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ABSTRACT

The general objective of this study was to study Piaget's notion of the sequential development of number conservation in 85 children averaging 5.9 years of age. The question addressed was to determine if a set of ten equal addition conservation of number tasks were scalable. A large coefficient of reproducibility, .912, was computed. Other indices computed suggest that the obtained coefficient was not artifactual. This study appears to validate Piaget's contention that cognitive development is sequential, suggesting that conservation of number on equal addition tasks may be a single attribute of a whole scalable universe of conservation. (Author)

Scalability of Tasks: A methodological Study of Conservation on a Set of Equal Addition Tasks

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Many psychologists have been concerned with the question of whether or not cognitive development is a continuous or discontinuous process within a child. That is, does growth in cognitive thinking develop on a continuum such that the successful development of one phase is prerequisite to the successful development of more complex phases?

Piaget's position on this issue is that development is an inherent, unalterable continuous process, yet within this development process there are a series of distinct developmental phases and stages (Maier, 1965). Essential to Piaget's theory is that each phases always remains the same (Piaget, 1952). Even though the age at which each child completes each phase may vary, the sequence of the phases through which each child proceeds is assumed to be invariant.

This broad Piagetian framework is based on a theory which sees development as a continuous process with each phase or developmental task depending on the successful accomplishment of previous phases or tasks along the continuum. Piaget, however, intentionally avoiding a statistical approach is concerned with the pattern and order of sequence rather than a quantitative analysis (Maier, 1965). Flavell (1963) suggests the necessity of much research to validate Piaget's position of continuous and sequential development. He also suggests that an effective approach to validating Piaget's theory is through scalogram analysis.

The purpose of this study was to assess the acquisition of one attribute, that of conservation of number on equal addition tasks through scalogram analysis to see if it does define a scale or continuum. This attribute involves a child's understanding that two sets of objects equal in number are still equal in number even though an object is added to each set and the perceptual configuration of the sets change.

Conservation of Number on Equal Addition Tasks

Piaget has investigated extensively a child's growth in cognitive thinking. A central prerequisite for acquiring and developing logical thinking is conservation of number (Piaget, 1965). Conservation is the "ability of the individual based on previously acquired skills and structures to realize the invariant aspects of properties of objects in the face of transformations" (Sears, 1971). Conservation of number on equal addition tasks specifically within this study concerned the four- to seven-year-old's understanding that two sets equal in number are still equal in number after the addition of one object to each set and a transformation of the perceptual configuration. Within this study the transformation in the configuration of the sets resulted from merely the addition and manipulation of one of the sets. Examples and illustrations of these transformations follow. There were two basic types of variations for equal addition tasks used in this study.

One type of transformation involves merely the addition of one object to each of the two sets of objects. If two sets of objects are placed in two identical rows, the addition of one object to each of the two rows may affect the rows in similar or dissimilar ways. For example, an object may be placed at the end of each row, changing the length of the rows equally. In another example, however, one object is placed within the original configuration of one row, while another object is placed at the end of the other row. In this task the density and length of the two rows are affected in a differential fashion by the addition, thus bringing about dissimilar effects.[1] (These examples are illustrated as Figures 1 and 2 respectively.)

Figure 1 about here

Another type of transformation of the two sets of objects involves both the manipulation of the objects and the addition of objects. An example of this transformation, as indicated in Figure 12, consists of changing one row by adding an object and by contracting the arrangement. The other row is changed only by the addition of an object to the end of the row.

Figure 2 about here

Numerous conservation tasks were formulated from each of these types of transformations by changing either the size of the objects, the distance between the rows, the orientation of the task in space, or the arrangement of the objects. Because these changes will result in configurations having very different perceptual attributes, these tasks were as-

[1]This study utilized blocks of different sizes and shapes. Implicit throughout all illustrations and discussions is correspondence of objects with blocks.

