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# Development of Planning Behaviour and Decision Making Ability of Children

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**Abstract**
Decision making, a complex mental activity underlying the act of choosing from among the alternatives in attaining a goal constitutes the core component of planning, a higher order cognitive process as per the PASS theory of intelligence. An attempt, therefore, has been made in the present study to examine the development of planning behaviour in children with increasing age and grade. Marker tests of planning were administered to a group of 60 children, 20 each from Grades Three, Five and seven in order to see the group difference among them in respect of planning at its various levels. Results revealed age and grade related changes in the development of planning behavior at lower levels, but not at higher level. The findings have been discussed in terms of developmental changes in children in cognitive functioning with regard to planning and consequences of formal schooling and suggestions have been made for the improvement of the planning skill through remedial training.
**Keywords**: Decision making, Planning, PASS theory, Cognitive training

## 1. Introduction

Decision making is a complex mental activity that underlies the act of choosing from among the alternatives in attaining a goal. Decision making, thus, precedes an impending action. But, in order to make a decision one has to plan out his/her course of action so that the goal can be attained. Planning, therefore, is anticipatory to decision making. Within the framework of PASS model of intelligence which explains all intellectual activities in terms of four different but interrelated cognitive processes, namely, planning, attention, simultaneous and successive (PASS) processes, planning is considered to be a higher order cognitive process and the essence of human intelligence (Das, 1984; Das, Naglieri and Kirby, 1994).

The PASS (Planning-Attention-Simultaneous-Successive)theory of intelligence which has got its root in the clinical observation of Luria (1996, 1970, 1973) proposes that cognition is organized in three systems and four processes. The first system is the planning system, which involves executive functions (EFs) responsible for controlling and organizing behaviour, searching, goal-setting, selecting, constructing and executing plans or strategies, monitoring performance, evaluating the course of action and decision making. The second system is the attention system, which is responsible for maintaining arousal levels and alertness and ensuring focus on relevant stimuli to the exclusion of irrelevant ones. The third system is the information processing system which employs simultaneous and successive processing to encode, transform and retain information. Simultaneous processing is engaged when the relationship between items and their integration into whole units of information is required. Successive processing, on the other hand, is required for organizing separate items in a sequence. The four processes can also occur at three levels, i.e., perceptual, memory and conceptual varying from one another in terms of abstraction they involve and thus, maintain a hierarchy with perception at the bottom, conceptualization at the top and memory, in-between.

The four processes are also carried out in different blocks or areas of the brain. Thus, attention-arousal is located in Block1 that involves brainstem, the diencephalon and the medial regions of the cortex. Coding is the function of Block 2 that includes parietal, occipital and temporal lobes, whereas, planning is carried out in Block 3 that entails the frontal, especially, the pre-frontal areas of the cortex.

The PASS processes, however, operate on a knowledge base that includes one's past experiences involving his/her learning, emotions and motivations and the performance (behaviour) emerges out of it.

There is a developmental consideration is discussing the relationship between coding and planning (Ashman and Das, 1980; Das, 1984 ; Dash and Mahapatra, 1989). In other words, coding must develop upto a certain extent before planning emerges as a separate process. Further, Luria views that elementary forms of planning, i.e., conscious control of one's own behaviour does not appear before the age of 5. Thereafter, planning develops till one reaches adulthood (Dreher and Oerter, 1987; Becker et al., 1987; Welsh et al., 1991). kreiltler and kreiltler (1987) views that with increasing age planning develops because children develop an awareness and a knowledge base about planning and also cognitive abilities to deal with large amount of information and hypothetical solutions. However, no study so far has revealed the developmental changes in planning behaviour at its various levels, i.e., perceptual, memory and conceptual. Planning being a higher order cognitive process and playing an important role in problem solving and decision making is required to be studied from this perspective. The present study is an attempt in this direction.

The objective of the present study was to examine the age and grade-related changes in the planning

behaviour of children at its three different levels, i.e., perceptual, memory and conceptual. It was hypothesized that with increasing age and grade-related experiences, children would differ from one another with respect to their planning behaviour at the three levels.

## 2. Method

### *2.1 Sample*

The sample consisted of 60 school going children, 20 each from Grades Three, Five and Seven in the age groups of 7-8, 9-10, 11-12 years respectively. The subject were selected from several primary schools in the city of Cuttack,Odisha from among a population of approximately 100 students in each Grade. On an average the three groups of children were about 2 years apart in chronological age, and there were both boys and girls in each group. All the children were normal showing no signs of physical or emotional handicap.

### *2.2 Tests*

All the subjects were administered three marker tests of planning, namely Visual Search, Trail Making and Planned Composition. The description of the tests and there scoring procedures have been given below.

Visual Search. The Visual Search has been used as a test of frontal lobe dysfunction. It is established as a marker test of planning. The test consisted of 7 test cards and 1 practice card. At the centre of each card was an encircled target pattern which appeared only once in the field of many distracting patterns surrounding the target. The subject was asked to take note of the target pattern, which may either be a number, a letter or a picture, and to find in the distracting field, the one that resembled the target pattern. The time taken by the subject to find out the pattern constituted the visual search score

Trail Making. Trail making is a part of the Halstead - Reitan Battery which has been used as a neurological screening device for detecting frontal lobe dysfunctions. This test was reported to measure planning and was subsequently identified as a marker test for 'Planning' (Ashman, 1978). The test consisted of two parts, A and B. In part A, the subject was instructed to connect encircled numbers distributed randomly over the page in correct serial order. (e.g., 1-2-3- - -). In part B, which consisted of numbers and letters, the subject was required to draw lines alternatively between numbers and letters in correct increasing sequence (e.g., 1-A- 2-B-3-C - - -). The total elapsed time to complete the test was recorded.

