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CHAPTER II

CONCEPTUAL UNDERSTANDING OF THE VARIABLES

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References
2.1 Introduction:

Normal children acquire the language spoken by others in the environment in which they are nurtured. There is no innate predilection for one language over another. At birth, a child cannot either comprehend or produce any language. By age 5 to 6 or on entry into formal schooling, the child has acquired much of the phonological and grammatical systems of the specific language to which he has been exposed. The number of words known and the message to which these words refer (the semantic system) continue to expand throughout life.

Many factors can be isolated for acquisition of early reading. But most important recently researched variables are conservation and metalinguistic abilities of the children. Therefore the present chapter discusses three variables in the following order of importance:

1. Language Development Factors
2. Conservation
3. Metalinguistic Abilities
2.2 **Language Development Factors**

This is a very broad term which includes even conservation and metalinguistic abilities. Under this term, these two abilities would be cursorily treated.

Language is a single phenomenon consisting of both receptive and productive modes. When the oral code is used, the receptive mode is listening and the productive mode is speaking. When the graphic code is used, the receptive mode is reading, and the productive mode is writing.

All four modes are different, but closely related, aspects of language. The relationships, however, are not static. In infancy, listening precedes intelligible speech, and reading and writing are nonexistent. During the years of early childhood language growth is rapid; the level of spoken language begins to approximate that of oral reception. Around the age of six reading instruction begins, with writing coming somewhat later. Some educators believe that reading and writing should be taught concurrently, or even that writing instruction should precede reading instruction. There have also been attempts to teach reading at the age of two, when language development is most concentrated.
Although such attempts may be misguided for other reasons, they do show an appreciation for the unitary nature of language. The common root, and hence the reason for the interdependence among the four aspects of language, lies in the search for meaning. It is our nature to expect things and events in the world to conform, to follow certain patterns, to make sense. When they do not, we seek further explanation to satisfy our need for order and consistency, or we force the information into a form we can deal with. We are constantly bending information to suit our predilections much more than we care to think. It is this realization that has led psychologists to form what is known as the cognitive movement.

The basic premise of cognitive psychology is that knowledge is not a simple reproduction of what is experienced, but an active construction embodying elements of what is previously known, what is believed, and what is expected. This constructive nature of experience carries over into our dealings with language, both oral and written. Language has a cognitive basis, which is the same whether the activity be listening, speaking, reading, or writing. This cognitive basis makes use of symbols and, in due course, what Piaget calls "operational thought".
2.2.1 Analysis of the Reading Task

Reading is an activity that involves extracting meanings from print and assimilating that meaning to one's existing store of information. This definition differs from the commonly accepted definitions that separate reading from thinking and that, in essence, construe reading as casting one's eyes over the printed text and decoding the words. In common parlance it makes perfect sense to say "I read it, but I didn't understand it" or (as I have heard some proud parents claim) "My five-year-old can read anything." On the other hand, when a student arrives in school claiming that he or she has read a book but can answer no questions about its content, we are liable to conclude that the student has not really read it. So the common definition seems to fluctuate between regarding comprehension as a necessary component of reading or as a desirable aspect superimposed on the basic process. This ambivalence has been a source of confusion for teachers and has led to an inordinate emphasis on the decoding aspects of reading at the expense of comprehension.

(1) Prior Knowledge:

What does the child need to have or be able to do in order to read? First and foremost is experience.
We cannot make sense of something we have not experienced, or as the old philosophers put it, "Nothing is in the mind which was not first in the senses." Our understanding is bounded by the limits of our concrete experience, and only to the extent that we have had such concrete experience can we begin to extrapolate and build on this knowledge base by means of new generalizations, logical operations, or feats of imagination.

Teachers may pay lip service to the need for concrete experience, accepting the general principle but forgetting in specific cases that a particular child may not have had the requisite experience to understand fully the topic under discussion. As children proceed up the grades, the content of their schooling rapidly becomes more abstruse and complex, relying more and more on abstractions. The wise teacher consistently probes the extent and depth of the child's understanding and builds links back to the concrete by use of examples and illustrations. In kindergarten and first grade, such probing is an absolute necessity. We cannot assume a commonality of experience among children coming from a broad diversity of ethnic and social backgrounds.

The reader uses prior knowledge and experience to make sense of the text. In all our experience, we
are unconsciously making predictions about what we will find "around the bend" either in the realm of nature or human behaviour. In a sense we are walking bundles of expectations, though we don't go around consciously articulating these expectations. Only when they are violated are we surprised enough to remark on the fact and to speculate about the reasons for the irregularity. Reading is no different in this respect. We sit down to read a book with very definite expectations, and we express our displeasure (or occasionally delight) if these expectations are not met.

The child too expects what is being read to follow certain conventions both in content and structure. Several researchers in the past seven or eight years have demonstrated that even four- and five-year-old children have well-formed ideas about the necessary components (or structure) of a story, as well as the order in which these components typically appear (Stein & Glenn, 1979). There has been little corresponding research on their expectations about content or about the language in which stories should be couched.

(2) **Conceptual Network** :

The second factor necessary to reading comprehension, and related to the experiential background, is a large
conceptual network. A major assumption built into the notion of word recognition is that the child has only to recognize the word and it will immediately trigger not only the essential meaning of the word but, with any luck, a network of associations that give richness and depth to the essential meaning. It is not at all clear that this assumption is always, or even regularly, met. The child may certainly recognize the word. What meaning and associations the word conveys are another question.

Vocabulary development may be the single most important preparatory step for reading, but it must consist of true development of the ideas surrounding a concept and not just the dictionary definitions of more and more words. For this reason, vocabulary development conducted prior to reading seems to be more beneficial if the words are studied in context rather than in isolation (Hughes, 1977).  

The child must also learn certain concepts that Piaget has identified as the cornerstone of thought - difficult concepts involving spatial and temporal relationships, cause and effect, probability and certainty, physical and psychological reality, and abstract social concepts governing human relations such as morality,
justice, democracy, peace and war, and religion. There is good evidence from Piaget's own work and that of his followers that such concepts evolve very slowly and may be improperly understood even by adults.