Figure 1 Changing Row Lengths Equally (Task 1)

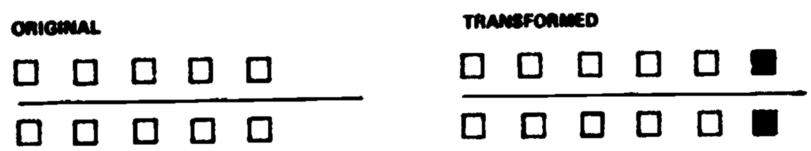
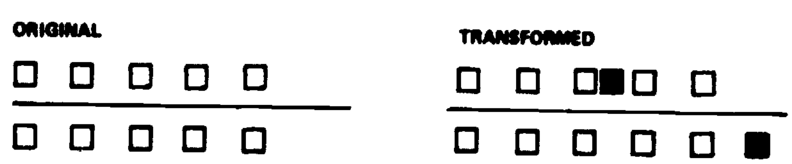


Figure 2 Changing the Length and Density of Rows Differentially (Basic Task: Task 2)



sumed to be of different levels of difficulty for a child. It was assumed that some children would conserve on some equal addition tasks but not on other tasks.

Although the tasks differ in difficulty it is possible to only speculate as to why certain tasks would be more different than others. One reason might be that a child may not have within his realm of experience the needed scheme or category in which to relate the perceptual change (Vernon, 1966). Another reason may be that some perceptual changes are more salient or attract more attention. That is, more attention may be attributed to certain perceptual changes because more movement of the objects is involved. Differences in the degree to which the tasks are varied should also result in differences in difficulty. For example, a task involving both the addition and manipulation of objects will not be of the same difficulty as a task involving only the addition of objects. A task with different size objects will be of a different level of difficulty than a task with constant size objects. Changing the distance between the sets of objects will influence the difficulty of the task. A task in which the objects are placed in close proximity and in which a one-to-one correspondence is readily apparent should be easier than a task in which the distance is increased between the objects. Also, rotating the rows to a different position in in space should affect the difficulty of the task.

The perceptual literature does not appear, however, to indicate how these tasks could be ordered into a single hierarchy of difficulty from easiest to hardest. Thus, it was not possible to arrange the conservation tasks a priori into a difficulty hierarchy as a function of their perceptual differences.

Preliminary Tasks

To establish a child's ability to distinguish objects as belonging to a group and to assess his familiarity with the term "bunch", each child was asked to identify a bunch of objects prior to his or her exposure to the actual tasks (Rothenberg, 1968). The configuration of a bunch of objects was that of a vertical row of five objects (Figure 3). Also assessed prior to administration of the equal addition tasks was the child's understanding of the concept of numerical equivalence. This involved a task (Figure 4) in which each child duplicated a model row of five objects (Rothenberg, 1968). Each child was instructed to make a row below a line just like the row above the line. The line was implicitly indicative that one group of objects was separate from the other group of objects. If a child was unsuccessful in identifying a bunch of objects or duplicating a row, he was not considered for further testing. If the child was unsuccessful on these tasks, the child was then asked the following questions concerning the model and duplicating the row. "Does this bunch (examiner points to the model row on one side of the line) have the same number as this bunch (examiner points to the duplicated row on the other side of the line)?" (Rothenberg, 1968). This question was asked in order to assess the subject's understanding of numerical equivalence and to familiarize the subject with the question format that was to be used with all of the equal addition tasks. An affirmative response was required in order for the subject to be considered a member of the universe of conservers and to be considered for further testing.

Figures 3 & 4 about here

If a child was sucessful on the preliminary tasks he was exposed to an additional task which was considered to be an elementary conservation of equal addition task. It was assumed that successful performance on this task was "prerequisite" to performance on the other tasks. There were nine conservation tasks in addition to the prerequisite task. All ten of the tasks were similar in that their original configuration consisted of two rows of five objects placed on opposite sides of a line. In all the tasks, the transformation involved the addition of one object to both top and bottom rows. The tasks differed, however, in one of the following ways: either the placement of the added object, or the manipulation of the objects, or the size of the objects, or the spatial orientation of the task or the arrangement of the objects.

Placement of the Added Object: The Prerequisite Task and the Basic Task; Tasks 1 and 2

Initially two equal addition tasks were defined in which

Figure 3 A Bunch of Objects

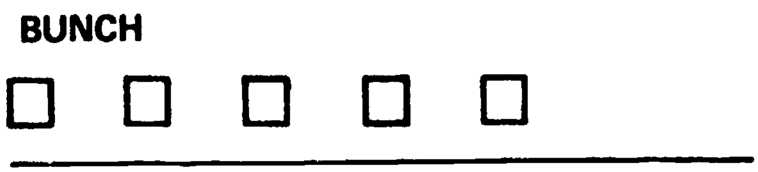
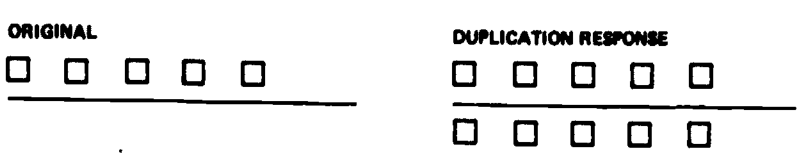


