Chapter I

Introduction

Reasoning ability is a unique power of human beings that leads them to the higher level of intellectual functioning. No-doubt, every species is intelligent in the sense that they are adopted to their environment well enough to survive and reproduce. Piaget called this ability practical or material intelligence, while human beings are capable of reflective intelligence i.e. they can think about or reflect upon their own experiences, thoughts, and can use reasons. Thus reasoning is a semantic process based on mental models. In other words, people are able to maintain models of only limited number of alternative states of affairs and they accordingly use models representing as much as information possible in an implicit way. In this way this cognitive ability is an active organizer of information.

Since a few decades ago Piaget and other cognitive-developmental scientists became curious to study that how the nature of cognitive organization changes as people develop through a series of stages.
Earlier in 1910s and 1920s Watson and other behaviorists believed that all infants are "blank slates" at birth and that how they behave as they grow up depends mostly on what they have learned. They assumed that human nature is neither good or bad. People are reactive and they simply react and respond to their environment. Since cognitive scientists such as Piaget believed that mind is not a "blank slate" on which knowledge can be written nor a "mirror" that reflects what he perceives. People are active agents who construct their own understanding of the world. By acting on the world, individuals learn both about it and about their own actions. In this way they adapt their knowledge to the world. Actions in this sense are voluntary behaviors, including not only bodily movements but also talking, listening and thinking.

In the course of acting upon things, an individual transforms both the things he acts upon and himself taking note of these transformations he abstracts from them i.e. he identifies a common element in several transformations and uses it to build a new action that is more mature and more complex (Nelson, 1974; Piaget
1983). He abstracts as he develops is called a scheme.

A scheme is the cognitive structure that underlies an action or thought. Thus schemes are ways of processing information and they change as we grow. Thus the process of adaptive nature of knowing involves the process of assimilation and accommodation. Intellectual assimilation is the process of extracting from the environment which is needed for developing and maintaining schemes. Assimilation accounts for the child's ability to act on and understand something new in terms of what is already familiar (i.e. his available schemes). When people apply a scheme to a situation they assimilate the situation to a scheme. When they adjust that scheme, they accommodate the scheme to the situation. Schemes thereby, become better and better adopted to the person's world. In this way human beings gain intelligence by adjusting their schemes to accommodate new information, but at the same time they assimilate this learning into the mind's structure. For example on seeing a new object for the first time we try to fit it into what we know. If it does not fit in our
existing concepts (i.e. if unable to assimilate it), we may have to change our concepts or form a new concept (i.e. accommodation).

Mind always tries to find a "balance" between assimilation and accommodation to eliminate inconsistencies or gaps between reality and its picture of reality. This process is called equilibration. Thus equilibration moves development from simple to more complex scheme through the dual action of assimilation and accommodation.

Stages of Mental Development:

As human beings develop they use more complex schemes to organize information to understand the entire world and to build their own realities. Piaget divided intellectual development in four discrete and qualitatively different periods (Piaget 1952; 1983). The first period termed as sensorimotor period (from birth till about 2 years of age) when infants use comparatively few schemes many of which involve actions such as looking, grasping and mouthing. This period is, therefore, called sensorimotor because infant's intelligence relies on the senses and on bodily motion
for equilibration. Thus they build their intelligence by elaborating and modifying these schemes in the process of adaptation (Piaget, 1962). One particular form of adaptation is the circular response by which infants discover their bodies and use them to change the environment. Infants acquire a number of fundamental intellectual abilities during the first 2 years. These include concepts about the uses of similar objects, imitation (Garvey, 1977) and understanding of object permanence (i.e. the realization that an object exists independently of an individual's own perception of it) (Piaget, 1952), memory (Cohen and Gelber 1975) and symbolic representation (Mandler, 1983). Infants proceed through several stages in their play with objects from simple exploration to complex imitating and pretending behavior. In the final stages of objects play, infants demonstrate memory ability and show an understanding of social relationship and the appropriate use of objects.

