Chapter 1

Introduction

In our today’s fast-paced and competitive life, it is generally assumed that everyone experiences problems of varied nature and/or difficulty during the lifespan. From a cognitive psychological perspective, a problem involves a state where no obvious, standard or usual means of attaining a goal are present. Some problems are easier and so can be solved quickly - without much effort. While others are tricky one and we are not able to solve them as quickly as easier ones. Problems may differ on the basis of their nature also. Few problems are emotionally toned such as a quarrel between husband-wife, while others are less emotional, but may involve emotions (e.g. Anxiety) in certain conditions (e.g. Arithmetic problems). Problem solving studies mainly focus on less emotional problems, but it is considered that the ways or strategies we use to solve both emotional and non-emotional problems are similar.

Broadly, problem solving carries the meaning of a goal with some barriers/constraints. Sometimes the barriers are so strong that each avert or at least seriously interfere with success. From the cognitive psychology perspective, the process under which we employ mental strategies to crack problems is known as problem solving. Many ways of solving a problem are possible. Trial-and-Error method that was observed by Thorndike is among them. Solving the problem with this method is a ‘hit-or-miss’ approach in which one tries one solution after another until one finds the correct answer. Some people solve problems by trial and error method, while others come to solve at a sudden, i.e. some ‘insight or pop-up’ have directed them to crack the problems. Famous Gestalt psychologist, Kohler referred to this sudden/abrupt awareness of a solution to a problem as ‘insight’. Cognitive psychologists support a different viewpoint and they propose that insightful solutions are consequences of reforming a problem in such a manner that the basic elements of the problem rejoin together abruptly to solve the problem. This reforming may occur when an individual perceives the problem in a different manner/way, sees novel information, or differentiates those associations of the problem that were earlier not detected by him.

A device or implement, especially one held in the hand, used to execute a particular function, is a tool. It is a physical item that is used in the accomplishment of a goal; especially
this process the item is not absorbed. When the term 'tool' is used, we have to keep in mind the physical implements and artifacts which were used in bringing modifications into objects available in our environment. This suggests that tool has not one but several other meanings, for example, the tool itself, the function that can be performed by the tool and the potential role of an item in completing user’s objective. The way animals and humans both learn to represent the tool and its function may give us interesting inside knowledge about how a tool is being used. Tools are mediator of our interaction with the surrounding world.

Looking from research perspective, every animal and hominid activity which was related to tools can be used in differentiation of those species and modern era human. Although this kind of status has not been especially in fashion for about last hundred years, yet many researchers in their work on the tools laid stress on that, as use of tool may be found across other species also. It means that it is not the sole turf of human race any more. Hence the statement “man is a tool using animal” can’t be taken as the determining unique feature of mankind. There is one argument that humans’ tool use is outstandingly different, from the animals' tool use, or that such difference pinpoint in direction of elemental and essential difference between human and animal. So that, we need to be discussing how the use of tool is different in humans and animals. The type of engagement is appropriate for the tool user, for the effect of seamless intervention of activities and for the gain of ideal level of performance, which would look like being the requisite criteria while considering the tool use and to talk about some important features of these kinds of engagement.

Tools look as a fundamental factor of our lives which makes it impossible to imagine the world around us without them. A tool is anything handheld implement that may be used in execution of a task, just like a knife, a hammer or a spoon, pointing at any kind of support which may be taken to help in execution of a task. A tool is just like an element of what according to McCullough (1996), applied intelligence, for example, technology which allows one to expand over the limited collection of cognitive and manual skills which are in possession (Baber, 2003). There is a firm feeling that the growth of skills sets a tool apart from other technology and machinery. Both of the definitions for the word 'TOOL' shared a notion of objects in the environment which help us in doing things.
Thus, the tool is a physical entity, a gadget which may be used to create an item or accomplish a task, but not consumed in that process. A tool is somewhat that requires significance through the function that may be used to perform or maintain. Overall, tools are physical articles that user manipulates in such a way as to both affect changes in some features of the surroundings and also to represent an addition of the user himself. The influence is different and aimed at a specific purpose or goal, or the linked activities for coordination and control.

When being used, tools are extensions of the hands like a part of user's body or almost as an attachment, and this way is no more staying as a part of the user's surroundings. Except at times it is not in use, the tools are only a separate article of the environment, portable and graspable, to be sure, but yet external to the viewer (Gibson, 1979). It is the belief of the anthropologists that use of the tools was a crucial step into mankind's evolution. Humans (primates) evolved an opposable thumb which is useful in handling tools and increased dramatically in intelligence. The most significant advancement in the history of humans was development and use of the tool. The early tools were made up of sticks and unmodified stones. The hand axe is one of the earliest distinguishable tools. The most crucial items that ancient human used to climb to top of food chain were and are tools. With the invention of tools, humans were able to complete task that human's body alone could not, such as using bow and arrow or spear. In the past record of technology, invention of techniques and tools is a major part or step. Tools allowed hominids to conquer their environment, to build, to hunt and to execute significant task that made life easy. Stone was used to make the first tool. Thus, Stone Age would be the period of history used as reference by the historians.

Long before the emergence of Homo sapiens their human ancestors were using stone and other tools, near about two million years ago. Stone Age is separated into three different periods by the historians based upon methods of tool design and sophistication. Paleolithic period which literally means old age of stone is the first period. It began about 2 million years ago with the development of first tool by Homo habilis and lasted up-to 12 thousand years. It is a common belief that Homo habilis was first hominids to make and use the tools. Africa was the home to these creatures millions of years ago. Homo habilis had the advantage of larger bodies & large brains. In the process of stone tool making, the "core" of a hard stone having specific flaking characteristics as flint was hit with a hammer stone. The flaking formed sharp edges which were
used as the tool, chiefly in the structure of scrapers and choppers. During Paleolithic period humans used to group with each other in small society like a band surviving by gathering the plants, and scavenging or hunting wild animals. This is characterized through the use of stone tool, while at that time humans also used bone and wood tools.

Prepared-core technique was introduced approximately 300,000 years ago in The Middle Paleolithic age. Now from a single core stone multiple blades could be rapidly formed. A bone, wood or antler punch may be used to give shape to a stone in a fine manner with the process of pressure flaking. Pressure flaking was introduced in the Upper Paleolithic age, beginning approximately 40,000 years ago. The Mesolithic or Middle Stone period began about twelve thousand years ago and continued through eight thousand years ago. People of Mesolithic age were nomadic hunter-gatherer. The animals which were killed for food also provided humans with bones and antlers from which weapons and tools were made. Small flint blades of various shapes known as microliths are particularly associated with the Mesolithic age.

The Neolithic or New Stone period lasted from eight thousand years till five thousand years ago. The people of this period were skilled and invented a range of tools for processing of crops and food production. After Neolithic age came the metal age then industrial revolution and now the technological advancement.

