Cognitive Development in Adulthood: A Fifth Stage?

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Recent investigations of the Piagetian stage of formal operations suggest that consistent, progressive changes in thought structures may extend beyond the level of formal operations. The present study systematically searches for new structures. It suggests a new stage to account for these structures and offers empirical evidence to support the hypothesized fifth stage. Two formal stages are defined operationally: the problem-solving stage (traditional Piagetian formal operations stage) and the problem-finding stage. The commonly accepted criteria for a stage model are applied to justify the two-stage hypothesis. Particular emphasis is placed on the sequencing criterion and on evidence that the problem-solving stage is the necessary but not sufficient condition for the problem-finding stage. The discussion centers on the theoretical and empirical importance of considering the two-stage hypothesis, and further research questions are suggested.

The stage of formal operational thinking has been given special status as the "final equilibrium" in cognitive development (Inhelder & Piaget, 1958). Inhelder and Piaget characterize formal thought as essentially hypothetic–deductive. Its most distinctive property is the reversal of direction between reality and possibility. Specifically, the formal stage implies the ability to engage in abstract thought, that is, to deal with propositions, to generate hypotheses and subject them to empirical investigation, and to employ proportionality and combinatorial systems in problem solving.

Recent research seems to indicate that formal operational thinking is not necessarily the final equilibrium. Perhaps consistent progressive changes in thought structures extend beyond the level of formal operations throughout adulthood (Gruber, 1973; Gruber & Barrett, 1973). The suggestion is that although formal structures are stable, having achieved equilibrium and remaining available throughout life, they may also be building blocks for new structures that go beyond those traditionally defined as formal. These new structures may constitute a level beyond the level of formal operations.

It is the purpose of the present research, based in part on Gruber's work, to systematically search for these new structures; to identify a possible fifth stage of cognitive development; and to offer empirical evidence in support of this stage.

Gruber (1973) undertook the analysis of the development of creative thought in adults, particularly in those characterized as genius in their accomplishments. He used a retrospective case history approach to analyze the process that Charles Darwin went through in the development of his theory of evolution. Gruber likened that process to the transitional phase a child goes through in advancing from the stage of preoperational thought to that of concrete
operations. He suggested that significant changes in adult thought closely paralleled growth in children's thought. Both changes, in adults and in children, involved a process of grouping, experimenting, discarding one position after another, restructuring ideas, and interacting with other people. For Gruber, the concept of continuous cognitive growth in adulthood seriously challenges the concept that adult thinking achieves a state of final equilibrium in the sense of an end point beyond which no new structures appear.

Gruber's notion of growth in adult cognitive development is partially substantiated by the 38-year follow-up study of intelligence from preschool to middle age (Bradway, 1944; Kangas & Bradway, 1971). The limits of the mental growth curve were not established in those studies. Male subjects continued to show an increase in IQ as adults, with the amount of that increase a function of pre-adult intelligence.

If Gruber's work is taken seriously, Piaget's description of the stage of formal operational thinking needs to be refined. This refinement should take into account Gruber's suggestion that consistent, progressive changes in thought structures may extend beyond the level of formal operations.

Two formulations can account for these structures: (a) The Piagetian notion of formal operations is a single stage made up of a series of hierarchical substages, or (b) it is made up of two quite distinct stages, each of which conforms to stage criteria.

The present research investigates the second position, the two-stage hypothesis. The question then becomes: Can a description of formal thought involving two distinct stages in the scheme of cognitive development be theoretically and empirically justified? To begin a response to that question, both stages need to be defined. The structures traditionally thought to constitute the stage of formal operations are structures that can be characterized as convergent or problem-solving phenomena. These structures are normally assessed in the process of seeking a solution to a specific presented task. To highlight the distinction between the traditional Piagetian formal operations stage and the hypothesized fifth stage, this traditional stage was renamed the problem-solving stage.

Cognitive growth and change, following Gruber, represent divergent phenomena, the structures of which, if identified, would be the contents of a new stage. This newly hypothesized fifth stage was named the problem-finding stage. Processes characteristic of this new stage would include creative thought vis-à-vis "discovered problems" (Getzels, 1964; Getzels & Csikszentimihalyi, 1970; Getzels & Csikszentimihalyi, Note 1); the formulation of generic problems (Taylor, 1972); the raising of general questions from ill-defined problems (Mackworth, 1965); and the slow, cognitive growth represented in the development of significant scientific thought (Gruber, 1973). These processes give hint to the structures that might make up the new stage.