Figure 4 The Duplication Task



the original configuration consisted of two rows equal in length and in number and arrangement of objects. In both tasks the transformation consisted of adding an object to each of the two rows. These tasks differed, however, in where the added object was placed. In Task 1, the prerequisite task, the addition of one object to each of the two rows changed the length of the rows equally. Task 1 was always administered first to a child and the child was required to pass it in order to be exposed to the other nine tasks. Thus, Task 1, as previously noted, was the final screening task; a prerequisite task (See Figure 1).

In Task 2, the added object was placed within the arrangement of the top row while another object was placed at the end of the bottom row. Thus, the density of the arrangement of objects in the top row was increased while the length remained the same. In the bottom row the density remained the same, but the length increased. For convenience of reference, this task will be referred to as the "basic task" (See Figure 2).

Six additional tasks were generated as variations of the basic task. These six tasks differed from the basic task either by a change in the size of the objects, the distance between the sets of objects, the orientation in space or the arrangement of the objects.

Size: Tasks 3,4 and 5

Tasks 3,4 and 5 were constructed as a function of variations in the size of the objects in the basic task. In Task 3, the sizes of the objects in the top row were the same as those in the top row of the basic task. The sizes of the objects in the bottom row were larger than those in the bottom row of the basic task. In transforming the configuration the added objects conformed in size to the other objects in the row to which they were added (See Figures).

Figure 5 about here

In both Tasks 4 and 5 three different objects were used in each row. Also, the sizes of the objects in the top row were different than the sizes of the corresponding objects in the bottom row. The differences between Tasks 4 and 5 were the sizes of the added objects. In Task 4, the added object in the top row was small while the object added to the bottom row was large (See Figure 6). In the transformation of Task 5 the objects added to both the top and bottom row were small (See Figure 7).

Figure 6 about here

Figure 7 about here

Orientation in Space: Tasks 6 and 7

Tasks 6 and 7 were defined by rotating the basic task in space to a vertical or diagonal position. In Task 6 the objects were aligned in two vertical columns (See Figure 8) while in Task 7 the objects were aligned in two diagonal rows

Figure 5 Addition of Similar Size Blocks to Top Row and Larger Block to Bottom Row (Task 3)

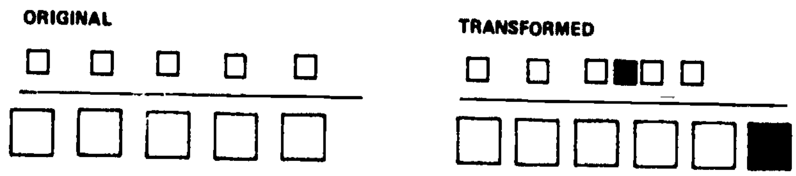


Figure 6 Addition of Unequally Sized Objects to Rows (Task 4)

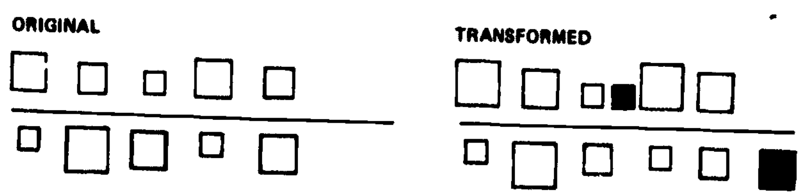


Figure 7 Addition of Small Blocks to Top and Bottom Rows (Task 5)