In general this period is acknowledged as the origin of modern civilizations and commencement of the nation-states. In the origin of modern civilizations the changes occurred are in under following:

Physical Change:

As hominid evolved in-to human or *Homo sapiens*, he went through many physical changes. Early man learned to walk on two legs. This gave straight to their spines; the foramen magnum was moved from behind the skulls to the undersides. Hominine face flattened, and the space between the eyes was now lessened, because of this they were able to see from side to side and look forward.

Early man developed a taste for a rich diversity of food, based on his teeth and jaw structure, *Australopithecus robustus* the early hominid, and was vegetarian plant-eater. But
Australopithecus afarensis and Homo erectus, who were later hominids, tear meat with their incisors and to chew it they used their molars.

**Mental change:**

There were considerable mental changes in early hominids. From Australopithecus afarensis who had hardly three hundred cubic cm of small brain-size, hominin heads ultimately expanded to Homo neanderthalensis's remarkably 1950 cubic cm. Some of the prolonged brain power was shifted to dealing out sights and sounds from processing scents. Another considerable portion was being used in control of the language and auditory functions. Smell was not so important now as more power of the brain was now being used in listening, talking and looking.

In comparison to Neanderthalensis the brain of modern Homo sapiens is actually smaller in size, but it is theorized by paleoanthropologists that once an optimum size is reached by the brain for specific kinds of work, it began to miniaturize, integrating and specializing. So, in product we get that the brain of current human besides being smaller in size, its significant functions are much more closely jam-packed into a narrower space for more competent performance. In this way the evolution process continued in early humans.

**Technological Change:**

The Paleolithic Era witnessed millions & millions of years of human experience, this time-period is many fold longer than the merely 10,000 years that something resembling civilization's existence. There were many changes in the lifestyle of humans in the first primitive era. There were four great developments which occur and represented the most momentous change in the lifestyle of humans. The four changes were summarized as: fire, shelter, the idea and range of tools. Language as fifth tool, acts as both a mental change and cultural artifact.

Most of the animals become skilled to get foodstuff and resources from the surroundings. Almost all of the knowledge which it accumulated vanishes when an animal dies. This rule was changed with the ability of precise communication ability of humans. Now individuals can pass the learning of their lifetime on to others, that is the knowledge can be handed down and stored to the following generation. Unlike other animals, humans slowly accumulated more ways to deal with the environment and preservation of the knowledge. It could add up the knowledge
from centuries. This 'collective learning' process explains the distinctive features of human history.

Acceleration in the pace of technological change is one of the earliest sign of the presence of modern humans. Little change was shown in the course of a million years or more by the use of stone tools. New types of tools appeared with the appearance of humans. These implements were precisely designed, variedly and delicately made for specific tasks. The speed of technological change was still slow by the modern standard. It was the changes which transformed human history at an accelerated speed in the Big Era Two.

Migration and adaptation: People learned to live in more diverse environments with the changing technologies. Homo sapiens were now able to live in places, such as dense forests and deserts about 100,000 years ago, that no earlier hominids had occupied.

Fire: One of the most important turning points in human evolution was the exploitation of fire, a source of energy which is very simple with many profound uses. We can't pin point the precise date of the discovery of fire; but the burnt animal bones at the beginning of Mankind are evidence to suggest that human tamed fire before one million BC; scholarly consensus indicates that fire was controlled by Homo erectus between five million BC and four million BC. Early humans used charcoal and wood to fuel the fire and used it to cook food which helped the food become more digestible. It also improved food's nutrient value and increased the number of foods which can be eaten.

Shelter and Clothing: Shelter and clothing were other important technological advances made during the Paleolithic era. We can't exactly date the adoption of both technologies, but we can term these advances as a key to progress of humanity. Dwellings became more sophisticated and more elaborate with the progress of Paleolithic era than; as early as three million eighty thousand BC, humans were able to build temporary wood huts. The hides and fur of animals were used as clothing, helped humanity to survive the regions which were colder.

Culture and Language: In terms of technology, language was the most important development of the Paleolithic Age. You can't hold or touch language and it is not strictly speaking a technology. In its place, it relies upon change in human brain— To govern the lips and tongue to produce exact sounds, the speech centers were developed, memory was developed
to hold the list of the words, rules were developed to govern the use of the words in different situations, and hearing centers were developed in the brain to process distinct sounds as words within a set of rules.

To get an idea of the working of the world people started having a name for things -- be it an animal, a plant, a tool, a stone, or an event. They taught those ideas to future generations and so on. Young people learned to classify what plant not to eat or which plant to eat, they also learned the difference between the living and dead within their family and beyond; learning to build tools and also the rationale of those tools. Additionally, children learned the do's and don'ts -- a list of taboos and prescriptions to govern their actions.

Some of these prescriptions and taboos were forgotten and new ones were learned with expansion of humanity across the globe. Different lists of forbidden and acceptable activities were developed, it was due to difference of places, difference of flora and fauna and new dangers. Many people and tribes and cultures of the world originated this way. By 20,000 years before the present, humans were everywhere, every place of this world with the exception of some islands off the beaten track of human exploration.

**Range of tool:** Tools have a different type of range but mainly two categories, i.e., hand tools and power tools play important role in today's scenario and daily life.

A 'Power-tool' is in principle a hand-tool driven with power or 'manageable' power-tool; it is distinguished with the help of these names from the stationary power tool like the 'drill-press'. The category of 'power-tools' includes not only tools which are driven by electricity but small 'pneumatic' tools which are driven with the help of 'compressed-air' such as 'Air-Impact Hammers' and 'wrenches'. Chain saw, gas powered drills are examples of Gasoline-engine-driven tools.

The electric drill and the electric circular saw are the most trendy 'power-tools'. The 'Electric-Drill' also rotates a tool bit like its manual counterpart, but there is no manual prototype for the circular saw. Reciprocating saws, Jigsaws and saber have common blades, as do 'Electric screwdrivers', but most of the 'Power Tools' are present-day creations that are built around the ever-present 'Electric Motor'. Some current power tools are polishers and some are sanders [belt, circular, reciprocating and oscillating nibblers & shears]. Before World War II, power tools were
in limited industrial and commercial use but are now produced in millions, largely for the home workshop.

**A hand tool** is any tool that is not being run on power – meaning, one powered by hands (manual labour) rather than by a motor or an engine. Few examples of hand tools are spanners, pliers, garden forforks, secateurs, screwdrivers, rakes, hammers and chisels. Hand tools can be termed generally less risky than power tools. Since the Stone Age hand tools have been used by humans when stones were used for cutting and hammering. Tools were made by casting the tin and copper alloys during the Bronze Age that is what the period is called the *clay moulds*. Stone tools were less sharp and harder than Bronze tools. Bronze was replaced during the Iron Age, and this made tools much stronger and more durable. The tools developed by Romans were similar to those being produced today.

A tool is any device/implementation 'used directly upon a piece of material to shape it' into a preferred form. We cannot pin point the date of the earliest tool. The sharpened stones are the common ancestors to the present array of tools that were crucial for early human survival. A 'knife' of sorts that could also be used 'to hack, to pound and to grub' was rudely fractured stones which were first found and later made by hunters who needed a general purpose tool. A variety of single-purpose tools came into being in the course of a vast interval of time. Roughly 10,000 years ago, with the development of agriculture and animal domestication, a higher degree of tool specialization was the demand of a settled way of life; the identities of the chisel, saw and axe were customary more than four thousand years ago.