(3) Language Background - Syntax, Semantics, Decoding:

Beyond experience and a conceptual network, the child needs the language facility to express ideas and ask questions (Hunter-Grundin, 1978). Language before school is learned entirely through discourse with adults or other children. At the infant and toddler stage, language is shaped by adults responding to the child's babbling and, later, to one- and two-word sentences. With the emergence of symbolic thought, dialogue with children who are at a slightly more advanced cognitive level becomes the most important vehicle for advancing the child's learning. Piaget believed the reason for this was that the more advanced child makes remarks that are contrary to the experience of the younger child, thus creating cognitive conflict. The resolutions of this conflict through questioning or thinking about the matter carries the child forward to a new level of equilibrium or functioning. What Piaget did not mention is that this type of dialogue also takes the child to new levels of language usage, because new terms are learned as well as
new ways of expressing both old and new ideas. For this dialogue to be most helpful to the child, however, the child's partner must be only slightly ahead; too great a gap and the child will be unable to assimilate the new information.

Language is a sequential matter, and rules have been devised for its proper use. Many of these rules fall under the rubric of syntax, by which we mean acceptable ways of stringing language together. There is not complete correspondence between syntax and meaning, for it is possible to frame a sentence that is not syntactical but whose meaning is perfectly clear. On the other hand, a relationship does exist. Using better syntax may improve the clarity or precision of a message, whereas excessive violations of syntax may obscure the meaning or even render the sentence meaningless.

Gujarati is a complex language with a variety of correct ways of using syntax (and even more incorrect ways) in order to achieve the same meaning. Children learn these infinite variations only gradually. (Athey, 1972)⁴, and many of them are never learned at all. Moreover, there are sometimes subtle differences in meaning between so-called equivalent sentences, for instance between the active version of a sentence and its passive counterpart.
"John hit Mary" implies a deliberate action on the part of John, whereas "Mary was hit by John" suggests that the hitting may have been accidental, that the event "happened", so to speak, to both of them. It is not clear at what developmental level children begin to make these distinctions and to sort out all the complications of the language. Nor do we know at what point they make generalizations from a single instance to a class of similarly structured sentences. The alert teacher should be aware of these subtleties and take advantage of every occasion that arises to point them out to students.

Semantics is that part of language that has to do with meaning. Meaning, in the context of young children's acquisition of language, has already been discussed. Meaning in the context of schema theory is another important aspect of semantics.

Two things are noteworthy about schemas. First, they are heavily dependent on prior experience. We could not develop this scenario unless we had a great deal of experience with the event. Second, on the basis of our experience, we are able to make a great many inferences, many of them almost unconsciously.
The ability to make inferences is learned through experience and, more especially, through dialogue. If a two-year-old runs after a bird, and the bird flies away, it is fairly easy after a few tries to make an inductive generalization without assistance from adults. Depending on the age of the child, the adult's role is to verify, to articulate, and to expand on what the child is thinking.

The parental role in child-adult interaction has been shown to be extremely important. What is significant is not so much the amount parents talk to their children, but the quality of their talk. Effective parents confirm or disprove the child's utterances, they explain and comment on the scene, and they expand the conversation rather than restrict it. This parental role should also be the role of every teacher of young children. Parents and teachers who exhibit this quality are not only teaching children how to talk, they are teaching them how to think.

Drawing inferences becomes particularly salient when the child begins to read. One reason for this is to be found in the study of pragmatics, which examines the context in which language is transmitted and understood. In oral language, comprehension relies heavily on the immediate context in which the statement is made. Domestic animals and prelinguistic children rely entirely on
context in order to extract meaning. If we throw a stick and yell, "Fetch," at the same time pointing our arm in the direction of the stick, it doesn't take a particularly astute dog to figure out our intent. Similarly, young children, who are vulnerable to the moods of their parents, become very adept at reading nonverbal cues. As the language system develops, children become less dependent on contextual cues, though even as adults we continue to rely heavily on them in oral discourse.

Reading is at the other end of the spectrum from oral discourse. It is removed from the concrete environment and placed in a world of its own. The beginning reader is not only coping with an unfamiliar code, but is also trying to extract meaning without the usual contextual clues from the environment.

Decoding is another essential aspect of language. The underlying importance of the decoding process is apparent to anyone who has tried reading print that is too small or a ditto sheet is too faint. All the hypotheses and expectations in the world do not help if the words can't be made out. On the other hand, reading theorists who are aware of the complexity of the reading process have reacted against the overemphasis
on, decoding that has characterized much of our reading instruction. Children must learn to decode letters and words, but the learning should take place in contexts that have meaning for them.

Although many of our teaching strategies are geared to teaching at the level of the letter or word, the typical reading task involves the integration of the meanings expressed in separate sentences with one another to form a meaningful overall message. In recent years, researchers have begun to focus on properties of text that make for cohesiveness (Halliday and Hasan, 1976) and on the processes required of the reader to maintain continuity of meaning. One such process, known as anaphoric reference, refers to those forms that are used to refer back to something previously mentioned in the text. Studies have shown that elementary children are not in full control of these anaphoric relationships (Moberly, 1978).

2.2.2 Developmental "Tools" for the Young Child:

So far, the discussion has shown that the young child approaching reading for the first time comes well-equipped with developmental tools to lighten
the task. Readers should not be misled, however, into thinking there is a very clear, formal beginning to reading, for which the child has been preparing during the preschool years. Early reading and writing should be no more formal than early speaking. They should be introduced without fanfare when and as the occasion demands.

By first grade, the child should bring to reading not only a wealth of experience, informal training in reasoning, an extensive grasp of the language and its uses, but also familiarity with books and writing implements as communication tools. Some decoding skills will have been acquired informally through parental guidance, so that the child already has the idea that a code is involved. When the circumstances are propitious, the child also understands some of the practical uses of reading and writing. Most important of all, young children have the intrinsic motivation to learn. The teacher does not have to spend time thinking up ways to motivate these children, but ways to capitalize on their boundless enthusiasm and to direct it into constructive learning channels.