Planned Composition. This verbal marker test of planning requires subject to write a story after seeing a picture card. The picture card used was card No. 2 of the Thematic Apperception Test (TAT). The stories written by the subject were rated by the experimenter for 'organization', 'expression' and 'Individuality'. The experimenter gave a score between 1 to 7 to indicate his/her evaluation of the story ranging from poor to good in each of the three criteria. The maximum possible score for this test is 21.

### *2.3 Procedure*

Children in each of the three groups were tested in separate rooms provided by the Head Masters of the respective schools. The tests of Visual search and Trail Making were administered individually to the subjects, whereas, Planned Composition was administered in a group of 5 children at a time. But all the tests were administered in Odia, the native language of the subjects. The tests were administered following establishment of adequate rapport with each subject and exposure to a few practice items. The tests were administered in the same order as described in this section. The testing for each subject was approximately 35 - 40 minutes. The entire testing period ranged over three weeks.

## 3. Results

Keeping in view the objective of the present study, the data were analysed by means of one-way analysis of variance. Since Visual Search and Trail Making involved reaction time measure, the time scores were transformed logarithmically to avoid any extreme score fluctuations. The group means were calculated on the basis of these transformed log-scores. Table 1 presents the means and standard deviations of the three groups and the *F* values reflecting group differences on the three measures of planning below.

 

**Table 1** Means, standard Deviations and F values Reflecting Group Differences on Planning Measures (N = 20 in each group)

| Test | Grade | | | F |
|---|---|---|---|---|
| | III | V | VII | |
| Visual Search | 8.80 (1.38) | 7.90 (0.77) | 7.26 (0.99) | 10.32** |
| Trial making | 7.58 (0.43) | 7.09 (0.42) | 6.93 (0.41) | 13.35** |
| Planned Composition | 11.90 (3.01) | 12.65 (3.28) | 13.60 (4.08) | 2.05 |

** $p < .01$ Figures in parenthesis are SDs.

It may be seen from the table that mean time taken by the subjects to perform on the tests of Visual Search and Trail Making decreases with increasing age and grade level and the mean score obtained on Planned Composition increased with increasing age and grade level of the children. Yet, the F value was found to be significant for Visual Search and Trail Making, but not for Planned Composition suggesting a group difference in respect of planning skills as measured by Visual Search and Trail Making but not on the skill measured by Planned Composition.

## 4. Discussion and Conclusion

The study intended to examine the development of the process of planning at its different levels as a function of age and grade related experiences of children.

The development of planning behaviour in the children was clearly evident from their performance on two of the measures of planning, i.e., Visual Search and Trail Making. Visual Search measures planning at perceptual level and Trail Making , at both perceptual and memory level. Planned Composition, which measures planning at conceptual level, on the other hand, could not differentiate among the groups with respect to that skill. The hypothesis framed in this connection, therefore, is partially supported.

It is no wonder that planning process would develop as a function of age and grade-related experiences. Earlier studies have already proved this (Dreher and Oerter, 1987; Becker et al., 1987; Welsh et al.,1991; Krelitler and Kreitler, 1987). The present study adds a line of support to those findings. The important point of discussion, however, is the manner of such development. Luria views that each functional unit of the brain involves three higherarchically arranged cortical zones, namely, primary, secondary and tertiary, one upon the other, which control the functions of each unit. The PASS processes which operate at three levels, i.e., perceptual, memory and conceptual seem to be the function of these hierarchical zones (Mahapatra, 2015a). In case of planning, the cortical centre which controls it, i.e., the pre-frontal areas, undergo significant changes first between age 3-7 and then again at age 12 and accordingly children exhibit changes in their planning behaviour. In the present study also the ability for planning at perceptual and memory levels was found to increase with age and grade-related experiences of children but not the conceptual planning. In fact, searching a target item visually and following a sequence as was measured by the tests of Visual Search and Trail Making in order to reach a goal demands strategic behaviour and decision making at simpler level i.e., at perceptual and memory levels. But, composing a paragraph or a story needs more abstract level operation involving organization of thoughts and imagery, making decisions for adopting appropriate strategies or even developing new ones and monitoring as well as evaluating one's own course of action towards the attainment of the goal. Studies (e.g., pea, 1982) suggest that by the age of 12 children become capable of this form of complex planning ability, although adult level performance may not be possible at that age. Children should also develop the required level of writing skills for the planning skills to be effective. And studies suggest that children's basic writing skills are sufficiently developed to allow planning skills to operate on it by the age of 12 (e.g., McCutchen, 1995). Yet, in the present study children with increasing age (even at age 12) and grade-related experiences did not show any difference with respect to their composition skills involving conceptual planning.

Development of cognitive functions and their underlying structures is facilitated in a stimulating environment. The school system and the teaching method, thus, plays a significant role in it. But if the instruction fails, then remedial measures are to be adopted. In fact, remedial measures like PREP and COGENT (Das,2009) which involve cognitive enhancement training and are based on the PASS theory of intelligence have been proved to be effective in this direction (Mahapatra, Das, Stack- Cutler, and Parrila, 2010). The training involves verbalisation which boosts planning because it allows one to formulate strategies for solving problems

 

and regulate activity through one's overt or covert speech. This particularly helps to prevent quick deterioration of detailed verbal information involved in the problem and enables one to record and review the strategies he/she adopts to solve the problem and reach the goal. The decision made regarding selection and adoptation of particular strategies, thus become more appropriate and effective. We can focus on this information and take necessary steps for the development of decision making and planning behaviour in our children.

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