Removal of material from a work-piece was the common feature of these tools typically by some type of 'cutting'. Most tools are characterized by the presence of a cutting edge. The pursuit and creation of improved cutting edges has been the principal concern of toolmakers. The effectiveness of tool was enhanced extremely by hafting— handles were being fit on a piece of sharp stone, for better control and more energy or both.

Psychology's most exciting issue is that 'what are the psychological mechanisms in Human Tool Use?' It was a surprise that very less attention was received by this question from psychologists (Johnson-Frey, 2004; Le Gall, 1992). What specific number of attempts to reach the model in which one can find that how humans perform tool behavior (here 'How' issue is referred). These attempts fall into two categories:
(1) In the first category, it is assumed that there is no hidden meaning in the tool, and the meaning is internally created and stored through its use.
(2) In second category, it is assumed that there are inherent meanings inside tools, which are detected and exploited without the mental calculations of the user.

The former category holds many attempts ('Buxbaum, 2001; Rothi, Ochipa, & Heilman, 1991; Roy & Square, 1985; Yoon, Heinke, & Humphreys, 2002'). These all are computational models, which are based on the 'core assumption' of tool use. 'Core assumption' is this, whenever a tool is used (for example Hammer), its object properties (heavy, rigid, handled etc.) need the extraction of sensory information, which can be directly or indirectly transferred to suitable 'motor output' ('grasping, hammering'). The latter category falls in to J. J. Gibson's ecological approach of perception. According to J. J. Gibson (1979) the properties of tools can't be perceived but what they afford (a heavy, rigid object affords pounding), this is the theory of affordance.

Specificity of human tool use is also a crucial point next to how humans perform tool behavior. In many ways the dissimilarity between non human and human tool use has been observed (Johnson-Frey, 2007) such as impulsively engaging in object to object manipulation (Gibson, 1991), vast range of tool use skills or making one tool to create another new one (McGrew, 1992). Leroi-Gourhan (1971, 1973) describes that humans have a quality to use tool so as to adjust their way of interaction with the environment. This characteristic is found in all humans of all culture and ages. There are many examples as for traveling horse, cycle, car, boat, plane etc are used by humans, and same as basket, can and vehicles are used to transport goods. A specific feature which is clearly noticeable at the 'species level' through 'technical evolution' is information processing revolutions which exist between human changing and the surroundings. One will have a pretty good mental image of the place where one grew up if asked to imagine it with cars, P.C., street lights, house hold items and so on. So, any theory believed to be answering the questions related to How and Why about human tool use?

This topic addresses two tricky epistemological issues which are concerned to 'tool use'. First is: what is a tool? Many studies which couldn't precisely define 'tool use', because their point of view finds tool behavior somewhat obvious? Consequently, the question arise that to which length a tool is used by human and consider non-human analogous. Here, we have two approaches (i) 'Computational view' (ii) 'Ecological view', which accounts for 'human tool use'.
Neither of the approaches are satisfactory in solving the WHY issue. But the story is different on 'HOW issue', as 'ecological view' providing a superior account on the relationship of organism and its environment of perception to stress that it is for 'action'.

In theory, the framework of affordance works on the 'idea' of 'perception and technical reasoning' working jointly in 'dialectical' way. Humans have the 'ability to view' that how 'body action' described as a 'problem' to be solved and exactly here 'technical reasoning' occurs. But if the 'ability' of 'technical reasoning’ is there, then it gives an illusion to humans of working less(e.g. TV remote control), even though they have to use 'body actions'- to recognize affordance and to get result of 'reasoning' (with the help of fingers pushing buttons). This is called the 'principle of dialectic'. The 'dialectical reasoning theory' of 'human tool use' is inspired by 'theory of affordance' by Gibson (1979) and work of Gagnepain (1990) on human brain's 'dialectical functioning'.

**AFFORDANCE**

The concept of affordance proposed by perception psychologist, Gibson (1979) expounded that in the ecological environment animals can perceive instinctively if the objects around the environment can provide the necessities for surviving. When organisms perceive the physical properties of the environment such as shape and dimension, in the same time, they can perceive the functions provided by the environment as well. Gaver (1991) pointed out that the concept of affordance emphasizes human body dimensions, physical shape, the relation between properties and shape, and the perceptive information provided by objects.

When constant objects’ constant properties are perceived (e.g. size, color, shape, texture, motion, composition, animation and position relative to other objects), an 'observer' can detect the 'affordance' of the object, means what thing is to be furnished for good or ill. It depends on its properties what an observer affords.

In keeping with his maturing vision of affordance, Gibson (1986) says that affordance can be found in the 'ecological approach' to 'visual perception'. One can find verb 'afford' in dictionary but the noun 'affordance' can't be found there. It is made up, when there is something which brings both environment and animal in one term. It implies animal and environmental complementarity.
A very important fact that has been told about affordance is that affordance of the environment in a sense is objective, genuine and physical, as well supposed to be subjective, mental and phenomenal on the basis of which any organism perceives an object. But affordance is neither an objective property nor a subjective property; or it is both depending on as you like it. Affordance crosscuts the dictionary as both subjective and objective, with the help of both inadequacies can be understood. It is physical and psychological both or neither. Affordance can be pointed in two ways, to the environment and to the observer. Gibson places a simple glimpse of the unusual but accessible aim of affordance concept using an especially revealing analogy.

When affordance lacked in terms of its second order abstraction, it overlaps across category and dichotomies; exterior-interior, collective-individual, objective-subjective, diachronic-synchronic (Still & Good, 1992). Affordance is to a 'situated' behavior, what a niche is to a habitat. Gestalt perceptual principles of figure/ground and "direct perception" is being used for the operationalization of special features of an environment and acting organism's reciprocity, is reflected by affordance.

What an environment means for an organism can be understood through affordance. Without prior synthesis or analysis one can perceive affordance directly, as claimed by Gibson. For example, one can tell just by looking at an object if it can be grasped or not, as there is sufficient evidence/information about it to make an authentic deduction (Sheehy, 2004).

It is easy to understand with the help of Gibson's model that processing of percepts which are derived from environment, is unnecessary to the perception of affordance and it can be said that his theory is economical. The psychological features which are taken as 'interior' by empirically minded psychologists are found exteriorized with the help of Gibson’s descriptive account of affordance. Whether or not affordance is apprehended by individual organism but it is taken as a feature related with the environment, even though it is clear that 'individual organism' apprehends the affordance. 'Gibson's model' comes under the 'figure/ground synthesis' affordance emerges from both context and meaning.

