A Child’s Conception
Of Pictorial Space
Based on theories by Jean Piaget

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Why do children draw the way they do? Most adults take children’s art at face value, simply enjoying the drawing’s charm, simplicity and honesty. Looking at a child’s drawing makes us feel good. However to Jean Piaget, a child’s drawing holds keys to understanding his/her stage of cognitive development.

Piaget spent much of his professional life listening to children, watching children, and pouring over the findings of researchers from around the world. He produced 60 books with theories on most everything. He often collaborated with other researchers. (www.time.com). Early in his career, Piaget noticed that children progress through orderly stages of development, representing increasingly comprehensive ways of thinking. This led to the development of his theory of cognitive development in children.

According to Piaget, the first stage of cognitive development is sensori-motor intelligence. This period lasts from birth to two years of age. During this time babies organize their physical action schemes, such as sucking, grasping and dealing with the immediate world. The next stage of cognitive development is preoperational thought. Children in this stage are usually two to seven years old. They learn to think using symbols and internal images, but their thinking is illogical. Following this stage is the concrete operations period. Typically children in this stage are seven to eleven years old. During this time children develop the ability to think systematically, but they must refer to concrete objects and activities. The last stage is the formal operation period. The child is usually eleven years old. This period lasts to adulthood. Children develop the capacity to think systematically on an abstract level. (Crain, 2000).

As Piaget’s research matured, he sought to link the development of children’s drawings with their progression through the cognitive development stages. In collaboration with Barbel Inhelder, Piaget defined the stages of pictorial development in children. The problem this project seeks to answer is whether it is possible to determine a child’s stage of cognitive development using Jean Piaget’s stages of pictorial development. In addition, comparisons between similar aged children will be used to see if they fall in the same stage of development.
It is hypothesized that it will be possible to determine the stage of development of a child by his response to the task “draw a tree behind a house.” Children in similar stages of development will have similar solutions to the drawing task. This will be revealed when the drawings are scored. Further, it is hypothesized that children who have been identified by a school district as “gifted” will have responses that show a more advanced stage of development than same age children in a regular class.

The children participating in this study will undergo several tasks. The inspiration for these tasks and the project as a whole is based on papers written by Kathleen Preston and Violet Kalyan-Masih. (ERIC_NO: ED142291, 1977; ERIC_NO: ED113046 1975).

First, the child will be asked to “draw a picture of a tree behind a house.” The child will be given a sheet of plain, white, 8 1/2” x 11” paper and six colored pencils. The completed drawing will be scored and evaluated to determine how it fits into Piaget’s stages of pictorial development. The ideas for the scoring system were generated by reviewing the models for drawing a human figure as detailed in *Children Drawing.* (Goodnow, 1977).

Following the drawing task, the child will be shown two balls of clay and told the balls are the same weight (a Piaget task). The shape of one ball of clay will be rolled into a “hot dog” shape while they are watching. The child will be asked if the balls are equal weight. The child who answers that the balls of clay are NOT of equal weight is said to be operating in the preoperational stage of development. Piaget states that the preoperational child cannot conserve. The child centers on one dimension (length or width) and cannot mentally reverse the transformation and arrive back at the same quantity. (Phillips, Jr., 1981). If the child successfully answers the first question, he/she will be given an adaptation of Piaget’s three-mountain task.

The three-mountain task can determine a child’s ability to imagine an object from the perspective of another person. The preoperational child cannot perform this task at all. A child operating in the concrete operational level will be able to get most, if not all, the answers correct. (Phillips, Jr., 1981). Piaget’s original task used a pasteboard
model of three mountains, each a different color, a different height, and with a different shape on top of the summit. The child is shown several pictures representing the mountains seen from different viewpoints. Next, a doll is placed in a number of different places around the mountains and the child’s task is to discover what perspective the doll will “see” in each of the different positions. The child will have to imagine, and reconstruct the changes in perspective that will accompany the doll’s movements. 

