Evaluation of Piaget's Concrete Operational Tasks on Seriation and Transivity among Enugu Children: Age and Gender as Factors

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Abstract

The study investigated Piaget's concrete operational tasks on seriation and transivity among Enugu children with age and gender as factors. A total of 527 participants comprising 234 male and 293 female pupils were used for the study. The sampling technique was based on multi stage sampling of pupils attending the urban and rural schools namely; St. Theresa's primary school I and St. Cyprian's primary school I both in Abakpa Nike in Enugu East Local Government Area of Enugu State as urban sample and community primary school Neke/Mbu in Isiuzo Local Government Area of Enugu State as rural sample. The participants were within the ages of 7-11 years with a mean age of 8.29 and standard deviation of 1.79, urban males (n = 118, x = 8.00 and standard deviation of 1.69), urban females (n = 149, x = 8.42 and standard deviation of 1.81), rural males (n = 116, x = 8.42 and standard deviation of 1.77), and rural females (n = 144, x = 8.28 and standard deviation of 1.85). Four sets of objects developed by the researcher to measure seriation, and transivity were used for the study. Seriation as a concept was measured with two different objects: circular seriation objects and square seriation objects; while transivity as a concept also was measured with two different objects: Rectangular-bars transivity objects and cylindrical transivity objects. Statistical analysis based on data obtained yielded the following results a two-way Manova analysis was conducted and it showed a non-significant multivariate effect of the three independent variables in relation to the two dependent variables of $F(4,526) = 1.80$, $p = .073$; Wilks' $\Lambda = .97$ for age and $F(2, 526) = 1.19$, $p = .303$; Wilks' $\Lambda = .99$ for gender respectively. Meaning that, age and gender of Nigeria children do not influence their concrete operational tasks both in seriation and transivity outcomes. The findings were discussed in relation to literatures reviewed and suggestions made.

Keyword: Seriation, Transivity, Evaluation, Children, Age, Gender

Background of the study

Development occurs when physiological changes and the psychological processes stimulated by them are integrated in such a way that the individual is increasingly able to master environmental stimulations and adjust to challenges of living (Tuckman et al., 2010). And cognitive development is one of the important aspects of human development.

Cognitive development is a progressive reorganization of mental processes as a result of biological maturation and environmental experiences (Piaget & Inhelder, 1973). Accordingly, children construct an understanding of the world around them, experience discrepancies between what they already know and what they discover in their environment, (Piaget & Inhelder, 1973). Piaget (1977) posited the idea that cognitive development is at the center of human attributes and that reality is a dynamic system of continuous.

Piaget (1977) noted that reality is a dynamic system of continuous change and, as such, is defined in reference to the two conditions that define dynamic systems. Specifically, he argued that reality involves transformations and state. Transformations refer to all manners of changes that a thing or person can undergo while state refers to the conditions or the appearances in which things or persons can be found between transformations (McLeod, 2012). For example, there might be changes in shape or form (for example, liquids are reshaped as they are transformed from one vessel to another, humans change in their characteristics as they grow older), in size (for example, a

series of coins on a table might be placed close to each other or far apart), or in placement or location in space and time (for example, various objects or persons might be found at one place at one time and at a different place at another time) (McLeod, 2012). Thus, Piaget (1977) argued, if human intelligence is to be adaptive, it must have capacity to represent both the transformational and the static aspects of reality. He proposed that operative intelligence is responsible for the representation and manipulation of the dynamic or transformational aspects of reality, while figurative intelligence is responsible for the representation of the static aspects of reality (Santrock & John, 2004). These various forms of intelligence have been observed to differ at different levels among children when age and gender are considered. Further, children's ability in relation to their environment, especially interaction with objects of different sizes and shapes and also their mental ability to recognize interpersonal relationships with respect to how they adapt tend to influence how they perceived the physical world. This also manifest even in their ability to engage in seriation and transivity.

Seriation refers to an individuals' ability to sort objects in an order according to size, shape, or any other characteristic. For example, different-shaded objects may make a colour gradient. Transitivity refers to the ability to mentally sort objects and recognize relationships among various things in a serial order. For example, when told to put away his books according to height, the child recognizes that he starts with placing the tallest one on one end of the bookshelf and the shortest at the other end.