Linguistically speaking, in addition to some decoding skills, the child has a full-blown syntactic system
consisting of the basic syntactic forms, though some of the more intricate forms will not be mastered until much later. Vocabulary is extensive and concepts are well developed. The child has developed a large network of schemas through varied experiences, and has learned to make inferences. It is also possible that the young child has some acquaintance with the understanding of nonliteral uses of language such as metaphor.

For the child who has had a normally caring family and a wealth of opportunities for learning, reading should not present a formidable obstacle. It should be an activity as natural as play or as its linguistic counterparts, speaking and listening.

2.2.3 Changes in Language Factors with Age

According to Piaget language and thought have their roots in a common origin, the symbolic process. Thereafter, he seems to feel, language and thought develop into two separate, but related, systems. The implication of this separation is tied to the receptive-productive dichotomy introduced in the opening section. It means that at any given time in the child's development, language may outstrip thought, or thought may outstrip language. We have clear evidence that this is the case.
Psycholinguists who study language development in the young child usually use performance tasks to measure young children's understanding of verbal requests, because the inability to articulate masks their ability to understand what is required of them. Even some highly intelligent adults seem to be quite inarticulate when it comes to expressing their ideas. On the other hand, school instruction relies so heavily on the verbal mode that a few simple probes disclose that children's understanding of subject material frequently lags far behind their ability to read or reproduce it. Adults also use terms that they do not fully understand, as newspaper and magazine editors sometimes delight in pointing out. It is incumbent on teachers to keep in mind the close relationship of language and thought and to constantly ensure that one does not surpass the other to an undue degree.

Piaget suggests that with the advent of concrete operations around the age of school entry, the child becomes capable of certain mental operations that were not formerly possible. The most important of these is conservation and its reciprocal operation, reversibility. Teachers are familiar with the much-cited experiments on conservation using balls of clay or beakers of water,
but the property of conservation has much wider applications than those pertaining to these simple objects. It refers to time and space and to other concepts that we have identified as critical to logical thinking.

At this stage the child is ready to understand the "conservation" of language - that the same thing may be said in many ways, or that one may preserve meaning while changing the order of words in a sentence. Such insights are the early forerunners of metalinguistic awareness, which begins to appear in the elementary years. Metalinguistic awareness means that the child not only uses language appropriately - he or she has been able to do that since the age of two - but also understands the functions and forms of language, and can be objective about his or her own and others' use of language.  

As previously noted, human beings are inherently wired to make sense of their world and to impose structure on it, sometimes at the expense of perception matching reality. Children strive to make sense of all their experience, including their experiences with reading. We should not be surprised, therefore, to find that beginning readers look for meaning, even at the expense
of distorting what is on the printed page. We should be pleased that this is the case, for it means that reading is not seen by them as an unintelligible, even bewildering, task.

However, children cannot go on indefinitely ignoring what is on the page before them. Reality intrudes in the shape of the teacher insisting on decoding skills being used to produce a literal rendition of the text. At this point we find, disconcertingly, that the child seems to abandon the quest for meaning and to make all kinds of errors that are nonsensical in the context of the sentence or passage. Again, we should not be unduly alarmed by this development, which, with patience and guidance, will pass. Before the components of a skill become integrated into a smooth performance, it is normal for the learner to focus on one component and forget about the others. Decoding is difficult. It involves many fine visual discriminations and subsequent integration of the discriminated letters into words. It is no wonder that children experience initial difficulty with the lexical code and temporarily forget all about meaning. As reading becomes more fluent and automatic, children impose their own monitoring system on what they are reading and correct their errors to ensure
that meaning is preserved. There is some evidence that this monitoring can be taught, or at least induced, in children (Raphael and Tierney, 1981).

2.3 Piaget's Model of Cognitive Thinking

It is now recognized that the cognitive stage of development for each child must also be considered a factor in his or her ability to achieve intellectual mastery. The four periods that comprise the course of cognitive development are:

1. the sensorimotor period,
2. the pre-operational period;
3. the period of concrete operations, and
4. the period of formal operations.

The first of these, the sensorimotor period, occurs during infancy, followed by the pre-operational period, which usually lasts until around the age of seven.

Children entering school around the age of five or six or seven are moving from the pre-operational stage of intellectual development to concrete stage. Moving from one stage to another is not an "all or none" procedure; and a manifestation of whether or not a child
has reached the age of concrete operations is the ability to 'conserve', that is, the ability to realize that an object maintains its identity even after it has been subject to certain clearly visible transformations.

Observing children in initial grades of primary schools, the investigator herself noted that some children who were having difficulty in reading were also having difficulty with the property of conservation. So she formulated the hypothesis that some children between 5 to 7 years of age have reading difficulty because they are pre-operational in their intellectual development and the characteristics of the pre-operational stage interfere with their ability to read.

2.3.1 Characteristics that hamper Reading

What characteristics hamper the pre-operational child from developing necessary reading skills?

The egocentric pre-operational child is unable to achieve the tasks of centration, conservation, class inclusion and seeing states in transformation. Piaget cites the example given in his book, Origins of Intelligence in Children.
"In the supplementary reading programme only sixteen children could conserve mass. When the ball was made into a snake they responded that there was more clay in the snake than in the ball because the snake was longer."\(^{10}\)

This tendency of the pre-operational child to focus on a specific part of a stimulus is called centration. A child at the pre-operational level will attend to isolated parts of complex situations while an older child will see the stimulus as an integrated whole with multiple parts.

2.3.2 A Problem of Reading Readiness

This is the only characteristic cited here, the others may be cited at the appropriate place but this characteristic raises the question of reading readiness among the children of pre-operational period.