(Gruber, 1977). In this study, paper cone representations of the three mountains were used instead of the pasteboard model to make the task portable. In addition, a step in the questioning was added. The child was asked to identify the picture that represented what he/she saw from where they sat. This step was added to ensure the child understood the directions. The children who answered correctly at least two of the four questions about what the doll sees were then asked a verbal question developed by Mrs. Barbara Khirallah at the University of Dallas. The child is asked to imagine opening a can of orange juice by taking off the lids on the top and bottom, then cutting the paper part of the orange juice can lengthwise. Imagine flattening the can. What three shapes does the orange juice can and lids make? Successfully answering this question involves abstract thinking, a characteristic of Piaget’s formal operations stage. (Crain, 2000).

This study was conducted in several locations. Five children, ages 2 to 4, were tested in the home of their caregiver. The children knew each other well and were acquainted with the test administrator. They were tested approximately 30 minutes after their arrival in the morning. Other than their chatter, it was quiet. A group of eight children were tested at a gathering of mutual friends. This was not an ideal setting. Loud music made it necessary to conduct the test outdoors. The children were excited to be together but were also eager to participate in the study. Soon a line formed of willing volunteers. Two children were tested after Sunday School in a quiet room. In fact, one boy used one of the “mountains” as a cone to whisper his answer to me. Two other children were tested in a relative’s home which was quiet. Six children were tested in the after-school art program at McCoy Elementary School in Carrollton, Texas.
The teacher was talking to other students but this did not disturb the students in this study. They were located in an area off to the side of the room. The rest of the students were tested in the after-school program at McCoy Elementary. The children sat off to the side at their own tables. Occasionally other students would stop by to see what was going on, but they were told that they would be chosen later. It should be noted that the principal of the school did not want the study conducted during school hours since their teacher’s time is limited with the students. This limited access to children in the LEAP program for highly gifted students (I.Q. 140+) to those who participate in an after school program. Thirty five children completed the drawing and tasks. Three children had incomplete testing.

To understand the results of the drawing scores and to understand what characteristics to look for in the children’s drawings, it is necessary to become acquainted with Piaget’s stages of pictorial perception and how he relates these to the stages of cognitive development.

There are several precursors to pictorial perception. Piaget begins with a child’s scribbling which occurs in children up to almost three years old. He describes scribbling as having no purpose or aim that can be discerned. There is no variation between the drawings no matter what the model. The child will be unable to close a line to form a shape. A child that scribbles would be in the sensori-motor stage. (Golomb, 1992).

Scribbling evolves into topological relationships in the drawings. They form the foundation for the next stage of visual perception, synthetic incapacity. These relationships are acquired in the order listed below.

– **Rule of proximity:** Most basic spatial relationship. For example, in the drawing of a face the various parts are drawn near to each other and not scattered to the edges of the paper.

– **Rule of separation:** the elements that are drawn are distinguished from each other. Difficulty drawing simple geometric shapes.

– **Rule of order:** some degree of spatial succession and symmetry is attained; parts are arranged sequentially. For example, facial features are in the correct order; in a profile of a dog the tail is drawn on the end of a dog, not on the head.
Rule of enclosure: further differentiates between the inside and the outside of the figure or simple geometric shapes

Rule of continuity: attachment of body parts (Piaget, 1969).

Stage 1: Synthetic Incapacity begins around the age of three or four. During this stage a child would be operating at an early preoperational stage. This stage is dominated by topological relationships, for example:

- a body with arms and legs stuck onto a head with no torso
- parts of figures juxtaposed instead of linked together, for example a person sitting above a chair instead of on it
- no Euclidean relationships: no proportions, length or shape relationships, no perspective (Piaget, 1963).

During this study, the five children in the synthetic incapacity stage exhibited egocentric speech. For example, “The tree is windy” or “I have to draw the sun or it will be dark.” Their drawings exhibited topological relationships like those Piaget described. Their drawing scores ranged from 1 - 5. One drawing collected in this project incorporated a person. It had the eyes above the mouth with the legs stuck to the head (no torso). The children also used only one color, further simplifying their drawings. When given the balls of clay task, no child passed, supporting Piaget’s theory that these children would be in the preoperational stage.

