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# Generative Thinking among Young Zimbabwean Children: A Case of the Third Eye

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## Abstract

*The present investigation compared the generative thinking of second-graders (7-8-year-olds) and fifth-graders (10-11-year-olds) in order to see the extent of generative thinking among children of different ages. Precisely, the study aimed to test age trends in children's generative thinking. Participants were 40 second-graders and 40 fifth-graders, randomly selected from four schools in Harare's high-density suburbs. The research design used in this study, was of a survey type. Interviews were used to collect data. Crosstabs and a two sample t-test were used to analyse the data. Overall, the study established significant age-related differences in children's generative thinking. Fifth- graders were more imaginative/generative and showed more sophistication in their reasoning than second- graders, who mostly patterned their ideas on conventions and thus portrayed limited generativity.*

## Introduction

This study examined and compared the extent of, and age trends in, the generative thinking of second-graders (7-8-year-olds) and fifth-graders (10-11-year-olds) with the ultimate aim of seeing how generative thinking develops in young children. It is vital to study the development of generative thinking because it has been found to be a contributor to other cognitive skills such as image formation, story production and detecting relationships between phenomena (Richards and Sanderson, 1999). To this effect, children's generative thinking is clearly an exciting and essential field of study. Furthermore, the fact that the field of generative thinking is an emerging one (Feldman, 1999) means that much more should be learned about the development of generative thinking in young children.

## The Concept of Generative Thinking

Generative thinking involves the production of new and original solutions to problems. It could be viewed as active construction of a creative instantiation of some known concept, object or action (Ward and Sifonis, 1997). It allows us to go or interpret beyond concrete experiences, focussing on what is possible and not

necessarily on what is real. Generative thinking, therefore, involves the construction and modification of representations that are relevant to some goal (Ward *et al*, 1997). In the current study, the goal was to place the third eye where it could be most useful.

It should be noted that like creativity, generative thinking involves both novelty and utility. Since, in this study, subjects were required to imagine being given a third eye and to place it on whatever part of the body they felt it should be, novelty involved placing an eye outside its usual location (face region), while utility meant usefulness, e.g. placing an eye at the back of the head in order to see all round.

## Background and Literature Review

Developmental research shows that children are capable of thinking in a variety of ways on many tasks and in many diverse fields. For Siegler (1996), the fact that children think in a variety of ways and with different results suggests that some children are more generative in their thinking than others. Those that are generative in their thinking tend to be adaptive to the task environment and to produce novel solutions as a result of considering the consequences of alternative approaches to their thinking and actions (Siegler, 1996). Thus, generative thinking results in solutions that are novel and useful.

Though children's thinking is essentially generative (Nelson, 1986, Low and Durkin, 2000), as evidenced by such things as playing as builders or making car toys, research, for example by Ward (1994) and Stokes (1999), indicates that the development of generative thinking is gradual, but improves as a function of, among other factors, age, IQ, task type, nutrition, family and socio-economic influences (Richards and Sanderson, 1999). This shows that the extent of generative thinking in children varies from child to child as a function of, among other things, the above factors.

In an attempt to establish the extent of generative thinking among students, Ward (1994) asked college students to imagine and draw animals that might inhabit a planet elsewhere in the galaxy. The observation was that the majority of the students lacked imagination to the extent that they drew earth-like animals. These findings seem to suggest that age alone does not necessarily determine the extent of generative thinking. In fact, as already seen, children's generative thinking has been found to be influenced by factors such as task specifics, available knowledge and the

information processing skills that a child possesses (Runch, 1986). For Stokes (1999), children's generative thinking improves with tasks that are deliberately structured to achieve that. Corroborating evidence comes from Harrington (1975), who found that instructions aid generative thinking. Harrington (1975) found that adult subjects who received task instructions to be creative, produced more creative responses than those who did not receive such instructions.

Runch and Acadia (1991) observed similar results between two groups of adolescents. One group received originality instructions, while the other did not. Those who received originality instructions obtained higher originality scores than those who did not. This suggests that deliberate effort/instruction is necessary if we are to yield superior levels of generative thinking among children.

Other investigators such as Poole and White (1995) have argued that in order to foster generative thinking, children should be personally involved. Involving children in novel situations is promotive of generative thinking.

It is against such background that the present study was carried out to investigate the extent of, and age trends in, children's generative thinking using a hypothetical situation of a third eye.

## Methodology

The present investigation was premised on a series of investigations conducted by Shafer (1973), where children were asked to deal with hypothetical situations as a means of assessing the development and extent of their generative thinking. Thus, the present study owes much to palters, for example Shafer (1973), in this field in terms of methodological procedures and instrumentation.