The second period of cognitive development is the preoperational period which lasts from about ages 2 to 7 years and is divided into two parts (i) The preconceptual stage (from age 2 to about age 4) and the
intuitive or transitional stage (from about age 5 to 7). The preconceptual stage is highlighted by the increasing use of symbols, symbolic play and language. In the sensorimotor period thought was limited to the child's immediate environment but now the use of symbols and symbolic play mark the child's ability to think about something not immediately present.

As Elder and Pederson (1978) found that the youngest children (2 1/2 years old) needed props similar to the real thing for their pretending games. But the 3 1/2 years old were not in need of props for their pretending games. In this way once the children begin to use symbols, their thought processes became more complex (Piaget, 1950; 1951). They show that they perceive the similarity between two objects or two events by giving them the same name. They become aware of the past and form expectations for the future. Thus they distinguish between themselves and the person they are addressing. While Fein (1981) suggests that symbolic play helps children to become more sensitive to the feelings and points of view of others and also help them to understand that how an object can change in shape or
form and still be the same object.

However, at this age they are unable to distinguish between mental, physical and social reality. Due to children's ego centricity, they are unable to separate clearly the reality of personal existence and power from every thing else. (Piaget, 1954; Brawn, 1965). While Flavell et al. (1978) found the beginnings of non egocentric thought in young children's ability to hide toys from the sight of the experimenter. Whereas children in Piaget's study (1954) were unable to imagine the doll's view of the plastic model of a mountain range, but children in Flavell's study were partly able to imagine the researcher's perspective, so egocentrism is not absolute, thus these findings emphasized that when the motives and actions of people are clear to them, children have no trouble taking another's point of view.

But in the intuitive or transitional stage children begin to separate mental from physical reality and to understand mechanical causation. For example before this stage of development children may think that everything was created by their parents or some other
adult. Now they begin to grasp the force of other powers. Further Piaget (1968) reported that at this stage intuitive children by using "logic of functions" develop the ability to make one to one correspondences. They begin to understand multiple points of view and relational concepts although in an inconsistent and incomplete ways. Their comprehension of arrangements by size, numbers, and spatial classification is incomplete. As they are unable to deal with part-whole relationship. They are unable to perform many basic mental operations.

However, contrary to the above view the findings of Gelman (1979) suggest that children of 5 years are able to perform many other cognitive tasks such as counting, classifying, see cause and effect relationship and use rules to solve problems at least in rudimentary form.

The third period of Cognitive development is termed as concrete-operational period which ranges from 6 to 7 years to early adolescence. Children’s thinking begin to be reversible and flexible and considerably more complex (Flavell, 1963). Now children begin to make the connections and perform mental tasks necessary for a
more realistic and logical perception of the physical world. These mental tasks are called concrete operations. Inhalder and Piaget (1964) reported that at this time, children became able to think logically about familiar concrete things. In other words concrete operational children can theorize about the world but now they are unable to develop theories about abstract concepts, thoughts or relationships until they reach adolescence. Only in the fourth stage of cognitive development i.e. formal-operational period which range from early adolescence through adulthood people can think logically about the hypothetical ideas. This new intellectual processing is abstract, speculative and free of the immediate environment and circumstances. It involves thinking about possibilities of comparing reality with what might be and what could never occur.

The general ability to think abstractly first appears at the age of 10 to 12 years. Neo-PIagetian believed that this ability does not emerge full blown at 10 to 12 years of age but develops through at least two cognitive levels, one at 10 to 12 years and another at 14 to 16 years (Ariu 1975; Biggs and Collis 1982; Kenny
In building single abstraction, a person grasps an intangible characteristic of a broad category of objects, events or people. By using this ability, adolescents can rise to new intellectual heights using concepts that unite many concrete things by means of a single general idea.