The next stage is Stage II: Intellectual Realism. It occurs in children ages 4-8. The child draws not what is actually seen of the object but “everything ‘that is there’.” (Piaget, 1963). Characteristics of these types of drawings are:

- Drawings include more details
- Euclidean and projective relationships are just beginning to emerge
- Topological relationships are now universally applied to all shapes
  - Proximities are correct, or at least aimed at
  - Separations are made more clearly
  - In complex drawings the order of succession is found
  - Continuity is well defined
- Relationship of enclosure is important - often representing the interior of objects
Piaget also described typical “errors” in drawings by children in this stage. They include:

- Transparencies - see through objects
- Mixed views - example, front and side together
- Fold-out drawings - flattened perspective
- Arrange figures side-by-side ignoring vertical dimension-flat, no depth
- Lack of occlusion - one object stands behind another to partially obscure view
- Right angle bias - often seen in chimneys drawn at a right angle to the roof

(Golomb, 1992).

Twenty-one of elementary age children tested in this study are in the intellectual realism stage. They range in age from 5;7 to 11;10. The drawings that are representative of this stage have many of the errors Piaget noticed. The drawing scores range from 7 to 79. Frequently the drawings show mixed views, for example the roof is shown in perspective and the house is a flat rectangle. This trait is common in older elementary children and may be indicative of a move towards decenteration and away from egocentrism, resulting in the ability to draw perspective views of objects. As a group, the answers to the tasks were erratic, indicating cognitive development from preoperational to concrete formal stages.

The next period of pictorial development is Stage III: Visual Realism. It is most often seen in children between the ages of 8 - 12. Characteristics of this stage include:

- Projective and Euclidean relations develop from earlier topological ones.
  From age 9 (approximately) the child can draw in proper perspective
- Relationships of left, right, in-front and behind can be represented
- Drawings with straight lines, angles, curves, distance shown through various transformations
- Viewpoint of observer is respected
- Foreshortening will appear around adolescence, often with instruction

Nine children studied in this project had drawings with characteristics of this stage. This indicates that they are able to think abstractly (not dependent on concrete existence)
and see objects from another point of view. They range in age from 8;11 to 11;3. They all exhibit the characteristic of occlusion in the house with the tree in the correct position, behind the house. After completing the three tasks, seven students placed in the late concrete operational stage to formal operational stage.

Limitations of the project may have negatively impacted the results. It is difficult to evaluate conclusively the pictorial stage based on one drawing. Some older student’s could not conserve (task 1) but performed adequately on the other tasks. A study by Dr. David Elkind supports this. In replicating some of Piaget’s work, Elkind tested 469 students in junior and senior high school. He found that 87 percent of the students grasped conservation of mass and weight, while only 47 percent understood conservation of volume by age 15. Elkind also found that boys generally demonstrate the ability to conserve earlier than girls. (Bybee, 1982). Some students lacked a scheme of an orange juice can. The language was adapted to a soda can or a soup can. Another limitation was the motivation of some children changed during the study. For example, they got tired of drawing, they wanted to be with their friends or they were influenced by other students. Since access to LEAP students was only through the after school program, there were too few students who participated to make an analysis against the same aged children in a regular class. However, traits of giftedness are exhibited in their drawings such as drawing specific objects with rich details, using foreshortening, occlusion, size diminution, modeling to show volume and linear perspective. (Winner, 1999). They also completed all the tasks quickly compared to other students.

In conclusion, the “draw a tree behind a house” task is another tool educators can use to help them evaluate cognitive development of children. It is successful in identifying children that are in Stage III: Visual Realism because proper perspective is a strong characteristic of this stage. Children who are in this stage vary between concrete operational stage to early formal operational stage. The data collected from the three tasks show the ability of these children to conserve, decenter, and think abstractly.

Children in Stage I: Synthetic Incapacity also show strong characteristics. The
simplicity of the drawings combined with the inability to conserve and egocentric speech when drawing indicate the preoperational stage of development.

The most difficult children to identify were those who were not at an extreme. These children exhibited a wide range of “errors” in their drawings. Although the students were close in age, the results of the drawing and tasks varied from preoperational to concrete operational stage.