Operational intelligence is the active aspect of intelligence. It involves all actions, overt or covert, undertaken in order to follow, recover, or anticipate the transformations of the objects or persons of interest (McLeod, 2012). Figurative intelligence is the more or less static aspect of intelligence, involving all means of representation used to retain in mind the state (that is successive forms, shapes, or locations) that intervene between transformations (McLeod, 2012). That is, it involves perception, imitation, mental imagery, drawing, and language. Therefore, the figurative aspects of intelligence derive their meaning from the operative aspects of intelligence, because states cannot exist independent of the transformations that interconnect them.

Piaget (1977) stated that the figurative or the representational aspects of intelligence are subservient to its operative and dynamic aspects, and therefore, that understanding essentially derives from the operative aspects of intelligence. At any time, operative intelligence frames how the world is understood and its changes if understanding is not successful. Piaget (1977) stated that this process of understanding and change involves schemata, assimilation and accommodation (Tuckman et al., 2010).

(a) Assimilation

Assimilation describes how humans perceive and adapt to new information. It is the process of fitting new information into pre-existing cognitive schemes. Assimilation occurs when humans are faced with new or unfamiliar information and refer to previously learned information in order to make sense of it for example:

(b) Accommodation

Accommodation is the process of taking new information in one's environment and altering pre-existing schemas in order to fit in the new information. Through a series of stages, Piaget explains the ways in which characteristics are constructed that lead to specific types of thinking.

Piaget (1977) says assimilation is interpreting external elements into structures of lives or environments or those we should have through experience. It is through assimilation that accommodation is derived. Accommodation is imperative because it is how people will continue to interpret new concepts, schemas, frameworks, and more.
Assimilation is different from accommodation by how it relates to inner organism due to the environment. Piaget believes that the human brain has been programmed through evolution to bring equilibrium, which is what Piaget believes ultimately influences structures by the internal and external processes through assimilation and accommodation (Tuckman et al., 2010).

Piaget's understanding is that each of these two processes cannot exist without the other. To assimilate an object into an existing mental schema, one first needs to consider or accommodate the particularities of their object to a certain extent. For instance, to recognize (assimilate) an apple as an apple, one must first focus (accommodate) on the contour of this object. To do this, one needs to roughly recognize the size of the object. Development increases the balance, or equilibration, between these two functions. When in balance with each other, assimilation and these accommodations generate mental schemas of the operative intelligence. When one function dominates over the other, they generate representations which belong to figurative intelligence.

(c) Schemata

According to Piaget (1977) children actively seek out information and adapt it to the knowledge and conceptions of the world that they already have (McLeod, 2012). Thus, children construct their understanding of reality from their own experience. They organize their knowledge into increasingly complex cognitive structures called Schemata. Children possess many different schemata, and these change as the children develop. In the newborn, the schemata, take the form of innate reflexes and reaction patterns, like sucking. As the child grows and gains experience, the schemata shift from motor activities to mental activities called operations. These operations become increasingly complex with age. Piaget suggested that schemata are modified according to the principles of organization and adaptation, which continue to operate throughout the life span (McLeod, 2012). Organization is the predisposition to combine simple physical or psychological structures into more complex systems. Adaptation involves the two complementary processes of assimilation or fitting new experiences into current cognitive schemata, and accommodation, or adjusting current schemata to fit the new experiences. Most encounters involve both processes**.** With this pertinent understanding of the background of Piaget's theory of cognitive development, exploration of the stages of this theory is very important. Hence, this study will focus on the problem stated below:

Will age significantly influence seriation and transivity among Enugu children?

Will gender significantly influence seriation and transivity among Enugu children?

Hypotheses

The hypotheses stated below were tested:
Age will not significantly influence seriation and transivity among Enugu children.
Gender will not significantly influence seriation and transivity among Enugu children.