## Research Design

The research design, because of the nature of the study, was of a survey type. In Van Dale's (1979) view, surveys do not only have the advantage of being used on relatively large samples as is the case in the current study (N=80), but also allow the collection of detailed descriptions of existing phenomena or trends in order to see how they can be improved. To this effect, it was the intention of the present study to

examine the extent of, and the age trends in, children's generative thinking in order to see how children's generative thinking could be improved or accelerated.

## Sample

Forty second-graders (7-8-year-olds) and forty fifth-graders (10-11-year-olds), randomly selected from four schools in Harare's high density suburbs, participated in this study. Second and fifth-graders were involved in order to assess and compare the development and extent of generative thinking between the two age groups who, according to Inhelder and Piaget, represent a distinct thinking pattern (concrete operational thought). However, it should be noted that fifth-graders could already be in Piaget's (1964) formal operational stage (see Mpofu, 1994).

## Instruments

Interviews were used to collect data in this study. Interviews were preferred because very young children such as second-graders still have problems in writing (as would be the case with a questionnaire), let alone giving reasons for their choices in writing. This is, perhaps, why Poole and White (1995) argue that one of the many difficulties when conducting research with young children lies with the type of task and questions asked. In the present study, the task (placing a cardboard eye) and question asked (giving reason for placing a third eye in a particular location) took into account the numerous problems (e.g. developmentally inappropriate language) encountered when conducting research with children.

Children were given cardboard eyes and asked to stick them on any part of their bodies where they felt a third eye/extra eye could be, and to give a reason for placing it there. Some researchers such as Shafer (1973) have used pictures and asked their subjects to simply place a third eye on the pictures while others have asked their subjects to draw pictures and then place a third eye on the pictures drawn. Such procedures have been criticised. Studies by Cox (1993) and Freeman (1980) have shown that drawing itself is potentially too challenging for many young children, worse if accompanied by the placement of human features such as eyes. The present investigation recognised this pitfall (which might result in unreliable and invalid results) and opted to use a cardboard eye instead. This also has an advantage because research studies such as those by Low and Durkin (1998) have shown that when children are asked to use themselves as representations, they tend to place the

human feature in novel situations and to provide meaningful reasons which explain how the new feature would improve human functioning as a whole. The present investigator took this advice into account.

## Procedures

Participants were interviewed individually so that they would not be influenced by others. The interview was conducted in the form of a game. 'Let's play a game. Suppose you are given a third eye (showing the cardboard eye), show me by actually placing it, where on your body you would like it to be'. The child's response was recorded. Next, the child was asked to explain or give a reason for placing the eye in that location. The response was also recorded.

## Coding of Eye Placements

Following the procedures by palters such as Shafer (1973) and Ward (1994), participants' placements of a third eye were recorded as follows:

0 Failure/refusal to respond or to place a third eye on any part of the body.

1 Placing a third eye between the existing/natural eyes.

2 Placing a third eye on the forehead or below the natural eyes, but still within the face region.

3 Placing the third eye anywhere else in front - facing region of the body e.g. on the chest, stomach, knees etc.

4 Placing a third eye anywhere in the back region of the body e.g. buttock, back of the head etc.

## Coding of Reasons or Explanations

0 Failure/refusal to explain, or ambiguous explanation.

1 Attributing the placement to mass media e.g. 'I have seen it on television.'

2 Explanation referring to natural/biological location of eyes. e.g. 'That is where eyes are or should be.'

3 Explanation referring to how frontal vision would improve if a third eye was in that location. e.g. on the forehead: 'This would allow me to see further ahead.'

4 Explanation focussing on how vision would be improved or more useful if one was able to see all round e.g. third eye being at the back of the head.

All the subjects' responses were found codable, hence useful. This was mostly so because of probing by the investigator.

Having explained the motivation behind the present study as well as its theoretical and methodological framework, presentation and analysis of data follows.

## Data Presentation and Analysis

Coded data were key-punched for analysis. Two statistics were used. First, crosstabs showing percentages of respondents for eye placements and reasons/explanations for their placements were used. Second, a two sample t-test was applied to see if there were any significant differences in both eye placements and explanations for placements between second- and fifth-graders.

**Table 1 (a): Crosstab of Eye Placements for Second- (N=40) and Fifth-graders (N=40)**

| Eye Placements | Number of Respondents | | | |
|---|---|---|---|---|
| | Second-graders | | Fifth-graders | |
| 1. Failure or refusal to respond | 0 | (0%) | 0 | (0%) |
| 2. Placing the eye between the natural eye | 35 | (87.5%) | 6 | (15%) |
| 3. Placing the eye on the forehead or any other part within the face region | 1 | (87.5%) | 10 | (25%) |
| 4. Placing the third eye anywhere else in the front facing region | 1 | (7.5%) | 1 | (2.5%) |
| 5. Placing the third eye at the back region of the body | 1 | (2.5%) | 23 | (57.5%) |

## Discussion

Table 1(a) shows that all the participants responded to item one. This means that all subjects placed a third eye in some place, though, initially, some second-graders were unhappy about the idea of a third eye: arguing that it was not necessary at all since

human beings do not need three eyes. This suggests young children's inability to deal with hypothetical situations (Inhelder and Piaget, 1964). In the Piagetian view, this is so because young children have not yet acquired pre-requisite cognitive skills and knowledge that would allow them to show reasonable levels of generativity.