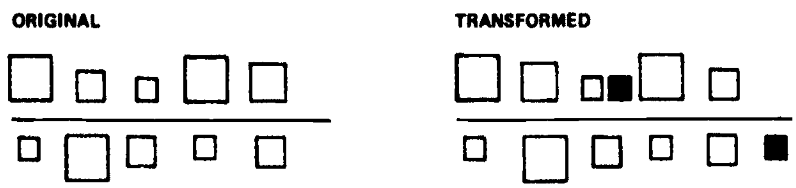
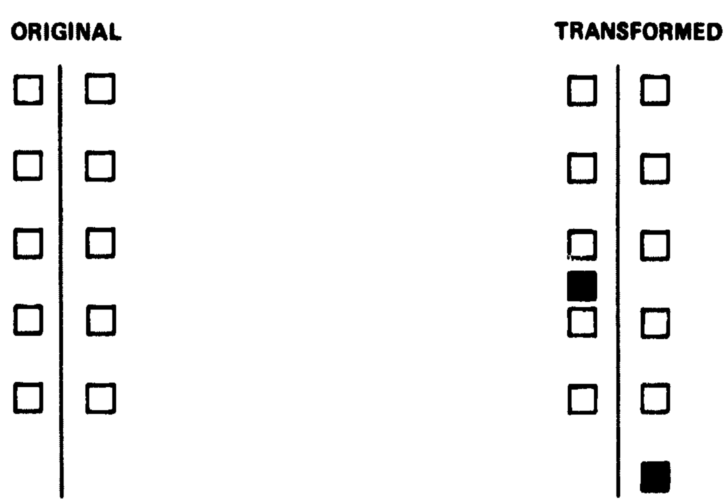


Figure 8 Alignment into Two Vertical Columns (Task 6)



(See Figure 9).

Figure 8 about here

Figure 9 about here

Distance: Task 8

Within the basic task the rows of objects were placed in close proximity to each other and a one-to-one correspondence between the rows was readily apparent. Task 8 was defined by increasing the distance between rows. In Task 8, the one-to-one correspondence between rows was not as readily apparent as in the basic task (See Figure 10).

Figure 10 about here

Arrangement: Task 9

Task 9, a variation of the basic task, was defined by changing the arrangement of the top row of the basic task into a V-shape, while the arrangements of the bottom row remained the same. The transformation within this task necessitated the placement of an object within the V-shape arrangement of the top row. While another object was placed at the end of the bottom row (See Figure 11).

Figure 11 about here

Manipulation of Objects: Task 10

Task 10 differed from all the other tasks in that the transformation of the original configuration involved not only the addition of one object to each of the rows but also the manipulation of the objects within one of the rows. The examiner

Figure 9 Alignment into Two Diagonal Rows (Task 7)

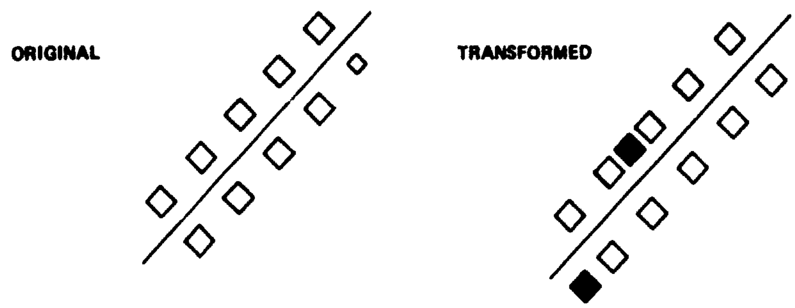


Figure 10 Increased Distance Between One-to-One Correspondence of Rows (Task 8)

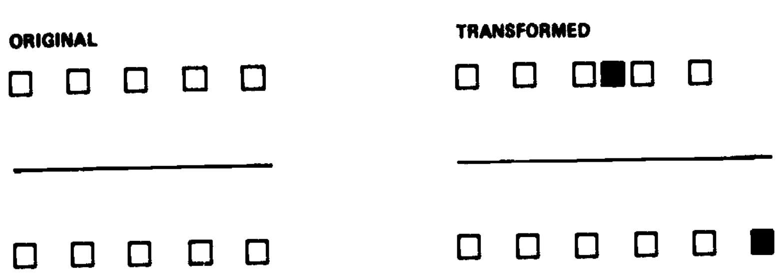


Figure 11 Manipulation of Top Row into V Shape (Task 9)