The credibility of the affordance theory would have been high if there was no placement inferred. Even after this a different event, 'immediacy' manifests with the perception of meaning. As immediately we perceive the color of a thing, same goes with the value or meaning of that thing. In plain words, the concept of affordance is based on the supremacy of 'perception' rather
than the sensation and the surface features have prime value ('Nakayama 1994'). The full focus of Gibson's theory was to highlight the rich & complex information in the environment rather than information to be insolvent and require management by mental process for the achievement of logical understanding of the 'world' (Collins, 2007). Chemero (2003); Hecht (2000); Heft (2001); Jones (2003); Kirlik (2004); McGrenere & Ho (2000); Michaels(2003); Natsoulas (2004); believe that Gibson's foundational adoption of Gestalt's direct knowing, reflecting the immediacy of perception, conflates with philosophic issues of realism. The radical nature of Gibson's assumptions is highlighted in this issue. Gibson wanted to understand that how perceptions inform the animal about the meaning of the environmental objects, being the only way of collection of information from outside world. For example, how perception helps a monkey that it can or cannot make a jump from one roof to another. Theories which answer this question are bifurcated into two categories. According to first theory, events and objects don't have inherent meaning which means that meaning is created internally and stored by the animal, which is, view of indirect perception. In second category, it is assumed that there is an inherent meaning in objects and events, which can be exploited and detected without mental calculation of the animal; it is called direct perception view. J.J. Gibson's theory falls in the second category.

In the proposal for the clarification for the affordance concept Stoffregen (2003) asserted, "Affordances are properties of the animal-environment system. The dynamics of the animal-environment system are an emergent property and as such, cannot be identified in the dynamics of the animal or in the dynamics of the environment". In one more account (Natsoulas, 2004); the matter is understood as "Gibson's proposed direct realism of perception. This direct realism should not be misconstrued to be naïve realism instead it is rather, one might say, a very sophisticated direct realism."

It is proposed that the central issue is not ontological but phenomenological. Gibson was criticized for his failure to explicate "direct perception" by Sheehy, Chapman & Conroy, (1997) and Ullman (1980). Well the idea is not bad to look for the understanding of affordance concept in Gestalt principles as from them it arises.

Organisms’ growth and change in environmental conditions are each said to give shape to the other one. According to evolved behaviors context of Darwin, structural invariants which helps to differentiate between types of aggression can be understood by examples of exhibit behaviors and sign stimuli. Only on the mere signal of same species in vicinity by perceptible
sign stimuli may trigger territorial protection act. Looking at more complex organisms many
different behaviors can be noticed as play fighting for mate, as the expansion of their affordance
depends, on structural invariant served by the acts. Gibson devised a way to gather more perfect
description of actions by matching specific behaviors and perpetual phenomenon with exact
environmental features. Generally, our aim is to only give ad-hoc, interpretive tag for
circumstances in which experimental behavior is ingrained. These tags can function as hidden
assumptions which blur as much about an event as they reveal.

**Definition of affordance:** There are many different views about the definition of
affordance. Affordance refers to an 'action option' formed by the relationship among an 'object'
and its surroundings (J. Gibson 1977; J. Gibson 1979). For any arrangement of the 'object' or
surroundings, for any given affordance there is no middle position it either exists or does not
exist. The most comprehensive 'definition of affordances' consider material chance of an action
happening. An object does not need to be alert of the 'afforded action', such as the affordance of
opening a covert flap.

In another way an affordance may refer to a perceived affordance. Definition for a
perceived affordance uses a more restraining that requires an agent to be aware of the affordance,
either through experience or direct perception. 'A perceived affordance is a possible action to an
object' (Norman 1988). Not like the customary definition, an association between the
surroundings and cognition of an agent is taken as perceived affordance. Usually in human
computer interaction (HCI) this definition is used.

Thus, the whole view of affordance refers to 'how' attractive an 'action possibility' is to an
agent, as in “this **switch** has affordance.” While the other definitions being 'dichotomous', this
definition imply a scale (continuum) of 'affordance'. This usage combines the easiness of
perceiving and/or perceived easiness of performing a probable act. Since this usage refers to one
or both of these traits, this form is vague from a 'theoretical standpoint'.

The widespread expressions in the above definition of ‘affordance’ are: opportunity,
immediacy, relation possibility and interaction. That is why, it is appreciated that affordance
refers to anything which is accessible to the individual to do something with. For instance,
proviso someone is 'left alone' next to a creek and needs to get across, a 'rock' on the 'water' can
be a signal to walk on it to get help in crossing the creek. This affordance straightly points out its
relevance from a mature human on that condition but it doesn’t indicate for a youngster who can't observe the rock (Van Lier, 2004).

**Affordance in term of technology according to Gibson:**

Norman began by his reference to Gibson’s earlier definition of 'afford and affordance' (1977, 1979) (also to the discussion Gibson and him have had about these concepts). Setting the paraphrase of Gibson (1979) within a Human Computer Interaction design background, 'affordance' as characteristic of an interface design feature is what the feature offers to the users, what it furnishes or provides. Gibson talks about 'physical properties', Norman named it 'real affordances'. An example given by Gibson explains how a rigid, horizontal & flat surface affords support for a creature. In his environmental vision, with respect to the user affordance is reckoned, here the creature is an element of the affordance association.

So, as 'Norman (1999)' pointed out, "Gibson saw an affordance as a material association between an actor e.g., user and material artifact in the world reflecting potential action on the artifacts. Affordance like this does not have to be able to be seen, recognized or even sought-after".

**Affordance in term of 'technology' by Norman:**

Norman (1999) raised the issue of a general misuse of the term 'affordance'. In plain words, a great deal of the complexity originates from uncertainty between what Norman calls perceived affordance and real affordance. To Norman [1999], the incompetent term affordance refers to the real affordance, that is regarding substantial 'characteristics' of any interface or machine that permit its function. Though, in several Human Computer Interaction and usability deliberations the term is used with no condition to reference to what Norman calls perceived affordance, which is about characteristics in the manifestation of a tool which provides clue for its appropriate process. Since there is much difference in two concepts, possibly orthogonal, Norman admonish the reader not to abuse the terms and particularly, not to use the term 'affordance' unaided for reference to his idea of 'perceived affordance' and, perhaps, without understanding the differences, not to use these terms at all.
Table 1.1: Comparison of Gibson and Norman’s affordance by McGrenere and Ho, 2000

<table>
<thead>
<tr>
<th>Gibson’s Affordance</th>
<th>Norman’s Affordance</th>
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<tr>
<td>✗ Offerings or action potentials in the location in relativity to the action capability of an actor.</td>
<td>✗ Perceived properties that may or may not actually exist.</td>
</tr>
<tr>
<td>✗ Independent of the actor's knowledge, culture, experience or abilities to perceive.</td>
<td>✗ Suggestions or clues as to how to use these properties.</td>
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<tr>
<td>✗ Binary existence: an affordance exists or it does not</td>
<td>✗ Dependent on the experience, culture or knowledge of the actor.</td>
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<tr>
<td></td>
<td>✗ Can make an action difficult or easy</td>
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Types of affordance:

Diverse kinds of 'affordances' were named for the role played by them during interaction supporting the users, reflecting the processes of users on the types of action users perform in task performances. Norman’s 'perceived affordance' changes into 'cognitive affordance', which helps the user with his cognitive action. According to Norman his 'real affordance' changes into 'physical affordance' and aiding the user with the help of his physical actions. A third type of 'affordance' is as well added which plays a very significant role in communication, evaluation & design, sensory affordance, helping user with his sensory actions. Functional affordance is the fourth kind, ties usage to usefulness.