A great deal of writing has been devoted to the concept of reading readiness, and numerous reading readiness programmes are carried out in nursery schools and Bal Mandirs, yet the possibility that children may be pushed into reading activities for which they are not intellectually reading exists. Asking a child to learn letters of the alphabet or whole words may be beyond his intellectual level of functioning.
Then, at what age is a child capable of learning to read? At what age should a child be taught to read? Educational administrators and theorists have been expressing their views on these questions for a long time. Since many decades two opinions are held:

- that young children are not ocularly equipped for the task of learning to read, and that they are also not mentally equipped have been frequently reiterated.

Patrick's views concerning mental readiness for reading are more significant. Thus he was the first man to use the term "readiness" in this context:

"It is a well known fact that child's powers, whether physical or mental, ripen in a certain time in the life of the infant when the motor mechanism of the legs ripens, before which the child cannot be taught to walk, while after that time he cannot be kept from walking. Again, at the age of seven, there is a mental readiness for somethings and an unreadiness for others."^[1]

The existence of early readers suggests a question about whether the customary age of beginning reading is later than it needs to be. Six years is believed to be the earliest age when most children have sufficient
"readiness" to read. In Russia the instruction begins at the age of seven years. If some children learn at four or five years, however, it does not prove that the schools are too late.

2.3.3 Cognitive Development - Onset of Conservation

It is now recognized that the cognitive stage of development for each child must also be considered a factor in his or her ability to achieve intellectual mastery. The four periods, mentioned earlier, that comprise the cognitive development decide as to when and to whom the reading instruction should begin.

Onset of conservation in children is the clear and assuring factor for beginning reading instruction. Shepherd, Renner and Bibens address themselves to this point when they state:

"Reading involves basically a set of abstract sounds represented by a series of abstract signs. The alphabet is an abstraction, a defined series, and to really understand it the child must be able to take the point of view of those who defined it. This may be asking too much of a child whose ego centrism is strong ..... according to empirical data upon which the Piagetian model is based, a pre-operational learner is not able to perform intellectual operations".
2.3.4 Theoretical Perspective

For Piaget the development of intelligence finds its deepest explanation in the structure of intelligence. But in so far as change in behaviour is more readily observable than an underlying structure, developmental observations have become the main method for Piaget to lay bare the structures of intelligent behaviour. What dreams were to Freud, the psycho-analyst, the developmental observations are to Piaget, the opistemologist.13

The following principles constitute major and important aspects of Piaget's theory.14

(1) The organism actively moulds the world of intellect.

While intellectual growth is depicted in Piaget's theory as a process of slow inward evolutionary unfolding, it is not to be construed as primarily a passive process. On the contrary, intellectual functioning is viewed as a particular manifestation of biological functioning, the intellect goes to work on the raw data of experience. Hence thinking is an organized activity which is manifested in certain characteristic ways of interaction with the environment. It is this continuous activity which brings about the growth of intelligence in accordance with
a pre-determined biological pattern, with the organism continuously participating in its own growth.

For Piaget, then thought is action interanalyzed. The very young child's intellectual functioning consists of sensory and motor adaptations to environmental events. It is, in fact, a process of assimilating experience through his mouth, eyes, ears and skin surfaces. Erikson has called this the period of taking in, of the "incorporative mode".

For Piaget represents the ascendance of assimilation over accommodation, the latter being the process by which the organism changes in order to absorb new experiences. The child's latter abilities to represent events symbolically through the processes of memory, imagination and conceptualisation are grounded in these early sensory perceptual and motor experiences.

(2) Learning takes place through adaptations of existing cognitive structures.

Intellectual growth occurs in response to three variables:

a. Maturation of the nervous system.

b. Experiences with physical reality, and

c. Interaction with the social milieu.
Assuming the first of these, transactions with the physical and social environment will be assimilated in so far as they can be fitted into the existing cognitive organization. In this process, however, the organization is changed, and thus becomes capable of a new level of assimilation at the next encounter. The tension created by the imbalance between assimilation and accommodation provides the motivating force for intellectual growth and expansion resulting in the attainment of new levels of equilibrium or understanding. The need to explore and learn initiates within the organism and becomes self-perpetuating, like R.W. White's drive for "competence".

(3) Intellectual development is continuous but results in qualitative differences

According to Piaget, operations such as negation, implications etc., are the ones that characterize adult thought. Operational thought, in exploring the possible as opposed to real, performs a number of logical steps such as combination, reversal, disjunction etc. On the propositional content and in addition can reason about its own processes. By contrast, the preoperational thought of the child is used to the world of physical objects, governed by perception rather than reason, and is unable
to comprehend such concepts as conservation or reversability, transitivity and classification.

The butterfly does not resemble the caterpillar from which it is evolved, although its development from one to other may be traced at every step. Adult logical thinking is qualitatively different from the sensory motor adaptations of the infant, or the pre-operational and concrete operational thought of older children, but it is founded on these earlier stages, and depends for its elaborateness of its functioning on the richness of its experiences at each stage along the route.

(4) Development is uneven both across and between stages

Piaget uses the term "horizontal" and "vertical" declages to conceptualize the observed phenomena of cognitive development.

Horizontal declage refers to the fact that, even when a level of thought is attained, it need not be uniformly applied in all areas. Hence a child may attain the concept of conservation but ordinarily this will be related to the conservation of mass before it is applied to weight or volume.
Vertical declage refers to the fact that a problem with similar content is approached at different stages with a completely different level of functioning. In the socio-emotional realm, Erikson has drawn attention to the different levels of approach at different ages to long problems such as maintaining a balance between trust and distrust, or establishing one's autonomy with respect to others. The difference in these levels is undoubtedly related to the development of cognitive functioning.

2.3.5 Cognitive Development: Operations and Structures

Piaget is now classified as a genetic epistemologist, since he is concerned with the nature of knowledge and the structures and processes by which it is acquired. This is in contrast to his not being a child psychologist in the practical sense concerned primarily with child growth and development. His main concern is to show that in all discussions of the development of knowledge, the roles of structures and experiences are not sufficient but must include also a mental logical structure called "equilibrations". Piaget argues that much of our knowledge comes not from within by the force of our own logic, a fact often forgotten in education. Piaget's work is crucial for educational philosophy as well as psychology.
Piaget discussed four basic factors that contribute to intellectual development. They are:

1. Psychological development.
2. Direct experiences with physical world.
3. Social transmission (communication, teaching etc.)
4. Equilibration or auto-regulation.

