (Otte and Davidon did not consider gender), the percentage unusual and the percentage common indices seem to provide more information concerning performance per se than does the mean originality index.

Specifically, percentage of unusual responses has a significant correlation with age, in that 5th grade subjects appear to give a higher percentage of unusual responses than do college subjects. The strength of this correlation, however, may be a function of the originality rating scale used. Because the focus of this study was on differences due to stimulus presentation within groups,

the identical originality scale was used for all subjects. Other researchers, for example Torrance, when making direct cross-age comparisons, use a weighted score (based on large normative samples) for each age group investigated.

The percentage of common responses does not show a significant correlation with age, which also tends to support the interpretation that the age effect discussed above may indeed be a function of the rating scale. Considering what a common response is (refer to the originality scale in the Appendix), it does not seem likely that the kinds of common responses given would be different for 5th grade and college subjects, while the variance at the other end of the scale would make it possible to favor one age group over the other. While not enough information is available to look specifically at differences in response types between age groups (nor was it the intent of the study to do this), Table 4 contains a sample of the most original responses given by 5th grade and college subjects, and suggest that such differences may exist.

In addition, with the percentage of common responses index, a significant presentation-gender interaction was found. This interaction is of special concern because no age effect or interaction was found, suggesting that this effect was not a function of the scale, as it was found at both the 5th grade and college level. Given the

TABLE 4

Examples of unusual responses given by 5th grade
and college subjects.

<u>5th Grade Concrete</u>	<u>College Concrete</u>
1) Put holes in it and hook it onto the faucet.	1) Under a skipping windshield wiper
2) Talk to that man on it	2) Flat marble
3) Go inside the building	3) To stop on
4) Put some together and use them for a ruler.	4) Dildo
5) Contacts	5) Talk to it
<u>5th Grade Abstract</u>	<u>College Abstract</u>
1) Put hands on it and make a clock.	1) Rattle around in man's pocket (feels nice)
2) Make a stethoscope	2) To rhyme with Lenny, Penny, Benny, etc.
3) As a record (stereo)	3) Make a film of it.
4) As a movie screen	4) Eat for copper plated hemorrhoids.
5) For a map	5) Use columns on back to build own home. (very sturdy)

direction of this interaction, it lends support to the significance of the difference between the concrete presentation and the abstract presentation, although this difference did not have the effect on performance originally predicted.

An explanation of this interaction is not an easy task. Possibly females, when given a concrete stimulus presentation, find it easier to cut through the response hierarchy and thus give less common responses than when stimulus presentation is abstract. The converse for males would indicate it is easier to cut through the response hierarchy when the stimulus presentation is abstract, while a concrete stimulus presentation tends to somewhat limit the male subjects' ability to cut through that same response hierarchy.

Why this would be true is difficult to say. As apparently no other study with divergent tasks has manipulated the abstractness of stimulus presentation and considered gender as a factor, the literature is of no help. Additional research to substantiate this interaction and investigate possible causes is needed.* Considering that most divergent tasks are presented verbally (abstractly, as defined by this study), especially for older subjects (Torrance, 1974), a review

*Such a study is presently under way at Michigan State University by Sawisch and Kidder, but the data is not available at this time.

of the mean percentage of common responses given with abstract stimulus presentation (i.e., 51.56 for males and 47.45 for females, as shown in Figure 2) suggest why this interaction has not been suggested before.

Hopefully this study serves to emphasize the importance of choosing an originality index that provides the specific information the experimenter is looking for. Given this concern, it may well be that the original hypothesis was based on a somewhat spurious index in that both the Goodnow and the Davidon studies used absolute number original as their originality index, which can be affected by fluency scores. Note that the fluency scores in this study did support the predicted presentation effects, especially at the 5th grade level. If the fluency scores had not been separated from the originality scores, then, the originality scores might have appeared to support the predicted presentation effects.

SUMMARY

The data in this study does not tend to support the original hypothesis that concrete operational subjects' performance would be facilitated more by concrete stimulus presentation than by abstract stimulus presentation; with the converse being true for formal operational subjects. There is a possibility, however, that other dimensions of performance not measured here might be affected by differential stimulus presentation as a function of cognitive development as described by Piaget.