Hartson (2003) categorized the affordances in 4 corresponding types i.e.,

1. 'Cognitive'
2. 'Physical'
3. 'Sensory'
4. 'Functional'

Norman’s perceived affordance correlate to Cognitive affordance. 'A cognitive affordance is a design characteristic which aids, supports, facilitates, helps or enables knowing and/or thinking about something (Rex Hartson, 2003). 'Cognitive affordance' is the element of a design which helps user with their cognitive activities, which encompass as learning, understanding, thinking,
problem-solving, decision-making and remembering. Real affordances relates to his physical affordances. Hartson addressed the property of stimuli which are sensed by the user i.e. texts, lights & sounds by introduction of the sensory affordance as a feature of design. Functional affordance is defined as ‘a design feature which helps a user in the accomplishment of task i.e. the usefulness of a system function’.

However, the two concepts differ, as Hartson classifies the actionable properties of screen-based user interfaces as Physical affordances, while Norman categories them as Perceived affordances.

The Primary Sources of Information:

Hartson identifies three primary sources of information which help us identify what we can do and how we are to behave/interact to carry out the permitted actions. These three sources of information are as follows:

- **Experiential source**: Information or knowledge the person has acquired from formal training, previous interactions with same or similar products/designs and passive observation. For example, a user of computers may have learned that clicking on screen, holding down mouse button and moving the cursor allows them to select a particular section of the text on screen.

- **Environmental source**: The physical/real affordance, that is revealed by actionable, perceptible properties of the item itself. In the real-world the environmental information exists naturally, as opposed to resulting from the artificial or contrived signals which have been implemented by another person or people (e.g. designers, architects, and town planners). However, in Human Computer Interaction (HCI), the physical properties of object are not innate; instead they are result of design decisions, intended to improve the usability & helping user to establish the 'when?', 'what?', 'where?', and 'how?' of HCI. Taking an example, the location and the size of a command button, such as 'Purchase Now' button or a 'One Click Purchase' when ordering products online, help the user determine which parts of the screen afford meaningful actions.

- **Cognitive source**: These are the qualities added to the environment or product by a person, designer or group of people to communicate what the users can do where they can do it, and when they can carry out these actions. For example, physical affordance,
such as command buttons, often has equivalent cognitive affordance, that helps the user predict the outcome(s) of their actions. Labeling physical objects in Graphical User Interfaces (GUIs) is an example of providing cognitive affordances. Labels, symbols, text, icons and any other meaningful design elements should, in theory, help the user accurately predict what they can do and what will happen if they were to interact with associated physical object. The quality and clarity of the relationship between the cognitive affordance and the resulting outcome(s) has a huge impact on the overall user experience. An inability to accurately predict what will happen, when interacting with the active objects within a screen-based interface, introduces significant scope for error and negative emotions, such as fear and frustration (of what might happen when planning actions).

Now a days, the term 'affordance' has been extended further than the sense which was initially hypothetical by Gibson. Here two types of affordances: first one is Natural and second is Cultural. The case of 'natural affordance' is the case of a flat hard surface is ‘walk able-on’ to the human beings as a flower is relevant to bee. For cultural affordance we can take the example of the case of a manufactured article or cultural artifact, intended use or the purpose of the item signals its intention. It’s an actuality that the feature of an item signals a type of significance. Specific values and meanings are referred by cultural affordance. 'Shotter and Newson' (1982), cited in Van Lier, 2004, defined 'affordance' in the terms of all types of enablement & constraints which one mediate & indirect.

**REASONING**

Reasoning is a very sacred thing as what is being said must be true, as the speakers understand it. It involves the exchange of meaning and not simply repeating words that both parties interpret differently. Reasoning consists of all the connections between experience and knowledge that a person uses to explain what he see, think and conclude. Realistic thinking process draws a conclusion from a set of facts.
**Types of reasoning:** When we start constructing an 'argument', it requires to make a decision whether we are going to use 'deductive' or 'inductive' reasoning to confirm our point. There are two main type of reasoning (1) **Deductive Reasoning,** (2) **Inductive Reasoning.**

**Deductive Reasoning:** Deductive reasoning works from the more general to more specific. Sometimes the term "top-down" approach is used in informal way. Deductive reasoning can also be called deductive logic. It is a process of reasoning in which one or more than one general statement get to some certain conclusion logically.

Deductive reasoning contains some true premises which take towards a true conclusion. Deductive reasoning is different than inductive reasoning because in inductive reasoning through specific conclusion we reach to general principles, on the other hand rule and logic are correctly followed by deductive reasoning. This procedure ensures the accuracy of the conclusion.

Deductive reasoning is narrower in nature but more specific in hypothesis which we test. Despite its narrow nature the conclusion addresses the hypothesis. Ultimately, deductive reasoning not only confirms the specific data but also tests the hypothesis. This type of reasoning moves from theories toward observations and findings. That is why in the example, 'all men are mortal' is a theory and 'Socrates is a man' is an observation. Now the conclusion to both statements is 'Socrates is mortal'.

**Inductive Reasoning:** inductive reasoning works in a totally different way than deductive reasoning. It works moving from explicit observation to generalization & theories.

Casually, it is called "bottom up" approach. It is also known as induction; in this construction of propositions is made which are taken from the abstractions of the observations of individual instances of members of the same classes. In this type of reasoning all of the premises are true but possibilities of the conclusion being false are there. Here, beginning with exact measures and observations, detecting regularities and patterns, formulation of some uncertain hypotheses which can be explored, and lastly ending up in development of some general theories or conclusion.
Table 1.2: shows the Difference between Deductive and Inductive Reasoning

<table>
<thead>
<tr>
<th>Deductive Reasoning</th>
<th>Inductive Reasoning</th>
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<tbody>
<tr>
<td>❖ &quot;Deductive reasoning is narrower in nature and is concerned with testing or confirming hypotheses.&quot;</td>
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<td>❖ Occasionally this is casually called a &quot;top-down&quot; approach.</td>
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<td>❖ Deductive reasoning working pattern is moving from theories to observation or finding.</td>
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<td></td>
<td>❖ &quot;Inductive reasoning is more open-ended and exploratory, especially at the beginning.&quot;</td>
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<td></td>
<td>❖ From time to time, this is called &quot;bottom up&quot; approach.</td>
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<td>❖ It begins with explicit observations.</td>
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**Inference and Arguments:**

Reasoning is a unique mental action also known as *inferring*, which is also referred as building or performing *inferences*. A simple & useful definition for ‘infer’ "is to draw conclusions from the premises". You can change the word ‘premises’, and can put: ‘information’ ‘data’ and ‘facts’.