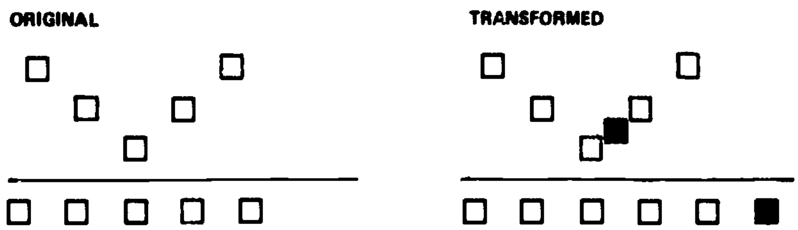
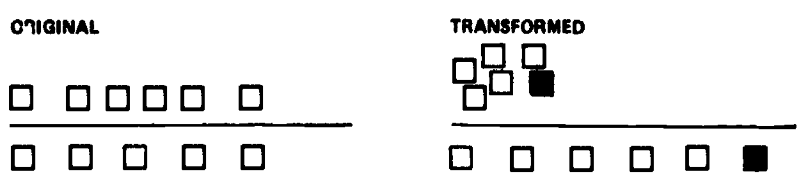


Figure 12 Manipulation of Top Row and Addition of Block in Top Row (Task 10)



grouped the objects in the top row together while also adding an object to the top row (See Figure 12).

Figure 12 about here

The Guttman Scale as Defined by the Nine Equal Addition Conservation of Number Tasks

In order for a Guttman scale to exist among such a collection of conservation of number tasks, all the tasks should be members of the same universe of content (Guttman, 1950). Since the equal addition tasks in this study have the addition of objects as a common basis and the ability to conserve as a common concern, it would seem that they should belong to the same universe of content. Specifically the universe of content is defined as conservation number on equal addition tasks. The equal addition tasks used in this study should be considered as a sample, not necessarily random, of the universe of content of conservation of number on equal addition tasks.

In order for the tasks to define a Guttman scale they must represent different levels of difficulty. More importantly, success on a difficult task should imply success on all tasks of lesser difficulty. Ideally, given the nine tasks in this study a child who has conserved on the most difficult task should conserve on all tasks of a lesser difficulty. At the same time a child who has not conserved on the least difficult tasks should not conserve on the most difficult tasks.

When a child conserved number on a task he was accorded a score of one for the task. If a child did not conserve he was accorded a score of zero. The total possible score for the nine tasks was a score of nine. Assuming the tasks defined a perfect Guttman scale, then a score of six would be indicative of conserving responses on the six easiest tasks and incorrect or nonconserving responses on the three most difficult tasks.

The degree to which a perfect Guttman scale is approximated may be inferred from the coefficient of reproducibility. This coefficient is computed as a function of the number of responses which would be correctly predicted across the sample of subjects when a less than ideal Guttman scale is defined. It is just the proportion of predicted responses that are not in error (Guttman, 1950). According to Guttman (1950), for a scale to be considered acceptable the coefficient of reproducibility must be at least .90 and, therefore, not deviating by more than 10 per cent from a perfect Guttman scale.

In summary, then, if a Guttman scale does exist among the equal addition tasks, then success on a difficult task will imply success on all tasks of lesser difficulty. A Guttman scale among the equal addition tasks will imply that conservation of number may be expressed on a continuum. The development of conservation would then be assumed to be continuous rather than discontinuous.

Sample

One hundred thirty kindergarten children of six classes at four heterogeneous schools located in the Cincinnati and Cleveland, Ohio areas were tested by a single examiner. Thirty of these children were not considered members of the sample because they were unsuccessful on either the "identifying a bunch", "duplicating a row", or the prerequisite task. An additional 15 children were eliminated because they did not appear to be members of the same universe from which the remainder of the sample was drawn (Additional comment on these 15 children will follow). The remaining 85 children composed the convenience sample used within the study. The sample consisted of conservers between the ages of 5.3 years to 6.5 years with a mean age of 5.9 years.

The task responses of all 100 children tested are reported in binary form in Table 1. The testing order of each child is noted in the extreme left column. The final 15 children are those children who were not considered members of the universe (Guttman, 1950) because of the nature of their responses.

Table 1 about here

Task Administration

The ten equal addition tasks were administered to the subjects individually by the same examiner in a separate room at the subject's school. The administration of the tasks took ten to fifteen minutes.