Thirty-five (87.5%) second-graders placed a third eye between the two natural eyes, while six (15%) fifth-graders placed it between the two natural eyes. Since generativity involves novelty (placing the third eye outside the usual place), it means that second-graders whose majority (87.5%) placed the third eye within the face region have not yet fully developed generative thinking. Only six (15%) fifth-graders placed a third eye between the two natural eyes, meaning that the majority placed it elsewhere.

Table 1(a) also shows that three (7.5%) second-graders and 10 (25%) fifth-graders placed the third eye on the forehead or any other part within the face region. One (2.5%) second-grader and one (2.5%) fifth-grader placed a third eye within the front-facing region of the body.

The biggest difference between second- and fifth-graders in their eye placements is observed in item 5, where only one (2.5%) second-grader placed the third eye at the back of the head, yet this is the crux of the matter. In contrast, 23 (57.5%) fifth-graders placed the third eye at the back of the head, indicating a marked increase in generative thinking. Not only did fifth-graders show novelty in their placements, but also considered utility, for they argued that this would assist in seeing all round.

Overall, what we observe is that while the majority of second-graders (87.5%) placed a third eye between the two natural eyes or generally within the face region, the majority of fifth-graders (57.5%) placed it at the back of the head. Most second-graders argued that it was the face that must 'contain' the eyes. On the other hand, fifth-graders considered utility (seeing all round), hence they placed it at the back of the head. These results are consistent with Shafer's (1973)observations that 6-9-year-olds not only lack enough generativity, but are also unable to give adequate reasons and explanations for some of their actions because of lack of formal operational schemes.

To see whether the differences between second- and fifth-graders in their placements were significant or not, a two-sample t-test was conducted. Below are the results.

**Table 1 (b): Two Sample t-Test and Confidence Interval for Eye Placements for Second Versus Fifth Graders**

Alpha Level: 0.05

| | N | Mean | St Dev | SE Mean |
|---|---|---|---|---|
| Placement | 40 | 1.150 | 0.533 | 0.084 |
| Placement | 40 | 3.02 | 1.21 | 0.19 |

**Interpretation**

Since p - value = 0.000 < 0.05 and the difference between means (-1.87) lies outside the given interval (-2.294;-1.46), we reject the null hypothesis, which states that the means of the two groups are the same. This means that the means of the two groups are significantly different at the 0.05 significance level.

From the above, it can, therefore, be concluded that there is a significant difference in eye placements between second- and fifth-graders. Fifth-graders have a higher mean placement score (3.02) than second-graders(1.150), indicating that they (fifth-graders) placed the third eye in imaginative locations. For second-graders, clearly, there is an age-related limitation in their placements, suggesting limited generative thinking at this stage.

**Table 2(a): Crosstab of Reasons/Explanations for Eye Placements for Second- and Fifth-graders**

| Reason/Explanation for Eye Placements | Number of Respondents | | | |
|---|---|---|---|---|
| | Second-graders | | Fifth-graders | |
| 1. Failure/refusal to explain or ambiguous explanation | 12 | (30%) | 0 | (0%) |
| 2. Attributing explanation to mass media | 3 | (7.5%) | 0 | (0%) |
| 3. Explanation referring to natural/biological location | 17 | (42.5%) | 3 | (7.5%) |
| 4. Explanation referring to how frontal vision would improve if the third eye was in fact in that location e.g. forehead | 7 | (17.5%) | 14 | (35%) |
| 5. Explanation focussing on how vision would be improved or more useful if one was able to see all round | 1 | (2.5%) | 23 | (57.5%) |

## Discussion

Twelve (30%) second-graders failed to give adequate reasons/explanations for their eye placements, while no fifth-grader fell within this category. Some of them gave answers such as 'I just felt it was the right place' or 'So that the third eye is near the other two eyes' etc.

While no fifth-grader attributed their explanation to mass media, three (7.5%) second-graders attributed explanation to mass media. Answers such as 'I saw people with three or more eyes on TV' and 'The TV sometimes shows people with three eyes located near each other' were given. What is interesting about all the answers given to items one and two by second-graders so far is that no one is making reference to how vision might be improved by having an eye in that location. This failure to consider usefulness or visual advantages indicates limited generative thinking; underscoring the fact that generative thinking is a late achievement only realised during or towards the formal operational stage. Seventeen (42.5%) second-graders and three (7.5%) fifth-graders gave reasons/explanations that have to do with biological location of eyes e.g. 'That is where eyes are found on a person.' Such an answer indicates either failure or hesitation to depart from the known. The child does not see or think of how he/she could use a third eye to their advantage, such as to see more and better. The high percentage (42.5%) of second-graders and the small percentage (7.5%) of fifth-graders falling within this category is further

testimony to the fact that the development of generative thinking is age-related and, hence, hierarchical in nature.