Inferences examples:

1. One sees smoke
2. and *infer* that fire is there

Consider carefully that there is a distinction among Infer and Imply, which are occasionally puzzled. We do not imply the fire but we infer the fire on the basis of smoke. On the contrary, smoke does not infer fire but implies fire. The word ‘infer’ and ‘imply’ are not equal, nor is it equal to the word ‘insinuate’. Inference can be done in four stages:

1. Observation: without bias, collection of facts
3. Inference: infer generalization of the relation between facts from the patterns.
4. Confirmation: with the help of further observation testing inference.
Inferences are built on the foundation of a variety of things – states of affairs, data and facts. Information to make the exploration of reasoning simple, all of these things in terms of a single sort of thing by logic and that is – *statements*.

After that, in same way logic treats inferences in terms of collection of statements which are termed as *argument*. There are many meanings for ‘Argument’ in normal English. The definition of ‘argument’ is applicable to logic is given as follows. "An argument is a collection of statements, one of which is designated as the conclusion, and the remainder of which are designated as the premises."

Another point to keep in mind is that in the context of normal discussion, an argument has an extra trait described as follows. "Usually, the premises of an argument are intended to support or justify the conclusion of the argument."

The word ‘statement’ should be taken as *declarative sentence*. In adding up to declarative sentences, there are also imperative, interrogative & exclamatory sentences. The sentence making up an argument is a declarative sentence; that is, all are statements. The following may be used as the official definition of ‘statement’.

"A *statement* is a declarative sentence, which is to say a sentence that is capable of being true or false."

Some examples of statements are.

1. It is cold.
2. I am busy.
3. Satan exists.

Monitor that whereas a *statement* is capable of being false or true, a *command*, or a *question*, or an *exclamation* is not capable of being false or true. It means that, in support of any sentence to become a statement it's not essential that humans know for sure whether it is false, or whether it is true. For example, ‘Satan exists’.

**Dialectical Reasoning:**

The dialectical thinking can be understood as the capability to view issues from numerous perspectives and to arrive at the best reasonable and economical reconciliation of apparently opposing postures and information. Dialectical thinking is a type of analytical reasoning which pursues truth and knowledge as long as there are conflicts and questions.
Dialectical reasoning refers to critical thinking about the problem and evaluation of contradictory viewpoints. Dialectical reasoning can be useful to resolve controversial issues & to assess opposing positions. Sometimes, there are quite a few possible ways to resolve problems and to understand issues, rather than only one particular correct response. Situation may arise in which information is not complete, where more than one approach may compete and we have to take most sensible decision based on what is known, even though there is no straightforward solution. On the other hand "dialectic" is a word with more than one meaning (Rychlak, 1976). The meaning from Encyclopedia of philosophy for ‘dialectic’ is “the rational growth of thought or reality through thesis and antithesis to a synthesis of these opposites.”

Moving back and forth between contrary lines of reasoning and using each to cross-examine is done in dialectical reasoning. Same as the jury are believed to do in arriving at a verdict: taking into account the evidence and arguments for and against a case, point and counterpoints. In this process opposing facts and ideas are weighed and compared for the purposes of determining the best solution, resolving differences, and coming to the most reasonable conclusion based on the evidence and logic.

Dialectical reasoning can be described as reflective judgment; the ability to integrate and evaluate evidence, relate that evidence to an opinion or theory then reaching at end which can be defended as reasonable and valid. For dialectical thinking, one should evaluate the evidences and examine the assumption, considering the substitute interpretation and be prepared to reassess our conclusion according to new evidences. The difference between a concept and an object lead unavoidably to a dialectic view of the character of the world. If considering ground and figure everything has its difference. Each and every thought is a compound consisting of few elements, belonging to a general class (the thesis), joined with what it is not within that general class (the antithesis), in addition a means (the synthesis) to resolve the contradictions arising out of that inequity. This process mechanism is a series which have three essential steps:

- A **thesis**, a declaration of a viewpoint, an idea or positions.
- An **antithesis**, a statement of possible contradictory idea or an alternative.
- A **synthesis**, an understanding of the two previous ideas in a way that integrate the most excellent aspect of the idea.
Mental model of reasoning theory:

There is explanation of contradictory possibilities in dialectical reasoning which as a result gained by cognitions, in which cognitive dissonance is reduced. In dialectical thinking more than one contradictory possibility can be found on the basis of cognition, in which a person tries to reach at a main result by driving away cognitive dissonance in these possibilities. But in dialectical thinking there are multiple ways instead of a general way by which one tries to reach to the result. Doubt is searched in every belief; "it could be that way but is it really?" reality underlies in the appearance (the thing in itself). In another words, all the perceived events are compared by counter factual alternatives. The reality of alternatives is constituted for counterfactual experiences. Knight and Grabowesky (1995) asserted that those counterfactuals are universal in normal human cognition. In his study Johnson-Laird (1995) said that mental model is suitable for deductive thinking, and important counterfactuals are also noted.

Mental model theory of reasoning was developed by 'Johnson-Laird & Byrne' in 1991. They applied deductive inference in main domains in which rational inference such as spatial and temporal deductions; propositional inferences, such as conditional, disjunctive and negation deductions; quantified inferences, such as syllogism; and meta-deductive inferences are included.

In mental models a person understands a specific phenomenon which represents reality. The postulates of internal representation of thinking process are consistent with theories in mental models. Johnson-Laird (1983) proposed mental models being the essential construction of cognition. There is unifying and central role of mental models representing items’ state of affairs. The theory can be understood with the help of three principal predictions:

(i) Models are built by the reasoners not on the basis of false but on what is true- a tendency which laid light on systematic erroneous belief made by people in reasoning.
(ii) Reasoning in one model is done easily rather than multiple models.
(iii) Instead of focusing on multi-model problems, reasoners concentrate on one model and that is why mostly they reach irrational conclusion and decisions.

To deal with the limitation of processing capacity the 'what is true' model is built, but there is a chance of it leading to illusions. Even then it does not mean that the irrationality of people cannot be corrected with remedial actions. Preventive methods can be used to ease the fallacies. Even after that reasoners have illusions that they can grasp what is beyond their capacity. It is our
thinking that judgment and choice in game theoretic settings can be affected by similar shortcomings.

Overall, it can be stated that reasoners can work with preventive methods on the basis of the understanding of hidden facts revealed after the processing of irrational facts and illusions.

**Principles of mental model theory:**

The way we reason, this theory is based on simple principles and there is a natural way to infer probability, making decisions, to repetitive reasoning about other people's reasoning. One can sum up the theory with the help of principles that have all been experimentally corroborated. If we go with model theory then we will find that stimulation of the events in mental models are basic factor for everyday reasoning (e.g. Johnson Laird, 2006).

**Principle assumptions of the theory are as follows:**

- **Representation of a possibility:** Every possibility is represented by a model. Having symbols for probability, negation believability and so on, structure of the world corresponds with its structure.