In developing a single abstraction according to Biggs and Collis (1982) one begins with at least two concrete instances that embody the abstract concept and compares them. Thus from the comparison the person begins to extract the concept. This development is shown by the way in which the understanding of particular types of conservation leads to the general abstraction of conservation of quantity. For example, a concrete understanding of conservation of liquid requires a child to co-ordinate the height of the water in a container with the width of the container to form the idea that the total amount of water does not change. But this concrete scheme by itself does not require a child to understand the general concept of conservation. The child knows merely that the amount of water stays the same in this type of task. Thus to form the abstract
idea of conservation, the adolescents combine their understandings of two or more specific kinds of conservation, such as conservation of amount of liquid and conservation of substance when a clay ball is flattened and reshaped. In this way the comparison between these two specific conservations allows them to abstract a general concept of conservation. Fischer et al. (1983); Pinard (1981) reported that sometimes person may even over generalize this concept of inferring conservation when there is none. For instance the volume of gas such as air does not stay the same when the gas is transferred to a new container of a different size.

The ability to combine a number of concrete instances, holding them all in mind at once, is what allows the adolescents to construct abstractions. This process is further illustrated by the way children solve simple while adolescents solve complex verbal analogies (Lunzer, 1965). As Keating (1980) reported that adolescents show growing inclination to treat everything as a mere variation on what could be.

Another cognitive ability acquired in adolescence is thinking about thinking. They also become extremely
introspective and self absorbed. At the same time, they begin to challenge everything by rejecting old boundaries and categories. In doing so, they become more creative thinkers (Keating, 1980).

Formal operational thought has been considered as a "second order" process. Because first order of thinking is discovering and circulating relationships between objects. Hence, second order involves thinking about one's thoughts, looking for relationships between relationships fluidly maneuvering between reality and possibility (Inhalder and Piaget, 1958). Gallaher (1973) reported the three characteristics of adolescent's thought as (i) the capacity to combine all variables and find a solution to a problem (ii) the ability to conjecture the effect of one variable on another and (iii) the facility to combine and separate variables in a hypothetical deductive fashion.

Thus Piaget's stages of cognitive development clearly illustrate one thing that the type of thinking characteristic of each cognitive period never simply disappears when a higher period is reached. In each period a person's ways of thinking not only develop from
but include those of the preceding period. In other words the periods form a hierarchy, in which each new type of intelligence is built upon and incorporates the type before it. (Figure I) An adult may, therefore, use any of four types of intelligence, depending on what he happens to be doing at the moment.

Although most cognitive developmental researchers agree that the course of development shows some kind of cognitive hierarchy, they disagree about the nature of stages of the development and the processes by which a person moves through them (Flavell, 1982; Sternberg, 1984). Thus in Piaget's theory dramatic and qualitative shifts in thought patterns are not shared by all developmental theorists. As Daniel Keating (1976) Commented that the lines drawn between childhood, adolescent and adult thinking are artificial. In his view cognitive development is a more continuous process than as reported by Piaget and suggests that children may have formal operational abilities in some latent form. For example, although few children have the ability to handle abstract thought, he asserts that some
infact do have this ability instead of new cognitive equipment are responsible for the appearance of these abilities in adolescents.

It is generally accepted that not all individuals are able to think in formal operational terms furthermore, adolescents and adults who attain this level do not always maintain it consistently (Flavell, 1971; Ford, 1979). As it is observed in day to day life that many people who find themselves facing unfamiliar problems in unfamiliar situations are apt to fall back on a much more concrete type of reasoning. A certain level of intelligence seems to be necessary for the development of formal operational thought.

Delisi and standt (1980), Neimark (1975) reported on the basis of their findings that the performance of college students typically reflects at least two stages—formal operations in the students special interests, such as their major and concrete operations in the other areas.

However, Piaget (1941) acknowledged the existence of some unevenness in performance of adolescent and called it decalage. He agreed that environmental factors
contribute to the unevenness but could not explain that how environment produces unevenness in the cognitive development while Bruner (1973)- a pioneer and father of Neo-Piagetian theory emphasized- the dominating role of environment in the development of cognitive abilities.

Further, Neo-Piagetian theorists criticized Piaget for his belief that schemes are highly general abilities, whereas Neo-Piagetian theorists emphasized schemes are abilities specific to the context in which they are learned (Feldman, 1980; Bruner, 1973; Fisher, 1983; Siegler 1981; Biggs and collis, 1982; cole et al. 1983) resulting in unevenness which is so common in cognitive development. For an ability to become general, the person must learn how to apply it in a range of different contexts.