Method

Participants

A total of 527 participants comprising 267 urban (118 male/149 female) and 260 rural (116 male/144 female) pupils attending urban and rural schools based on locality, and also based on gender (234 male/293 female) were used for the study. They were further classified into five categories based on age between 7-11 years for both urban and rural. The sampling technique was based on multi stage sampling of pupils attending; St. Theresa's primary school I and St. Cyprian's primary school I both in Abakpa Nike in Enugu East Local Government Area of Enugu State as urban sample and community primary school Neke/Mbu in Isiuzo Local Government Area of Enugu State as the rural sample. The participants were within the ages of 7-11 years with a mean age of 8.29 and standard deviation of 1.79, urban males (n = 118, x = 8.00 and standard deviation of 1.69), urban females (n = 149, x = 8.42 and standard deviation of 1.81), rural males (n = 116, x = 8.42 and standard deviation of 1.77), and rural females (n = 144, x = 8.28 and standard deviation of 1.85).

Instrument

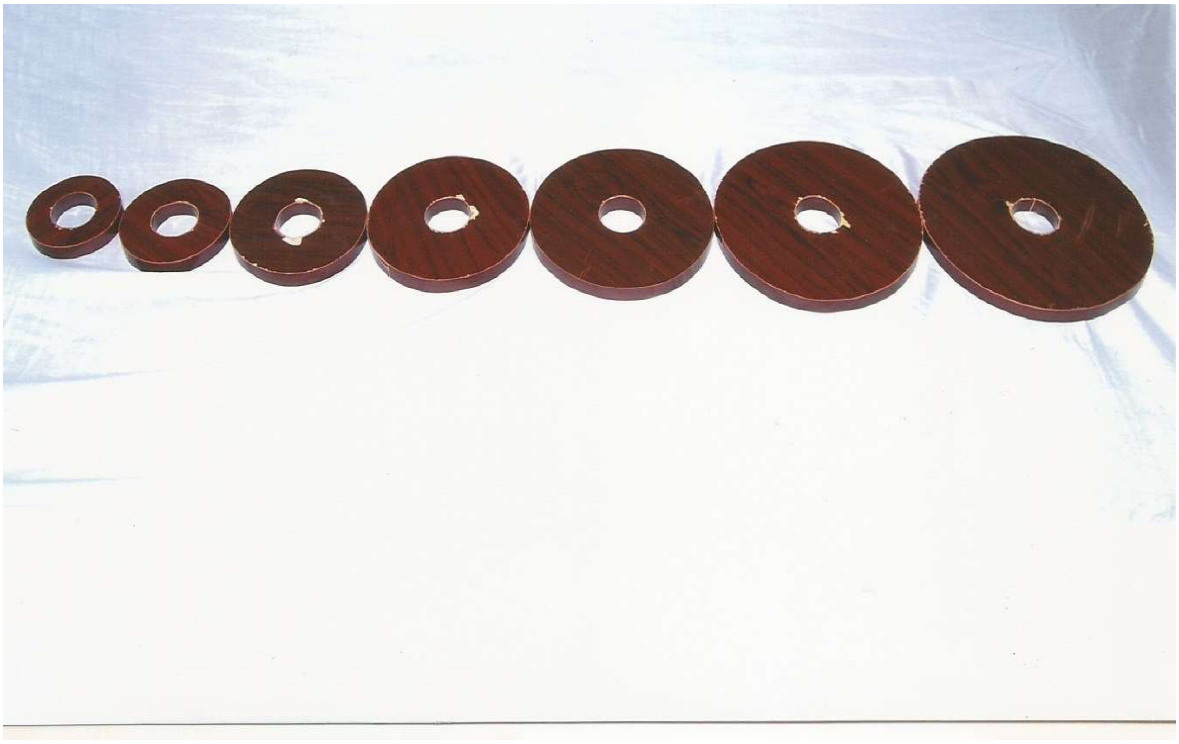
Two sets of objects developed by the researcher to measure seriation were used for the study. A total time limit of 25 minutes was used to administer the seriation objects.

Seriation

Seriation as a concept was measured with two different objects: circular seriation objects and square seriation objects. A total time limit of 25 minutes was used to administer the seriation objects, 10 minutes for instruction and demonstration, 5 minutes for circular seriation objects, 5 minutes interval of rest, and 5 minutes for square seriation objects.