- **Principle of models being iconic:** One can recognize the models by the situations they represent as the relations and parts of the situation are correspondent of the model. They represent abstractions even though they underlie visual images. As they justify and extend every type of relations, they are supplemented with the help of symbolic elements, for example, refusal.

- **Principle of deduction, incubation and explanation:** In a valid deduction, there is hold of conclusion on all premises of the model. Knowledge eliminates the possibilities of models in induction because of which conclusion goes beyond the provided information. In an abduction to get the explanation, knowledge introduces the new concepts.

- **Principle of dual process:** According to this theory reasoning has a dual process. System one & system two. System one: initial models of premises are constructed and are restricted in computational power i.e. recursive inferences can't be carried out. In system two, counter examples are searched after following up of consequences, here a counter example is a model of premises where the conclusion does not hold.

- **Principle of alternatives:** There is a need of number of alternatives in model, the tougher it is. Especially by overlooking a possibility, we are more likely to take long and
error. It will take us longer to make inference about a sequence depending on the position of the critical event in that sequence being last or late in the stimulation of the sequence of events.

- **Principle of truth:** Only ‘what is true’ is represented by mental models, if inferences depend on ‘what is false’ then mental model accordingly predicts the occurrence of compelling and systematic fallacies. In the representation of contrasts like what is permissible rather that impermissible and what is possible rather than impossible analogues principle is applied.

- **Principle of modulation:** It depends on content and knowledge. "If" can be modulated and changed by content and knowledge. For example, our disjunction is modulated by our geographical knowledge: Naman is at Delhi or he is at Mumbai. Not like most disjunctions, this yields exact finale: Naman is in Mumbai.

Informality of arguments in daily life and science is accounted by this theory, where as logic is infamously of small aid in analyzing them. If mental models are used for such arguments by people, then one have no reason to presume that they will place them out like the steps of proper evidence. The theory of mental models is likely to have deficiency and problems; it is fundamentally unfinished; in simple words, it is not an archetype. The supporters of rule theories have blamed it for being wobbly and deliberately being false. Predicted counter examples of a better theory may easily topple the model theory. If that is the case, then it is soothing that it will be accounting for its own failure.

**Argumentative theory of reasoning:**

Mercier (2010) says that beliefs are justified and decisions are weighed with the help of reasons in a cognitive process called reasoning. As such, cognition doesn’t have reasoning as the leading mode. As most of the time we use common sense in our everyday life, for example "it's hot outside, I should put on a hat." Reasoning is in contrast to this type of instant inference. Here at least one proposition, which is consciously held, intermediates the link between one thought and another. Because of this proposition a mental transition gets a piece of data or belief. Without the help of the intermediaries we can't justify to ourselves (or others) to a conclusion. Thus, the role of reasoning is to find plausible propositions, i.e. reasons, which will help in
justifying our decisions and beliefs. Therefore, creation, articulation and evaluation of arguments are linked with reasoning.

**Function of reasoning:**

The 'lone reasoner’ through correction of mistaken intuitions and self scrutiny makes better decisions and arrives at better beliefs with the help of the reasoning (function of 'Classical View’). Correction of the mistakes of intuition is the purpose of reasoning according to Daniel Kahneman, as does Descarte's view of acquiring knowledge through reasoning based on unquestionable first principles. If this is true, then use of reason by humans is expected to be really good. (If we take Mercier's point chewing food as primary function of teeth, it should be expected that animals with teeth in general will be successful at chewing, ingesting food for consequent absorption. There is no sense in taking chewing as the primary function of teeth if animals are not able to perform above functions successfully.)

In short, it can be said that the primary functions of reasoning are same in humans and animals both, but the way of execution and thinking is different because human beings have the ability to do a work in various ways.

**CREATIVITY**

Creativity stands for something new and with a meaningful value. In creativity making something unique on the basis of combining the previously known elements or configuring is involved. According to Mumford (2003) creativity involves production of something new which is useful and meaningful.

Creativity is a part of esthetic education in which every human being has the possibility to express his performance and choice. This way creativity can be distinct as a complex human behavior comprising creative thinking, creative production, creative knowledge, perception, understanding, ability, acceptance and communication.

Clearly, creativity is important after all, it provides us with new knowledge and new inventions that can improve the quality of human life. It is somewhat surprising to learn,
therefore, that until recently it was not the subject of extensive study by psychologists. Why was this so? One important reason was that although several methods for measuring creativity existed- for instance, asking folks to come up with as many uses for everyday objects as possible (known as the Unusual uses test; Guilford, 1950) or to formulate as many ways of improving a product as possible (Torrance, 1974). None of these seemed to be completely satisfactory. They did not seem to capture all aspects of creativity as it occurs in real-life situations (Sternberg & Lubart, 1996). Another problem was the fact that the concept of creativity was associated, in many people's minds, with forces outside the realm of science; for instance, with vague notions of "the creative spirit." This made psychologists somewhat reluctant to study this topic.

During the past two decades, this situation has changed and rapid advances have been made in our understanding of creativity, because creativity is clearly related to certain aspects of intelligence, and because it is an important topic in its own right.

There are many ways in which creativity is defined in humans. The most widespread definition (also the one used here) is that something new or different and also suitable to the task at hand is a creative act (Plucker, Beghetto, & Dow, 2004; Sternberg, 1999; Sternberg, Kaufman, & Pretz, 2002). Conventionally, the creative product should be measured new by expert in a specified area (see, e.g., Kaufman, Baer, & Cole, 2009; Kaufman, Baer, Cole, & Sexton, 2008); a question is raised by many recent theorists that whether a product’s uniqueness to the creators may also be of significance (Kaufman & Beghetto, 2009). A fresh study of more than 80 papers about human creativity presented the subsequent synthesized definition: “Creativity is the interaction among aptitude, process and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context” (J. Plucker., R. A. Beghetto., and G. Dow., 2004). The question of how new must a behavior is to be considered novel. Proposal of One model is that there are eight diverse ways in which a creative input can impel a field (R. J. Sternberg, J. C. Kaufman, and J. E. Pretz, 2002). Torrance (1994) defined four characteristics which help in assessing individual creativity. These four characteristics are as under:

Fluency: it has the ability of producing large number of ideas;

Flexibility: in which different kinds of large variety can be produced;
Elaboration: in which new ideas are developed and embellished; and

Originality: in which new, unusual and innovative ideas are produced.

According to Guilford, the fluency of ideas, flexibility of thinking and complexity of conceptual structure are the important traits of a creative person. So, the divergent nature of human action and thought characterize the sum of creative production. The ability to generate several complex ideas from one single idea or trigger is the indicator of divergence. Traditionally, the eight elements below are ones commonly thought of as inherent elements of creative production as well as attributes associated with creative problem solving abilities. These are as follows:

- **Fluency**: It refers to a free expression of ideas of different kind. Fluency is related to establishing word association and expression of words.

- **Flexibility**: It is the ability of using different techniques and ways to solve a problem. This tells us that how many ways a person can take or use to solve a problem. In a way quantitatively flexibility measures variety.