A relatively small percentage (17.5%) of second-graders and a relatively high percentage (35%) of fifth-graders gave reasons referring to how frontal vision would improve if the third eye was in a particular location, e.g. on the forehead. The fact that more fifth- than second-graders gave this reason shows that fifth-graders, who are chronologically more mature, think of utility in both their placements and reasons.

Of great interest in this study is the fact that while only one (2.5%) second -grader gave an explanation focussing on how vision would be improved or would be more useful if one was able to see all round, 23 (57.5%) fifth-graders gave explanations that focussed on how vision would be improved if one was able to see all round. e.g. 'So that I could see front and back at the same time.'

The big discrepancy between second- and fifth-graders suggests significant differences in generative thinking between the two groups, with fifth-graders displaying more instances of generative thinking than second-graders. However, to see if the differences in explanations between the two groups were real/significant or not, a two sample t-test was conducted. The results are given in Table 2(b) below.

**Table 2 (b): Two Sample T-test and Confidence Interval for Reasons/Explanations for Second- versus Fifth-graders**

Alpha Level: 0.05

| | N | Mean | St Dev | SE Mean |
|---|---|---|---|---|
| Explanation | 40 | 1.55 | 1.18 | 0.19 |
| Explanation | 40 | 3.50 | 0.641 | 1.10 |

95% C.I for mu explanation - mu explanation: (-2.37, -1.53)
t-test mu explanation=mu explanation (vs not =): t=-9.21 P=0.000 DF=60

## Interpretation

Since p - value = 0.000 < 0.05 and the difference between the two means (-1.95) lies outside the given interval (-2.37; -1.53), we reject the null hypothesis which states that the means of the two groups are the same. This means that the means of the two groups are significantly different at the 0.05 significance level.

We, therefore, can conclude that there is a significant difference in reasons/explanations given by second- and fifth-graders. Just like in the eye placements, fifth-graders have a higher mean score (3.5) than second-graders (1.55). This indicates that there was an increase, as a function of age, in the level of sophistication of fifth-graders' explanations and reasons for where they placed their third eyes.

Though the two groups involved in this study were both within Piaget's (1964) concrete operational stage (7-11year-olds), as already argued, some fifth-graders (10-11-year-olds) could already have attained Piaget's (1964) formal operational thought because, as Mpofu (1994) found out, Zimbabwean school children were capable of advanced classification (and perhaps other tasks) at an earlier stage than Piaget proposed. If this observation is accepted, then the current findings certainly confirm observations by Inhelder and Piaget (1964) that generative thinking is mostly achieved during the formal operational stage.

## Conclusion

The present study demonstrated significant differences in generative thinking between second- and fifth-graders, with the latter showing significantly higher placement and explanation mean scores. Most second-graders restricted their eye placements to the face region and gave reasons that did not implicate visual advantages. On the other hand, most fifth-graders gave creative responses and advanced reasons and explanations that implicated visual advantages.

In all, therefore, the current investigation has indicated that children have varied responses to creative tasks as a function of, among other factors, age. The different age groups responded differently to the task. It is, therefore, only fair to end up by acknowledging the fact that the findings of this study give more credit to Piaget's observations that cognitive development proceeds in stages: with children being

able to do certain things at particular stages, while at the same time, being incapable of other things.

## Implications

1. Since the study demonstrated that second graders have limited generative thinking, there is need for pedagogy to be attuned to the development of generative thinking among pupils. This is particularly necessary for those children who have not yet attained formal operational thought (grades 1 to 5); those whose generative thinking may still be limited. Novel hypothetical situations have been found to be promotive of generative thinking (Poole & White, 1995).
2. Studies by Poole and White (1995) have also shown that learning where the child is personally involved and learning that involves problem-solving accelerates generative thinking. The child, because of the natural curiosity to overcome challenges, makes an effort to find solutions by trying out alternative avenues to the solution and, thus, develops creative ideas.
3. As already noted, Runch and Acadia (1991) found that of the two groups, the one that received originality instructions obtained higher originality scores than the group that did not receive such instructions. This shows that deliberate effort/instruction is necessary if children are to be generative. For example, in the present study, a question explicitly asking children to consider where a third eye might be placed in order to give superior visual advantage might have produced different results altogether. Thus, such intentional manipulations can certainly yield superior levels of performance. Hence, educators should structure learning episodes in a way that stimulates and encourages generative or resourceful thinking. This will help children to be effective problem-solvers.

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