(i) Circular Seriation Objects

The instrument was designed to measure seriation based on tasks at concrete stage of development. It is made up of 7 circular objects with equal central circle of 2 inches in diameter; and also varying from 1inch (4 inch total diameter), 1½ (5 inch total diameter), 2 inch (6 inch total diameter), 2½ (7 inch total diameter), 3 inch (8 inch total diameter), 3½ (9 inch total diameter), and 4 inch (10 inch total diameter) in outer circumference. To administer, a participant was instructed to arrange first in ascending (from the smallest circle to the biggest circle) and second in descending (from the biggest circle to the smallest circle) order. A participant is also expected to arrange based on size, and total diameter. A maximum score of two is awarded for correct placement based on size and total diameter in relation to sequence of arrangement, while partial placement by one step deviation is scored 1, and two steps deviation and above is scored zero. A total possible score of 12 could be obtained for either ascending or descending arrangement. Hence, a grand score of 24 is expected to be achieved by any given participant and a least possible score of zero.



(ii) Square seriation objects

The instrument was designed to measure seriation based on tasks at concrete stage of development. It is made up of 7 square objects each with equal length, weight and diameter ranging from of 3-inch square; 4inch square, 5-inch square, 6-inch square, 7 inch square, 8 inch square, and 9 inch square.

To administer, a participant was instructed to arrange first in ascending (from the smallest square to the biggest square) and second in descending (from the biggest square to the smallest square) order. A participant is also expected to arrange the objects based on size, and diameter. A maximum score of two is awarded for correct placement based on size and diameter in relation to sequence of arrangement, while partial placement by one step deviation is scored 1, and two steps deviation and above is scored zero. A total possible score of 12 could be obtained for either ascending or descending arrangement. Hence, a grand score of 24 is expected to be achieved by any given participant and a least possible score of zero.

Procedure

The researcher conducted the investigation by obtaining permission from the head teachers of the primary schools. The data collection was achieved by administering the four sets of the objects across the target population namely: St. Theresa's primary school I and St. Cyprian's primary school I both in Abakpa Nike in Enugu East Local Government Area of Enugu State as urban sample and community primary school Neke/Mbu in Isiuzo Local Government Area of Enugu State as rural sample within a period of 9 weeks. Thus, 12 research assistants were involved in the investigation whereby each assistant administered the four sets of objects on one participant per day across five school days over 9 weeks period. The data collected for each day within the period of the investigation were recorded, tabulated, and analyzed for hypotheses testing.

Design/statistics

A 2x2x5 factorial design was adopted based on different categories of participants in relation to age as a factor, ranging from 7-11 years, gender based on male and female, across locality as a third factor categorized into urban and rural. Based on three independent variables or factors; age with five levels (7, 8, 9, 10, and 11-year-old); gender (male and female) and locality with two levels (urban and rural) and; a 2x2x5 Multiple analyses of variance F-test (MANOVA) was applied as a statistic to analyze the data in order to test the hypotheses.

Table 1: Summary table of Summary table of 2-way ANOVA F-test on evaluation of Piaget's concrete operational tasks on seriation and transivity among Enugu children: age, gender and locality as factors

Effect		**Value**	**F**	**Hypothesis**	**Error df**	**Sig.**
Intercept	Pillai's Trace	.975	9831.232[b]	2.000	506.000	.000
	Wilks' Lambda	.025	9831.232[b]	2.000	506.000	.000
	Hotelling's Trace	38.859	9831.232[b]	2.000	506.000	.000
	Roy's Largest Root	38.859	9831.232[b]	2.000	506.000	.000
Age	Pillai's Trace	.028	1.799	8.000	1014.000	.073
	Wilks' Lambda	.972	1.800[b]	8.000	1012.000	.073
	Hotelling's Trace	.029	1.800	8.000	1010.000	.073
	Roy's Largest Root	.022	2.834[c]	4.000	507.000	.024
Gender	Pillai's Trace	.005	1.198[b]	2.000	506.000	.303
	Wilks' Lambda	.995	1.198[b]	2.000	506.000	.303
	Hotelling's Trace	.005	1.198[b]	2.000	506.000	.303
	Roy's Largest Root	.005	1.198[b]	2.000	506.000	.303
Age * Gender	Pillai's Trace	.017	1.077	8.000	1014.000	.377
	Wilks' Lambda	.983	1.076[b]	8.000	1012.000	.378
	Hotelling's Trace	.017	1.075	8.000	1010.000	.378
	Roy's Largest Root	.013	1.632[c]	4.000	507.000	.165