It is the last of these four factors that Piaget studies in depth, because it has been given little attention and is yet of fundamental importance. The first three factors involve the individual as passive receiver. As his psychological system matures, he is confronted with many experiences, he is presented with much information. But intellectual development is not passive, it involves acts or operations by the learner. These acts, or mental operations, on objects in the physical world involve revising partial understanding, broadening concepts, and relating one idea to other.
For example, the child is confronted with a problem involving two balls of clay of the same size. One ball is made into two smaller balls and a child is asked which will make the water in a glass rise higher, the large ball or the two smaller balls. The child answers that the two smaller balls will. Why? Because there is more. The experiment is conducted and the water is found to rise the same amount in both cases. Some children are unable to reconcile the apparent contradiction. Others are able to assimilate this new information and generalize a correct answer for similar experiments. Piaget would say that the second group has achieved a mental "equilibration" or equilibrium. Their mental processes have accommodated this new information, generalized it, and it is now a part of their mental structure.

For this equilibration to occur, the child must act or "operate" himself on objects. It is not sufficient to explain why if ideas are to become a part of his own mental structure.

Piaget would agree with Dewey that child must experience things for himself.

To know an object or event, according to Piaget, is not simply to look at it, or hear about it and make
a mental copy or image of it. Knowledge is not a copy of reality. To know an object, is to act on it, to modify it or transform it and, in the process, to understand that why the object is constructed. Such an act is called "operation". An operation is the essence of knowledge. It is an interiorized (mental action) that modifies the object.

The operation is never isolated. It is always linked to some other operations and is a part of a total structure. A letter does not exist in isolation when reading is encountered.

From the above discussion, it seems that Piaget argues that there is a functional relationship between a child's physical and mental actions and the development of a logical thought. He asserts that "actions" lead to the development of "operations", and operations in turn lead to the development of "structures".

It is necessary to know operations and structures in greater detail.

2.3.5.1 Operations

Operations are mental acts, such as various types of conservation. Operations, have four main characteristics:
(1) Operations are actions that are internalized; that is, operations can be carried out in thought as well as in action. Internalized actions begin to emerge around the age of two years, the end of the sensorimotor period, when the child becomes capable of internal representation.

(2) Operations are reversible. It has been shown earlier that speech and reading are the same operations carried out in opposite direction.

(3) The third characteristic of operation is that it always maintains some invariant although a transformation or change always occurs. In the process of addition pairs of numbers can be grouped in different ways (2+1, 1+2) but the sum remains invariant. Similarly, in all conservation problems quantities are conserved during change in irrelevant dimensions.

(4) The fourth characteristic of operation is that no single operation exists alone. An operation is always related to a structure or network of operations. For example, addition subtraction operation is related to the operations of classifying, ordering and conserving number. Each of this particular operations emerges in development at about the same time and has a common core of cognitive pre-requisites. Each operation is
necessary for the other operation to emerge fully.
An operation differs in specific ways from an action.

An action can be an isolated event, such as a child manipulating an object. Actions can lead to the development of physical and logical mathematical knowledge. Logical mathematical knowledge eventually results in operations. So operations are mental activities that are internalized, reversible, conserved, and integrated with higher organizations (structures) and other operations. Thus the child who discovers through manipulation of objects that a particular collection of stones always has ten stones, regardless of how the collection is arranged, has or is constructing a mathematical operation. These actions are the child's actions.

2.3.5.2 Structures

Structures (schemata) are the highest order mental organizations one step higher than operations. Like operations, structures have certain characteristics. A structure is a totaling in that certain laws apply to all the parts of the structure. To quote Piaget:
The system of whole numbers is an example of a structure, since there are laws that apply to the series as such. Many different mathematical structures can be discovered in the series of whole numbers. One, for of associativity, commutativity, transitivity and closure for addition are all held within the series of whole numbers (Child's conception of numbers". p. 22)

The laws that govern a structure are also laws of transformation, so that in the case of addition of whole numbers a number can be transformed into another by adding something to it.

Also structures are self-regulating in the sense that one need not go outside the structure to find elements for transformation, and the result of the transformation stays within the system.

Structures are always related to other structures and that many structures are sub-structures of larger structures. For example, the structures of whole numbers is a part of the larger structure (all numbers), while includes fractional numbers, rational numbers, etc.

There are various types of structures which are as under :
(1) **Classification of Structure**:

An example of a structure is the classification structure. Elements of the classification structure emerge before the structure is complete. For example, children of 4 to 5 years of age can place objects into collections based on similar shape or colour characteristics. This is simple classification. Children of this age typically do not comprehend the inclusion principle, i.e. that a total class must be as big or bigger than one of its sub-classes. To quote Piaget:

"A child of this age will agree that all ducks are birds and that not all birds are ducks. But then, if he is asked whether out in the woods there are more birds or more ducks, he will say:

"I don't know! I have never counted them, it is the relationship of class inclusion that gives rise to the operational structure of classification. (Judgement and Reasoning). (pp. 27, 28).

Thus classification does not have characteristics of a structure before the inclusion principle is grasped.

(2) **Ordering or Seriation Structure**:

Similar is development to the classification structure is the ordering or seriation structure, which children
typically develop around age seven. A child of 4 to 5 years is presented with a series of stick's varying in length by perceptually small differences. The child is asked to order the sticks. From the smallest to largest pre-operational children perform this task without any structural frame work.

Around the end of the pre-operational period, children typically manage with trial and error to arrange all the sticks in a series. Their approach is still not systematic. After age 7 or so children develop a systematic co-ordinated method, that reflects a completely developed seriation structure. They seek out and select the smallest stick (or they begin with the largest), then the next smallest, and so on. The arrangement is made without trial and error.

The relationship between a child's actions on objects and the child's mental or intellectual development is made clear by Piaget. Actions lead to the development of operations; mental operations lead to the development of mental structures.