Table 1 The Response Matrix

Subject Order of Testing	Item (according to difficulty) 9	10	8	4	2	3	6	5	7	Total Score
2	1	1	1	1	1	1	1	1	1	9
4	1	1	1	1	1	1	1	1	1	9
5	1	1	1	1	1	1	1	1	1	9
9	1	1	1	1	1	1	1	1	1	9
15	1	1	1	1	1	1	1	1	1	9
18	1	1	1	1	1	1	1	1	1	9
19	1	1	1	1	1	1	1	1	1	9
23	1	1	1	1	1	1	1	1	1	9
24	1	1	1	1	1	1	1	1	1	9
27	1	1	1	1	1	1	1	1	1	9
28	1	1	1	1	1	1	1	1	1	9
34	1	1	1	1	1	1	1	1	1	9
36	1	1	1	1	1	1	1	1	1	9
46	1	1	1	1	1	1	1	1	1	9
53	1	1	1	1	1	1	1	1	1	9
55	1	1	1	1	1	1	1	1	1	9
57	1	1	1	1	1	1	1	1	1	9
60	1	1	1	1	1	1	1	1	1	9
62	1	1	1	1	1	1	1	1	1	9
63	1	1	1	1	1	1	1	1	1	9
64	1	1	1	1	1	1	1	1	1	9
65	1	1	1	1	1	1	1	1	1	9
72	1	1	1	1	1	1	1	1	1	9
76	1	1	1	1	1	1	1	1	1	9
79	1	1	1	1	1	1	1	1	1	9
83	1	1	1	1	1	1	1	1	1	9
87	1	1	1	1	1	1	1	1	1	9
90	1	1	1	1	1	1	1	1	1	9
94	1	1	1	1	1	1	1	1	1	9
97	1	1	1	1	1	1	1	1	1	9
98	1	1	1	1	1	1	1	1	1	9
42	1	1	0	1	1	1	1	1	1	8
45	0	1	1	1	1	1	1	1	1	8
48	1	0	1	1	1	1	1	1	1	8
50	1	0	1	1	1	1	1	1	1	8
20	0	1	1	1	1	1	1	1	1	8
21	1	0	1	1	1	1	1	1	1	8
25	1	1	0	1	1	1	1	1	1	8
74	1	0	1	1	1	1	1	1	1	8
32	0	1	1	1	1	1	1	1	1	8
85	1	1	0	1	1	1	1	1	1	8
86	0	1	1	1	1	1	1	1	1	8
38	0	1	1	1	1	1	1	1	1	8

Table 1 (continued)

Subject Order of Testing	Item (according to difficulty) 9	10	8	4	2	3	6	5	7	Total Score
17	1	1	1	1	1	0	1	1	1	8
47	1	1	1	1	1	0	1	1	1	8
49	1	1	1	1	0	1	1	1	1	8
22	1	1	1	1	1	1	0	1	1	8
69	1	1	1	1	1	1	0	1	1	8
73	1	1	1	1	0	1	1	1	1	8
30	1	1	1	1	0	1	1	1	1	8
61	1	1	0	0	1	1	1	1	1	7
67	1	1	0	0	1	1	1	1	1	7
56	1	1	0	0	1	1	1	1	1	7
77	1	1	1	1	1	0	1	0	1	7
52	0	0	1	1	1	1	1	1	1	7
8	0	1	1	0	1	1	1	1	1	7
39	0	1	0	1	1	1	1	1	1	7
31	0	1	1	1	1	1	0	1	1	7
96	0	0	1	1	1	1	1	1	1	7
99	0	0	1	1	1	1	1	1	1	7
58	1	0	1	1	1	1	1	1	0	7
33	1	0	1	1	1	1	1	1	0	7
82	0	0	1	0	1	1	1	1	1	6
54	0	0	1	1	1	1	1	0	1	6
80	0	0	1	1	1	1	0	1	1	6
70	1	0	0	1	0	1	1	1	1	6
91	0	0	1	1	1	0	1	1	1	6
41	1	0	1	0	0	0	1	1	0	4
11	0	0	1	0	0	0	0	1	1	3
68	0	0	0	0	1	1	0	1	0	3
6	0	0	0	0	0	1	1	0	1	3
75	0	0	0	1	1	0	0	1	0	3
14	0	1	1	0	0	0	0	0	1	3
12	0	0	0	0	0	0	0	0	1	1
40	0	0	0	0	0	1	1	0	0	2
43	0	1	0	0	0	0	0	1	0	2
66	1	0	1	0	0	0	0	0	0	2
10	0	1	0	0	0	0	0	0	0	1
78	0	1	0	0	0	0	0	0	0	1
92	1	0	0	0	0	0	0	0	0	1
3	0	0	0	1	0	0	0	0	0	1
37	0	1	0	0	0	0	0	0	0	1
88	0	0	1	0	0	0	0	0	0	1