The performance variables measured in this study were suggested by the studies done by Goodnow (1969), Otte (1962), and Davidon (1952). Both the Otte and the Davidon studies, however, used concept attainment tasks, which have a finite solution set. In addition, both the Goodnow and the Davidon studies used an index of originality that did not control for subject fluency (the Otte study did not use an originality index), while the data in this study indicates subject fluency is affected by stimulus presentation and level of cognitive development.

Perhaps a more appropriate approach would have been to look for differences in specific response types. Review of the flexibility index, located in the Appendix, indicates that while it is sensitive to changes in response sets, it is not refined enough to indicate specific response types. (If such refinements were made, it might then demand the use of different scales for each age level.) Note that while the Otte study used a concept attainment task, a significant age-presentation interaction was reported for response types.

The major implication of this study is more procedural than theoretical. Researchers in the future considering the use of an originality index should be sensitive to the possible influences due to subject fluency, and in addition, should consider the use of other originality indices in addition to mean originality if subject performance per se is the measure they are really concerned with. It might also be noted that response type, though difficult to quantify, might be an important addition to future studies investigating performance on divergent thought tasks, especially if the study takes a developmental perspective.

This study should also serve to sensitize future researchers to the possible influences of stimulus presentation. This is especially true in view of the stimulus presentation-subject gender interaction found

with the percentage of common responses index, a finding that obviously demands further investigation.

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APPENDICES

APPENDIX I
FLEXIBILITY CATEGORIES

APPENDIX I
Flexibility Categories¹

1. BUY: buy marbles, buy presents, etc.
2. MONEY: monetary uses other than to buy; tip, tax, loan it, etc.
3. SAVE: put in bank, collect, trade, etc.
4. CHARITY or GIFT: give to charity, give away, etc.
5. GAMBLE: bet, etc.
6. GAMES: spin, pitch, do magic tricks, use as a playing piece (checker), etc.
7. TRACE: circle template, trace Abe, etc.
8. ART: make pictures, collages, etc.
9. DECORATION: penny loafers, borders, etc.
10. JEWELRY: bracelet, ring, watch face, etc.
11. GOOD LUCK: penny loafers FOR good luck, wishing wells, etc.
12. WEIGHT: sinker, door stop, record player arm weight, etc.
13. DESTRUCTION: smash (railroad tracks), melt, threw away, etc.
14. WEAPON: slingshot ammo, weapon, target, etc.
15. ELECTRICAL: fuse, conductor, etc.
16. TOOL: screwdriver, window prop, scraper, shim (jam machines, doors), etc.

¹Based on data from 5th grade and College samples, and modelled after the Flexibility scale described by Torrance (1974).

Appendix I (Cont'd)

- 17. COVER or PLUG: eye cover, fill holes, ear plug, etc.
- 18. SYMBOLISM: insult, pacifier, or use penny as a pun
(play on words), etc.
- 19. OBJECT: used simply as an object of action; bury,
swallow, bite, throw, freeze, etc.

New categories can be created, but only if the response cannot be placed in one of the above categories.

APPENDIX II
RATING SCALE FOR ORIGINALITY

APPENDIX II

Rating Scale for Originality

1. Common, or intended use of the object; using a penny as money.
 buy something, even out change, loan it, etc.
2. a. Also a common use, though not the original intention of the object's production.
 fuse, collect, flip, draw circles, etc.

 b. This rating is also applied when almost any object can be used in the same way.
 bury it, kick it, burn it, freeze it, etc.
3. The object is often used, or substituted for, (also more specific than 2b).
 checker replacement, screwdriver, book mark, games, etc.
4. Apparent use, though less common than a 3.
 record player arm weight, art projects, jewelry, decoration, etc.
5. a. Not a common use, perhaps demanding additions or alterations.
 fish bait, slingshot ammo, melt for hardware, etc.

 b. May be an elaboration of a 4 response.
 earrings, make a belt, mosaic, etc.

 c. May be a slight play-on-words
 pacifier, conversation piece, etc.
6. Uncommon use, perhaps demanding a remote substitution, or a more obvious play-on-words.
 dike hole plugger, pencil sharpener, flat marble, peace offering, etc.
7. Very uncommon or unusual, (remote association).
 opaque monocle, phallic symbol, ant hole cover, standard of weight, etc.

Elaboration of a response can increase its rating, e.g., while "jewelry" is rated as a 4, "earring" is rated as a 5. This can be true of any rating level; while "ant hole cover" is a play on words (man hole cover), it is more unusual than an average 6 response.

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