Now, these details of the genesis of the formation of operations and structures would be classified in the stage theory propounded by Piaget.
2.4 Stages of Development: A Stage Theory

Piaget distinguishes four main stages in the development of these mental structures.

(1) Sensori-Motor Stages

The first is sensori-motor pre-verbal stage lasting approximately for the first two years of life.

(2) Pre-operational stage

The second stage is that of pre-operational representation. It marks the beginning of language in the form of words. Words are symbols of representation of reality. The word 'tree', for example, is not a tree but a symbolic representation of one. The child may be shown a picture of a bird and asked why it does not fly away. This use of symbols or "representation" marks the beginning of thought. At this stage there is a reconstruction or representation of experiences at the pre-operational or sensori-motor level. There are, as yet, however, no "operations".

In the sensori-motor stage the child is restricted to direct interaction with his environment, but in the pre-operational stage he begins to manipulate symbols
or representations of physical world in which he lives. The pre-operational period is often described as lasting from 2 to 7 years of age. However, this is only a rough guide.

(3) Concrete Operational Stage

The third stage is that of concrete operations, which is particularly important to the elementary school teacher because most of the time those children are in the elementary school, they are in this stage of development. For many mathematical ideas children reach the concrete operational stage at around 7 years of age. Some mathematical ideas, however, do not become operational or meaningful until 10 or 11 years of age and yet many teachers try to read these ideas earlier.

Piaget studied the concrete operational stage using the concept of conservation or invariance, which is a basic characteristic of this stage. For example, a child is shown two glasses containing the same amount of water.
The water in one glass is then poured into a taller glass with smaller diameter.

When the child understands that amount of water is still the same and rejects what perception tells him (one looks like more), he is using logic and has arrived at the concrete operational thought level for this concept. That the amount of water is conserved or remains invariant after the pouring operation is referred to as the concept of conservation of invariance. To arrive at this stage the child must realize that the process can be reversed that if the water is poured back into the original container, the amount should be the same. The psychological criterion for a reversible operation is that of conservation.

This is concept of operational stage because the child is obtaining ideas from operations on such concrete objects as water, clay etc. At the beginning on such concrete operational level the ideas of the child are still based on observation and experience with objects in the physical world, but he is beginning to generalize or break away from manipulation of objects as a way
of "knowing" when these generalizations are correct and complete the child is at the concrete operational level.

(4) **Formal Operational Level**

The last or fourth stage is the formal operation stage of the hypothetic deductive operational level. This does not usually occur until eleven or twelve years of age. The child now has reason of hypotheses or ideas rather than on needing objects in the physical world as a basis for his thinking. He constructs new operations, these of propositional logic, and he attains new mental structures. He is now able to consider all possibilities or combinations rather than these based only on experience of experiment. He begins to classify, order and enumerate in the verbal proposition form of deductive logic. He can operate with the form of an argument and ignore its empirical content. He can use the procedures of the logician or scientist - a hypothetic - deductive procedure that no longer seize his thoughts to existing reality. Piaget maintains that these logical mathematical structures produce thought rather than the reverse of thought producing logic.
2.5 Conservation or Invariance of Number

The idea of relation is important in the world of reality. It furnishes a basis of comparison of ideas in logic. Some of the comparison or relation of two quantities - 'the same as' or 'equal' or 'greater' than or 'less than' the 'same as' are the quantitative relations as constrained to the qualitative relations.

After considering the relations "greater than", "less than" and "equal" or "the same", the child is faced with the extent to which one set may be "greater" than another. To answer this question, counting is the usual procedure. This counting, as learned by the child may very well be a role activity. Before entering school his parents may have thought that their children knew counting. He has memorized a sequence of sounds - "one, two, three, four" - and therefore says that he can "count". However, if he is asked how many objects you hold in your hand, he may be guessing an answer. His counting is purely a role type learning. He has not yet learned to establish a one to one correspondence by matching number names to the objects being counted.

One-to-one correspondence or matching is fundamental to determining the number of a set and children need many readiness activities of a matching sort.
Such activities are appropriate at the concrete operational level. Children can see and handle objects. These activities in three dimensional space are followed by work-sheets or books in which there are pictures of sets and the children draw lines between pairs of objects in the two sets. This, of course, is moving toward the abstract since pictures are two dimensional representations of three dimensional objects.

After matching object to objects in pictures, children learn to match the number names or numeral objects.

1 2 3 4

They may then be shown several sets, each containing a different number of objects, and asked to write the number or objects below each set.

When they can place the number names in one-to-one correspondence with objects in a set and tell you, for example, in which of the above sets there are "four" objects, they are then beginning to count rationally. The teacher may think they then understand the idea of number four. However, the idea of number is so subtle that if he shows them another set of four objects arranged in some different fashion such as spread out more, thus,
the children say there is "more" in the spread out set. A child may if less than six and half to seven years of age "count" if asked the objects in each set and answer "four" in each case but still maintains that there is more in the spread out set. The spatial configuration of what he sees (perception) triumphs over the intellectual idea of the conservation of the number.

It is the conservation concept that he does not yet have and which is necessary for a real understanding of number. Number by its very nature is invariant. This the child does not understand.

The learning of the one-to-one correspondence number concepts is also a spontaneous process according to Piaget. It is largely independently and self determined. For example, a child of five or six may be "taught" to count objects laid out in a row but if the objects are rearranged in a more complex pattern such as a circle or zigzag, he can no longer count them. Thus the child counts:

□ O 0 Q

but may not be able to count.

○ ○ ○ or ○ ○ ○ or ○ ○ ○
However, usually at six and a half or even years of age, children can without being taught, determine the number of a set by matching its elements with those of another set. More important, the child knows the number of each set is the same regardless of the arrangement of the elements in the two sets. He has developed the concept of conservation or invariance of quantity which he must have to understand the concept of number. Conservation is a developmental process and not taught at any stage of development.

To understand number, the child must first develop its basic characteristic of invariance or conservation.