Table 1 (continued)

Subject Order of Testing	Item (according to difficulty) 9	10	8	4	2	3	6	5	7	Total Score
* 13	0	1	0	0	0	0	0	0	0	1
* 51	1	1	1	1	0	1	1	1	0	7
* 16	0	0	1	0	1	1	1	0	1	5
* 89	1	0	0	1	1	1	1	1	0	6
* 1	1	1	1	1	1	0	0	1	1	7
* 95	0	1	1	1	1	1	0	1	0	6
* 26	1	1	0	0	1	1	0	1	1	6
* 76	1	0	0	1	0	0	1	1	1	5
* 28	1	0	0	1	0	1	1	0	1	5
* 44	1	0	0	0	1	0	1	1	1	5
* 35	1	1	1	0	1	0	0	1	1	6
* 7	0	0	1	0	1	0	1	0	1	4
* 59	0	0	1	1	0	1	0	1	0	4
* 93	0	1	1	1	0	1	0	0	1	5
*100	1	1	1	1	0	1	0	1	0	6
* 81	1	1	1	0	0	1	1	0	0	5

* Eliminated from analysis

Analysis

The difficulty indices of the tasks were computed as the proportion of correct responses associated with each task and are reported in Table 2. Although there were two sets of tasks having identical difficulty indices different levels of difficulty were found to exist among the other tasks.

The difficulty of the items ranged from 1.00, on the prerequisite task to .65, Task 10. The items were of different levels of difficulty, but were somewhat homogeneous with respect to difficulty.

Table 2 about here

Because all subjects responding to all tasks passed the prerequisite task it was eliminated from the task sample when the tasks were assessed for scalability. In determining Guttman's (1950) coefficient of reproducibility a "response matrix" was formulated consisting of the children's task responses ordered according to decreasing scale score on tasks ordered according to decreasing difficulty (See Table 1). When inspecting Table 1 it may be noted that the last 15 children, those rejected from the sample, had responses that were illogical with respect to the type of response pattern suggested by the other 85 children. That is, they responded correctly to some difficult tasks and responded incorrectly to some of the easy tasks. Guttman (1950) refers to such subjects as "nonscalar types" and suggests that they be eliminated from the sample.

Table 2: Tasks Ordered According to Their Levels of Difficulty

Task	Description	Difficulty
9	Arrangement, change top row to V-shape	.65
10	Manipulation of objects; objects grouped to left in top row	.70
8	Distance between rows increased	.76
4	Size; small object added to top; large to bottom	.76
2	Basic; change density of top and length of bottom	.77
3	Size; uniformity of size within rows	.78
6	Orientation in space; alignment vertically	.80
5	Size; addition of small objects to both top and bottom	.82
7	Orientation in space; diagonal alignments	.82
1	Prerequisite	1.00

The coefficient of reproducibility computed from the response matrix was .912. This indicates that the tasks as responded to by the children deviated less than ten per cent from a perfect Guttman scale. Such an index is a necessary condition for defining a Guttman scale but not a sufficient condition. The percentage of children passing each item must also be considered.

Regardless of whether a scale exists, the reproducibility of an item can never be less than the percentage of respondents either passing or failing a task. Thus, if 80 per cent of the subjects pass a task then the reproducibility for that task, regardless of scalability, will not be less than .80. Any tasks having extreme percentages in the response categories would contribute to a spuriously high coefficient of reproducibility. A check to see whether a high coefficient of reproducibility did result from the difficulties of the tasks was determined through a comparison of the minimum coefficient that could be obtained from the tasks given the percentage of subjects passing or failing each task and the observed coefficient of reproducibility (Edwards, 1957).

Within this study, the minimum possible coefficient of reproducibility was .767 and when compared to the obtained coefficient of .912 it would seem that the high coefficient of reproducibility was not strictly a function of the task difficulties.