a. Design: Intercept + Age + Gender + Age * Gender

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Computed using alpha = .05

From table I above, a two-way Manova analysis was conducted and it showed a non-significant multivariate effect of the three independent variables in relation to the two dependent variables of $F(4,526) = 1.80$, $p = .073$; Wilks' $\Lambda = .97$ for age, $F(2, 526) = 1.19$, $p = .303$; Wilks' $\Lambda = .99$ for gender and $F(2, 526) = .677$, $p = .508$respectively. Meaning that, age and gender of children do not influence their concrete operational tasks both in seriation and transivity outcomes.

Discussion

The outcome of the investigation in relation to performance at concrete operational stage revealed that age and gender are factors that influence seriation and transivity. Age as a factor does not significantly influence seriation and transivity; while gender as a second factor yielded no significant influence on both seriation and transivity. Thus, all the hypotheses tested based on age and gender in relation to seriation and transivity were confirmed.

Hence, first hypothesis tested which stated that "Age will not significantly influence seriation among Enugu children" was confirmed. This means that age as a factor do not remarkably influence performance of concrete operational tasks on seriation and transivity. In addition, a non-remarkable difference in performance on seriation as a concrete operational task based on age showed that children within ages 7-11 years performed differently on seriation but not significantly. It showed that increase in age may also not contribute strongly in performance on seriation, whereby children of different ages within the concrete operational stage reveal not much difference in performance. The outcome of hypothesis one as observed supports previous findings with respect to Gakhar and Kaur (1985) where they found that simple seriation is attained at the age of 9+ and multiple seriation is attained at the age of 11+, in relation to ability to do Piagetian conservation, classification and seriation tasks at concrete operational stage. This indicates that concrete operational tasks on seriation are common among children even across ages.

Further, second hypothesis tested which stated that "Gender will not significantly influence seriation and transivity among Enugu children" was confirmed. This means that gender as a factor do not remarkably influence performance of concrete operational tasks on seriation. In addition, a non-remarkable difference in performance on seriation as a concrete operational task based on gender showed that male and female children within ages 7-11 years performed differently on seriation but not significantly. It showed that variations in performance based on gender do not strongly account for performance on seriation, whereby male and female children within the concrete operational stage reveal not much difference in performance. Bora (2012) found significant differences between male and female children with cognitive level of girls better than the boys. Cognitive analysis suggests significant gender differences in certain areas of self-perceived performance, with females demonstrating significantly higher levels of self-regulation and a more positive attitude to academic study than their male counterparts. The variation in performance as regards previous findings could be accounted for based on situational or cultural differences, even when the differences may not be remarkable and do not support earlier findings.

Limitations of the study

The limitations of the study were observed to occur at the initial period of data collection where majority of the participants from rural location were observed to be less stimulated in performing the sets of tasks in both seriation and transivity as compared to urban children. This could be accounted for by the degree of exposure urban children may have when compared to rural children. Most often urban children are prone to come in contact with toys, games, and other visual teaching aids that are not commonly found in rural schools.

Suggestions for further study

Based on the outcome of the study, the researcher hereby suggests that future researchers should sample from other primary schools in other local government areas of Enugu State with regard to age and locality as factors in order to cross validate the outcome of this study.

Summary and Conclusion

The findings of the study are summarized below:

Age as a factor was found to yield a non-remarkable influence in performance on concrete operational tasks in seriation and transivity among Enugu children, with performance observed to increase as age also increases based on cognitive development.

Gender as a factor was found to yield a non-remarkable influence in performance on concrete operational tasks in seriation and transivity among Enugu children, with performance observed to vary similarly between male and female Enugu children.

Based on the outcome of the investigation, the researcher hereby concludes that age and gender as factors yielded no remarkable variation and also observed to influence performance non-significantly on seriation and transivity in relation to concrete operational tasks among Enugu children.

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