Piaget contends that conservation is a necessary condition for all rational (reasoning) activity. The teacher cannot accelerate to any great extent the development of conservation concept, but she can provide an environment for it to develop when the child is able. And when the conservation concept has developed in a child, counting based on one-to-one correspondence develops almost automatically since it is according to Piaget, a spontaneous process largely self determined rather than taught.

Recent development in Piaget's theory and work in American and other European countries demonstrated that
conservation can be induced. This aspect is inconclusive and contradictory to the thesis and research evidences showed by the Geneva School.

But before coming to the problems of conservation, the important factors affecting cognitive development would be briefly dealt with.

2.6 Factors Affecting Cognitive Development

There are four factors involved in the transition through these stages of development which are discussed below:

(1) Maturation Factor

The first of these factors, maturation of the nervous system, is commonly taught to be an internal process, but the various stages occur at different ages in different cultures and different countries.

(2) Experience Factor

With reference to the experience factor, there are two types of experience that are very different from a psychological stand point and very important from a pedagogical stand point. First there is a physical experience,
and second there is a logical experience. The act of weighing two objects to determine if they have the same weight would be a physical experience.

The logical mathematical experience in contrast comes not from the object or objects themselves but from the action of the learners on the objects. For example, a child under 7 is given a set of pebble and asked to place them in a row. He is asked to count them in one direction and then in the other. He then places the pebbles in a circle and counts them in one direction and then the other. He then tries another arrangement. He discovers that the sum is always the same and is independent of the order. He discovers a property of the action of ordering, not a property of pebbles. This is quite another form of experience and marks the beginning of mathematical deduction. The subsequent deduction is "interiorizing" the action carried out on the pebbles so that pebbles will no longer be necessary.

(3) Social Transmission Factor

The third factor that of social transmission or educational transmission, involves the imparting of knowledge by language. This factor is important, but only when the child has a "structure" that allows him
to understand the language being used. And it is at this point that a child often becomes lost, the teacher not realising that he does not yet have the necessary structure. The relation "brother of" or "sister of" may mean something different to the young child. For example: He sees the other children as 'his' brothers and sisters but does not see himself as a "brother of" the other children in the family. The reversibility of the "brother of" or "sister of" relation is not yet understood. The children can think in only one direction.

(4) **Equilibration Factor**

The fourth factor equilibration or self regulation, is fundamental one, according to Piaget. One form of equilibration is the co-ordination of the first three factors. But there is another form. The child having passed through the necessary stages of maturation is shown two balls of clay of the same size. With the verbal guidance of the teacher, the child is asked to flatten one ball and is then asked which is more, the flat piece of clay or the ball of clay. He is not sure and compensates for the action of flattening by restoring the flat clay to its original form. He sees that they are the same. It is this compensation type action or reversibility that leads him eventually to a stage of
equilibrium where he knows that transformations in shape do not change the amount. This process of equilibration is an active process involving a change in one direction being compensated for by a change in opposite direction. The term equilibration or self regulation is used in the sense that is used in cybernetics processes with feedback and feed forward, of possesses that regulate themselves by progressive compensation of systems, in sense like an electronic computer.

2.7 Conservation: Stages of Development

Piaget concluded from many experiences of children that there are three stages of development. The first is the absence of conservation. Children at this stage think that the quantity gets larger or smaller as its configuration or shape is changed. Many five and six years olds would say the first set at the top in the illustration contains "more" because it occupies more space or because beads at the extremities are further away.

The extent of this lack of understanding of conservation of numbers can also be demonstrated by having a 5 or 6 year old take beads from a pile with both hands,
placing one bead at a time in each of the two jars, a jar for each hand.

Even though he has placed a bead in jar for each bead placed, in jar B, he thinks is more in jar B. Even if the child can count and says there are, for example, 30 in each container, he still says these are more in B because the beads are higher in B.

The second stage of development in children involves a state of transition children are able to say when a line is poured from one to two containers that the quantity is still the same, but are overwhelmed by perception when more than two containers are used; thinking that the amount must have changed since it looks like more.

The third stage, that of conservation of quantity, is that at which the child realizes the conservation or invariance of wholes, that the number of a set of elements is not changed when the elements are rearranged in some manner. At this stage children also know that for a continuous set, such as a given amount of liquid,
if it is poured from one container into others that
the amount stays the same regardless of the number of
containers or size of containers, in which it is placed.
Logical thought rather than perception is the basis
for correct answer. It is the logic of identity. It is
the 'same' liquid regardless, as how its shape is trans­
formed. The unique and the pervading importance of
the conservation or invariance concept is that the most
elementary forms of reasoning, whether logical, arithmetical,
geometrical, or physical, rest on the principle of invariance
of quantities.

Thus, there are three stages of the development
of conservation which are as under:

i. No conservation - NC
ii. Semi-conservation - SC
iii. Complete conservation - CC

For measuring conservation in children Piaget
has developed some standard tasks which were known popularly
as Piagetian standard tasks. They are thirteen in number
which are described briefly in below.

2.8 Piagetian Tasks for Measuring Conservation

Piaget Battery: A set of 13 tasks was selected,
representing a wide range of concepts which according to Piaget's writing, and the studies by Lovell, Hyde, Goodnow and others, show a clear progression in stages of response between about 6 to 11 years.18

They were also chosen for clarity and for ease in evaluating the response without extensive 'clinical' enquiry: that is, they were given with sufficient questioning only to ensure that the subject had or had not grasped the concept. (Detailed questions are given in Vernon's "Environmental Handicaps and Intellectual Development", Birth.J.Edc.Psy. 35. 9-20, 117-126).

(1) **Time Concepts**: Including day after tomorrow, day and time in another town, why a watch has two hands.

(2) **Left and right**: Pointing to teacher's seating position and stating whether each of 3 objects is to the L or R of another.

(3) **Equidistant Counters**: Placing a number of green counters equidistant from the teacher's and the subject's red counters.

(4) **Logical Inclusion**: White and blue sugares and blue circle: several questions such as - Are there more circles or more blue things? Why?
(5) **Tilted Bottle:** A half filled bottle is seen upright, then half hidden in tilted or on its side. S drops the water surface on an outline picture.