The argument for a fifth stage has to be based on commonly accepted criteria for a stage model. Among the most commonly agreed upon criteria are sequencing, progressive integration of preceding structures into later structures, and general structures. These criteria suggest that there is a hierarchical nature to any stage model. They further imply that stage-specific behaviors of the earlier stage must be accomplished before the behaviors appropriate to the next stage emerge. A further implication is that satisfying the requirements of the earlier stage is necessary but not sufficient for acquiring the new stage (Inhelder, 1962; Kessen, 1962).

The relationship between formal operational thinking in the Piagetian sense (problem-solving stage) and the new stage of problem finding should be such that all subjects who are successful in problem finding should also be characterized as formal operational thinkers in the Piagetian sense. However, not all subjects who are characterized as being in the problem-solving stage (the traditional Piagetian stage) should be characterized as also being in the problem-finding stage. The establishment of this relationship would satisfy the stage criterion of sequencing.

In the definition of the dependent variable, problem finding, the identification of certain general structures occurs, meeting a second
stage criterion. In the Discussion section, suggestions are made as to how the integration of earlier problem-solving structures into the new problem-finding structures takes place. This discussion addresses in part the question of the applicability of the criterion of progressive integration of preceding structures into later structures.

It is appropriate now to consider the definition of the two variables critical to this study, the problem-solving variable and the problem-finding variable, and the experiment that was designed to examine them.

Method

Sample

The sample for the study was made up of 60 female college seniors selected randomly from all of the female students enrolled in their first class in educational psychology at a middle-size southern state university. All 60 subjects participated in both task sessions, that of problem finding and that of problem solving.

Problem solving (formal operations). The independent variable, traditionally the stage of formal operations in the Piagetian model, was assessed by means of three Piagetian tasks individually administered: (a) the combinations of colored and colorless chemical bodies; (b) the oscillation of a pendulum; and (c) the projection of shadows (Inhelder & Piaget, 1958). Coding of a subject's performance level on each of the three tasks closely conformed to the analysis of each task as reported by Inhelder and Piaget (1958). Two raters independently scored each set of tasks. They assigned a whole-number value between 1 and 6 corresponding to each substage designated by Inhelder, with Stage 1a equal to 1, Stage 1b equal to 2 and . . . Stage 3b equal to 6. A subject was classified as a high problem solver if she received a Stage 3 classification on two out of three of the tasks. Bernstein's coefficient (1968) yielded a value of .85 on the rating of the Piagetian tasks. This coefficient was an estimate of rater accuracy (objectivity of the nominal category coding used by the two raters).

Problem finding. The dependent variable, problem finding, was defined in the literature (Getzels, 1964; Mackworth, 1965) in order to make a critical distinction between the formulation of a problem and the solution of a problem once formulated. Out of these theoretical statements an operational definition of problem finding was developed. This definition included three elements: (a) a problematic situation; (b) an opportunity for subjects to raise questions within that situation; and (c) a way of categorizing the questions once raised. The methods and materials developed by Arlin and Getzels (1974) were selected to assess this variable. Briefly, the problem-finding task consisted of a problematic situation, an array of twelve types of objects. The 12 objects were 1 C clamp; 1 black wooden cube; 1 scissors; 1 small piece of red cardboard with a dime-size hole in the center; 1 plain wooden cube; 1 quarter; 1 box top; 1 box bottom; 3 candles; 3 wooden matches; 10 thumb tacks; and 2 6-foot (1.8-m) cords. The basis for the selection of these particular objects was their earlier use in problem-solving research (Dunker, 1945; Maier, 1970; Daniels, Note 2). Because of this earlier use they were thought to be problem-rich materials.

The object array was accompanied by a set of directions which asked subjects to raise questions about the array in a 10-minute time period. Each subject wrote down the questions in the required time. Analysis of these questions required a way of categorizing them according to their generality (Mackworth, 1965). Thus the data were analyzed according to the "intellectual products" categories of Guilford's structure of the intellect model (1956). This meant that the questions were categorized from 1 through 6 corresponding to the six categories of the intellectual products model. Category 1 was units; Category 2, classes; Category 3, relations; Category 4, systems; Category 5, transformations; and Category 6, implications. Interrater reliabilities, based on the independent classification of the questions by two scorers, were approximately .80. The problem-finding variable represented the weighted average of the questions according to the intellectual products category. Order effect was controlled for by randomly assigning the subjects to either task as their first session. The order of administration caused no significant differences.