A major criticism of Piaget's theory has been that it does not clearly explain the transitions between periods. It does not state specifically how sensorimotor thought becomes pre-operational thought or how pre-operational thought becomes operational thought. Miller (1983) stated that Piaget did not describe precisely that how transitions take place within periods
except for the sensorimotor period.

There are numerous studies which have emphasized that there exists a relation between physical and cognitive development. As Epstein (1974) observed that whenever children enter one of Piaget's periods, their brains show unusually rapid growth, much more rapid than when they are within a period. A number of longitudinal studies also corroborate Epstein's findings that children seemed to show spurts in head growth at the approximate ages for the beginnings of the concrete operational period, the formal operational period and the second level of formal operations.

Further Epstein (1980) strengthened his views while using another measure of brain growth. The brain normally emits electrical waves, which are measured by the electroencephalogram (EEG) and these waves are affected by cognitive abilities such as thinking and problem solving. Some of the waves also show systematic development with age. He found that spurts did occur at approximately the same ages.

The studies of brain development and performance on standard infant tests conducted by Kagan (1982);
Harris (1983); and McCall (1983) suggested that an infant's individual Sensorimotor abilities actually develop through four levels i.e. (i) Single actions (ii) relations of actions (iii) systems of actions and (iv) Single representation. Earlier Emde et al. (1976) and Dreyfus- Brisa (1979) also reported that the brain shows major changes at each level of cognitive development.

There are numerous longitudinal studies which indicated that with age, there is a gradual decline in cognitive abilities. There are certain areas of intelligence which appear either increase or decrease during middle age. The first broad area of intellectual functioning is called fluid intelligence. It is based mainly on the speed and effectiveness of neurological and physiological factors. This includes such abilities as motorspeed, induction, memory and figural relations. These abilities are related to various intellectual activities including the areas of perceiving, recognizing and cognitively dealing with new information (Hora, 1970; Neugarten, 1976). Knox (1977) and Neugarten (1976) reported that fluid intelligence seems to increase until late adolescence and then declines
gradually throughout adulthood. By the end of middle of age, however, it has only been declined to the point that it occupied in mid-adolescence which is still quite high.

The second area of intellectual functioning is called crystallized intelligence. It reflects the ability to process and record the kind of information that people acquire through formal education and through daily contact with their culture. It includes such elements as verbal reasoning, vocabulary, comprehension, and aspects of spatial perception. Such type of intelligence increases over the life span as long as people are alert and capable of taking in and recording information (Neugarten, 1976) Earlier Dennis (1966) also observed that when people were tested longitudinally for skills involving the use of this kind of intelligence, they scored higher in their fifties than they did in their twenties. This is the reason for the scholars and scientists to be more productive in their forties, fifties and even their seventies because of their a great deal of accumulated knowledge and experience than in their twenties.
Thus in terms of overall intelligence, people in their forties and fifties tend to compensate for any decline in fluid intelligence by the increase in crystallized intelligence. As Knox (1977) puts it, they "substitute wisdom for brilliance". However, Botwinick (1977) reported that most adults in their forties and fifties have the same general learning ability that they had earlier, except in skills that involves speed. The losses in speed and memory beginning in the late middle age are frequently offset by gains in reasoning and understanding.

Horn and Donaldson (1976) have shown that many intellectual abilities decline to some degree in old age. Baltes and Schai (1976) stress that it is wrong to hold a stereotyped view of intellectual decline. However, a slight decline in short term memory (Fozard 1980) and a lessening of the ability to solve problems (Giambra & Aranberg 1980) were observed. Some of the lower IQ tests scores of the aged may be due to reduced physical and mental activity.
In this way both biological and environmental factors play a dominating role in modulating the process of cognitive development.

With this preliminary knowledge about cognitive development we may now pass on to the next Chapter dealing with Historical Resume.