(6) **Conservation of Liquid:** Water is poured from one of two-half-filled beakers into a tall glass or a flat dish which has more? Why?

(7) **Conservation of Plasticine:** Two equal balls S rolls into a so as age who has more? In addition one ball is flattened into a plate and S is asked, if both were dropped into the water beakers, what would happen to the level of water?

(8) **Insect Problem:** The tester draws an insect on top of a circle representing the edge of a jar. S is asked to draw what it would look like if it walked round the rim to the bottom.

(9) **Number Concept:** Cards are presented with the numbers 3, 2 and 5. What is biggest numbers you could make with these?

(10) **Conservation of Lengths:** Two equal-sized rods; does alteration of their relative position affect the length?

(11) **Dot Problem:** S is asked to make a dot in the same position on a sheet of paper as one drawn on the
(12) Shadow : 5 inserts the shadow on a drawing of a lamp and a man : scored for correctness of position, and length.

(13) Conservation of Area : Two fields (Green blotting paper) 2 cows and 12 horses (white blocks) : houses are scattered on one field, along the edge of the other which cow has more grass to eat, and why ?

2.9 Metalinguistic Ability - An Introduction

During the last decade there has been increasing theoretical interest in and empirical investigation of the relationship between metalinguistic abilities and learning to read (e.g. Downing & Valtin, 1979; Ehri, 1979; Ryan, 1980; Tunmer & Bowey, 1984). Although much progress has been made, especially in respect to the role of phonological awareness in learning to read, many questions remain. What are metalinguistic abilities, and where do they come from? Are metalinguistic abilities causally related to the acquisition of reading skills, or are they largely epiphenomeana of the reading
acquisition process? If metalinguistic abilities are causally related to learning to read, what role (or roles) does each of the different types of metalinguistic ability play in the acquisition of the competent skills of reading?

**What are metalinguistic abilities?**

Metalinguistic ability enables one to reflect on and manipulate the structural features of spoken language. Unlike normal language operations, which involve automatic processing, metalinguistic operations require control processing. Language users do not normally notice such things as the individual phonemes and words comprising an utterance, the grouping relationships between its constituent words, or whether the utterance is structurally ambiguous or synonymous with another utterance, unless they deliberately think about it; that is, unless they invoke control processing to reflect on the structural features of the utterance.

The relationship between normal language processing and metalinguistic operations is illustrated in Figure 7.5. This framework provides the basis for a definition of metalinguistic awareness as the ability to use control processing to perform mental operations on the products...
of the mental mechanisms involved in sentence comprehension. The framework also provides the basis for classifying the various manifestations of metalinguistic awareness into four broad categories: phonological, word, syntactic, and pragmatic awareness. Phonological awareness and word awareness refer to the ability to reflect on and manipulate the subunits of spoken language, the phonemes and words.

Syntactic awareness refers to the ability to perform mental operations on the output of the mechanism responsible for assigning intrasentential structural representations to groups of words.

Pragmatic awareness refers to the ability to perform mental operations on the output of the mechanism responsible for integrating individual propositions into larger sets of propositions through the application of both pragmatic rules and inferential rules. Thus, pragmatic awareness can be seen as awareness of the relationships that obtain between a given sentence and the context in which it is embedded, where context is defined broadly (prior text, prior knowledge, situational context, etc.).
Where do metalinguistic abilities come from?

Three explanations of the development of metalinguistic ability in children have appeared in the literature. The first is that metalinguistic ability develops concomitantly with the acquisition of spoken language and arises from error-detection mechanisms that monitor speech output. The second is that metalinguistic ability is a developmentally distinct kind of linguistic functioning, the potential for which develops separately from and later than basic speaking and listening skills and is related to a more general change in information-processing capability that occurs during middle childhood. The third is that metalinguistic ability develops after children begin formal schooling and is largely a consequence of learning to read.

On the basis of an earlier analysis of these views, we have concluded that the most supportable view is the second. Children with metalinguistic ability are able to separate a word from its referent, dissociate the meaning of a sentence from its form, and abstract themselves from the normal use of language to focus attention on intersentential relationships. In Piagetian terms, these metalinguistic performances require the
ability to decenter, to shift one's attention from message content to the properties of language used to convey content. An essential feature of both metalinguistic ability and concrete operational thought is the ability to control the course of one's thought, which suggests that both may be the reflection of a more general change in underlying cognitive capability, the development of metacognitive control over the information processing system.

Evidence in support of the second view of metalinguistic development comes from studies which show that middle childhood is the period during which the child develops a variety of metalinguistic abilities that are superficially dissimilar but significantly intercorrelated. This is despite the fact that each kind of metalinguistic performance requires component skills that are unique to the particular task designed to measure it. Further supporting evidence is provided by reports of positive relationships between these metalinguistic abilities and other kinds of tasks that also require metacognitive operations, such as nonverbal problem-solving tasks and Piagetian measures of operativity.
It should be noted that acceptance of the second view does not mean that some skills that are acquired or enhanced as a result of learning to read (such as the abilities to form and maintain a phonetic code in short-term memory and to generate orthographic images) do not greatly improve performance on certain kinds of metalinguistic tasks. Nor does the second view imply that high levels of metalinguistic ability emerge spontaneously in development. Rather, the second view proposes that during middle childhood, children develop the capacity for becoming metalinguistically aware when confronted with certain kinds of tasks, such as learning to read. Children may need first to reach a certain threshold level of cognitive development before they can perform the low level metalinguistic operations necessary to acquire basic reading skills, which in turn enable them to acquire the spinoff skills of reading that provide the basis for more advanced metalinguistic performances. This argument suggests that it is possible for children with little or no metalinguistic ability at school entry to learn to read normally, provided that they possess the level of cognitive ability necessary for acquiring the requisite metalinguistic skills. In support of these suggestions are several studies showing that Piagetian measures of operativity predict reading success during the initial stages of learning to read.
References:


7. Ibid.


10. Ibid., p. 23.