Implicit in all of this was the assumption that a higher order category question more closely approached the notion of a general or generic question than did a lower order question. An earlier study (Arlin, 1974) supported this assumption.

Results

There was a significant correlation between the problem-solving (Piagetian formal operations) stage and the problem-finding stage performance of the subjects, r(59) = .31, p < .01. Although this correlation is an important one, the crucial data for this study are reported in Table 1, a contingency table. The usual chi-square statistic seems inappropriate because only two cells

Table 1: Formal Operational Thinking by Problem Finding

<table>
<thead>
<tr>
<th>Formal thought</th>
<th>Problem finding</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Formal thinking</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Nonformal thinking</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

Note: These materials were designed by Arlin in consultation with Getzels at the University of Chicago.
in the table are critical to the argument that
the problem-solving stage is the necessary
but not sufficient condition for the problem-
finding stage. In pursuing this argument, a
comment about the column divisions of
high, medium, and low problem finding is in
order. The problem-finding variable was
normally distributed across the sample with
approximately 67% within ±1 standard
development. Therefore all subjects who were
≥+1 standard deviation were classified as
high problem finders, those within ±1 stan-
dard deviation of the mean were classified as
medium, and those ≥−1 standard deviation
were classified as low problem finders.
The two cells critical to the argument are
(a) formal operational thinking with high
problem-finding performance, and (b) non-
formal operational thinking with high
problem-finding performance.
The inference is that formal operational
thinking in the Piagetian sense is a necessary
condition for high problem finding. Inspec-
tion of the remainder of the table suggests
that problem solving (formal operational
thinking) is not a sufficient condition, since
61% of those characterized as formal
thinkers are not classified as high problem
finders.

Discussion
As is appropriate with an exploratory
study, the results are to be interpreted
cautiously. Only with refinement and replica-
tion can the existence of two separate stages,
the problem-solving stage and the problem-
finding stage, be established. Still, the initial
findings are encouraging. These findings, in
turn, do not lead to stated conclusions but
do suggest a series of questions for further
investigation.
One question for which only a tentative
answer is possible concerns the applicability
of the stage criterion of progressive integra-
tion of preceding structures into later struc-
tures. The assumption was that higher order
questions of the intellectual products cate-
gory closely approximate generic or general
questions which Mackworth (1965) defined
as the appropriate outcome of problem
finding. The expectation was that a sub-
ject who was a high problem solver (clas-
sified as employing Piagetian formal opera-
tions) but not high in problem finding should
have asked questions that structurally re-
quired combinatorial and systematic opera-
tions. An analysis of the questions such sub-
jects asked shows that a majority of their
questions appeared in the intellectual
products categories, relations and systems.
This suggests that relations and systems
questions are logically prior to implications
and transformations questions, questions
characteristic of high problem finders. The
parallelism can be carried further. Com-
binatorial thinking and the systematic
manipulation of one variable in a set,
helding all others constant, might represent
logically prior structures to the structures
underlying problem finding viewed as im-
plications or transformations, that is, general
questions. The data substantiated the pos-
sibility of such a relationship. It did not
clarify the exact nature of the structural
relationships.
Second, it has been widely demonstrated
that only 50% of the adult population ever
attains the Piagetian stage of formal
operational thinking, the problem-solving
stage. If this set of operations is the necessary
but not sufficient condition for the develop-
ment of problem-finding operations, what
proportion of the population can be ex-
pected to develop the cognitive structures ap-
propriate to this hypothesized fifth stage of
cognitive development?
Third, Gruber (1973) suggests that the ap-
parent slowness of cognitive change and
growth in children may be paralleled to the
cognitive change that takes place in the con-
struction of creative thought in the adult. If
this is true, one ought to be able to document
this parallelism and define the processes of
inventing, discovering, interacting, and con-
structing knowledge in terms of the fifth
stage.
Finally, a thorough investigation is needed
to determine the specific formal operations
of the problem-solving stage that lend
themselves to the development of the new
structures of the fifth stage.
These tentatively identified issues highlight
the necessity for further research efforts. They
represent a logical next step if one is to
search for evidence of the existence of a fifth
stage in cognitive development. This fifth stage, the problem-finding stage, may best characterize creative thought, the envisioning of new questions, and the discovery of new heuristics in adult thought.

REFERENCE NOTES

REFERENCES
Getzels, J. W. Creative thinking, problem solving and instruction. In E. Hilgard (Ed.), The sixty-third yearbook of the National Society for the Study of Educa-

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