Other ways of assessing the scalability of a group of tasks have been devised by Green (1956) and Loevinger (1947). Both are based upon or are very similar to Guttman's scalogram anaysis and are summarized in this conjunction by White & Saltz (1957). Green (1956) considered some problems associated with extreme task difficulties while while Loevinger (1947) considered problems associated with the homogeneity of the individual tasks with respect to all the tasks. Green (1956) has considered chance reproducibility that would be obtained with the same set of task difficulties assuming complete independence between tasks. This chance reproducibility for the tasks used in this study is .689. To eliminate the effects of chance reproducibility Green has devised the index of consistency. The computation of this index essentially partials the effects of chance reproducibility from the observed reproducibility. This index will be unity for a group of perfectly reproducible tasks and zero for a group of tasks that are completely independent. Green (1956) suggests that the index should be at least .50 for a group of tasks before they may be considered scalable. The nine tasks used in this study yielded an index of consistency of .717. Thus, according to even Green's (1956) conservative index of consistency the tasks used in this study define a scale.

Another index that is very similar to Guttman's coefficient of reproducibility is Loevinger's Index of Homogeneity. According to Loevinger (1947), a test is perfectly homogeneous if passing a difficult task implies passing all less difficult tasks. If the tasks are completely independent, the test being completely heterogeneous, the index will be equal to zero. Loevinger's index of homogeneity for the tasks in this study was .541. The interpretation of the index is difficult since its sampling distribution is not known.

The importance of this study is somewhat difficult to convey inasmuch as the indices used for description are quite esoteric. It is possible to summarize, in part, other studies investigating the scalability of Piagetian tasks by simply noting that in none of them were the indices generally as high as those reported in this study. In certain studies, Peel (1959), Dodwell (1961), and Kofsky (1966), the age ranges of the children are so wide that given the sample size one would have to get some degree of scalability when investigating Piagetian tasks (e.g., investigating copying when the sample age range is 2.1 - 7.9 years).

The indices determined in this study are summarized in Table 3. The conclusion is quite clear. Since the equal addition tasks were scalable, it would appear that a conservation of number on equal addition tasks continuum does exist, ranging from conserving to a very low degree to conserving to a very high degree. There were some children who conserved on difficult tasks as well as on easy tasks. Other children conserved only on the easy tasks.

Table 3 Summary of coefficients

Method	Observed in study	Minimum Suggested
Guttman		
Coefficient of reprodudibility	.912	.90
Minimum coefficient	.767	?
Green		
Coefficient of reproducibility	.912	.90
Chance reproducibility	.689	-
Index of consistency	.717	.50
Loevinger		
Index of homogeneity	.541	?

The fact that the equal addition conservation of number tasks were scalable suggests that the development of conservation of number on equal addition tasks is a continuous sequential process . In order for a child to conserve on a task he should logically conserve on all tasks of lesser difficulty unless he can conserve on the easier tasks. The process of developing the ability to conserve equal addition of number is then, it seems, a sequential, continual process rather than an all or nothing proposition of either nonconserving or conserving. With respect to conservation of number on equal addition tasks, this study seems to validate Piaget's theory that cognitive development is sequential and continuous.

Implications

The existence of Guttman scale and a conservation continuum among conservers on equal addition tasks would seem to have definite implications. First, minimizing the number of attributes investigated within one study seems to be a more successful approach in determining scalability. Perhaps, in the future more successful validation of Piagetian theory may result from minimizing the number of attributes studied at one time. Second, further research is necessary as to why some tasks are more difficult than other tasks. This study gives evidence attesting to the fact that some equal addition tasks are more difficult than others and that success on a more difficult task requires success on all less difficult tasks. The question, however, as to why this is so os still unresolved. Third, the scalability of the universe of conservation of number on equal addition tasks implies, perhaps, that other types of conservation tasks are scalable. In fact, perhaps conservation on equal addition tasks is a sub-universe of a whole scalable universe, that of conservation. Fourth, the equal addition tasks used in this study may, perhaps, be used as a test to measure a child's ability to conserve number on equal addition tasks.

The fourth implication is perhaps the most important when one considers possible explanations for the performance of the 15 children excluded from the analysis. Although no efforts were made,nor was it possible in retrospect, to investigate the background of those children excluded it is possible to speculate that perhaps they had some type of learning disability which obscured their performance on certain of the tasks used in this study. It would be interesting and perhaps informative to administer these tasks to a group of children "labeled as" educable mentally retarded. Would there be a large number of "nonscalable" children?

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