- **Elaboration**: It refers to the ability of enhancing ideas in a more elaborative way. In this a person elaborates the big ideas by organizing them and gives re-birth to new ideas. Added details and transparency improves interest in, and understanding of the topic.

- **Originality**: It refers to uniqueness of the responses of a person while solving a problem. When a person uses a totally unique and relevant response in problem solving than it is taken as the trait of originality.

- **Complexity**: It refers to making something new by mixing difficult, complex and many layered ideas.

- **Risk-taking**: The readiness to be daring, risk-taking, bold — trying something new in order to stand apart.

- **Imagination**: The ability to vision up, discover, to observe, to imagine, to conceptualize new idea and product – to be resourceful.
Curiosity: The trait which exhibits inquiring behavior, probing question, search, making able to look deep into ideas and the eagerness to get more knowledge about things.

Theories of creativity: The theories of creativity explain that some people are more or less creative in comparison to other people. It means that theories of creativity have focused on variety of aspects. Four "Ps" are recognized which most dominate the theories of creativity. For example, first is Process, second is Product, third is Person and fourth is Place. The thought mechanism and technique process of creative thinking are focused in cognitive approach. Theories invoke divergent thinking in spite of convergent thinking (such as Guilford) and which describe creative process (such as Wallas) are first and foremost theories of creative process. Another focus is on creative product that can be seen in measuring the number of attempts of a person's creativity (psychometrics), in creative ideas framed as thriving memes. The nature of the creative person comprises more universal intellectual habits, such as openness, levels of ideation, expertise & exploratory behavior autonomy and so on. A focal point on place considers the best situation in which creativity flourishes, including degrees of autonomy, access to resources and the nature of gatekeepers.

Stages of creativity:

The structure of creativity is very complex. In this a person creates new ideas and facts by thinking in divergent directions on different aspects. On the basis of the analyses of creative thinking and problem solving, behavior psychologists claim that it has some stages. According to Wallas (1926) Patrick (1937) and Vinacke (1952) no matter by which rule, norm or trick a person solves a problem or he is thinking creatively, either way there are four stages involved in the process as under:

Preparation: In the process of solving a problem preparation is the first stage. In this stage important facts related to the problem are gathered. So that problem can be defined correctly and evidences can be collected in favor or against the problem. Trial and error method is used in this stage. For example, if Einstein did not have full knowledge of physics and mathematics, he could not have given the theory of relativity. He was only able to give the theory on the basis of facts and evidences gathered with the help of his knowledge of the subjects. In this stage time limit is not set, it depends on the structure of the problem. If the
problem is easy it takes less time, if the problem is complex it would take more time. According to Zimbardo (1977) the age and intelligence level of the person also affect this stage.

**Incubation:** Incubation is the 2nd stage of creative thinking. In this stage passivity of the person increases and he stops thinking process for some time. This stage comes when many attempts fail in the process of solving the problem. In this stage the person stops thinking about the solution of the problem and either sleeps or rests. Even if the person takes his concentration off from solution of the problem but thinks about it unconsciously.

**Illumination:** This stage is also called insight and can occur at any instance after the incubation. According to Silverman (1978),"the sudden realization of a solution is known as illumination." This stage is found in each and everywhere in creative thinking. When in incubation stage, the person is unconsciously thinking about the solution of the problem he suddenly gets the solution to the problem.

**Evaluation/verification:** This is fourth and the last stage of creative thinking. Where evaluation of the solution is found through the illumination stage is done. The person checks if the solution found by him right or wrong? After evaluation if the person finds the solution wrong then he revises or verifies the overall process and again looks for a new solution.

**Creative tools and its principles:**

There are many tools and principles for creativity. The idea left by this variety is that basically no one knows the procedure of stimulating creativity. According to Plsek (1997) in spite of the variety of tools to support creative thinking, all such tools are based on three principles: (1) Attention; (2) Escape; and (3) Movement.

The tools of creative thinking are nothing but a variety of combination of practical ways to put into practice this heuristic-to focus attention, get away from the current reality, and carry on mental movement. The importance given to the three principles and the procedure of directing these mental actions differ among the methods. Being each situation encountered by us is different in terms of groups and person; because of this the variation makes sense. After understanding the three principles, one can acclimatize techniques to suit various desires, situation and personalities. The three basic principles are as below:
**Attention:** For creativity we have to first focus our attention on a particular thing; normally on something on which we have not focused attention before. Focus of attention is required in all methods of creative thinking. For example, to look for previously overlooked aspects we should construct a slow motion mental movie of the situation. In same way, rather than jumping in to the issue we should write alternative statements and placing them in a purpose hierarchy, as called by Nadler & Hibino, (1994).

**Escape:** Mental escape from our current pattern of thinking is required by the second principle of creative thinking while keeping focused our attention on the way things are currently done. For example, by a direct method called, Leaping Provocation. A group has been given a task to decrease the time taken in providing service to customers might for example, "A law has been passed which makes it illegal for customers to wait more than 30 seconds; what are we going to do now?" This announcement invites us to escape our current paradigm about flow of customers and for a moment, imagining a totally different world.

Creative thoughts can be inspired while walking in the forest we break out of the limitations of the existing ways, both mentally and physically. Likewise, when a person stares at his reflection in the mirror while shaving, he gets a mental escape for few moments which might allow a fresh mental connection about a workplace problem to emerge. It is not being suggested that the use of these comparatively passive techniques is the dynamic search of directed creativity. One can do better but to the point that plain distraction works in creative thinking, as it is a means of mental escape.

**Movement:** Movement is the third fundamental principle in the wake of the various tools of creative thinking that motivates us to connecting and exploring our thoughts. In simple words paying attention to a thing and escaping current thinking on it is not always enough for generation of creative ideas. Unluckily, in natural mental processes of judgment new thoughts are rejected as not creative or too ridiculous to dwell on.

Brainstorming which is a technique of classic creative thinking, the movement is a key principle behind it. There are some ground rules of brainstorming like generating as many ideas one can, without criticism, constructing on the ideas of others. In simple language, continue moving. Likewise, giving a task to a group to come up with a drawing which illustrates their idea
of the company’s future is also a movement technique. One cannot easily state the vision and be over with it, the mind must dwell on it long enough to complete the drawing. Throughout that time, mind, which never sits quite, produces new ideas and connections which may develop the fundamental concept.

**Value of these Principles:** After understanding these three principles which are described above one can develop new methods of creativity, own technique according to one's personality and preferences, especially suited to issues which one is dealing with and suitable to the dynamics of a particular group. As long as the novel technique contains rudiments that focus attention, provide getaway from the mental patterns usually linked with the topic and encourage a high level of supplemental movement. One can be logically certain that this is a fine chance in which one's natural expressions or creative ability can be enhanced. If one's technique doesn't succeed initially than one can modify the means or attention, escape or mix the movement and try again.

**Multi component process in creativity:** According to Guilford (1950) and Torrance (1974) both of whom acknowledged in creativity under the build were other cognitive variable i.e., such as original ideas, ideational fluency and being sensitive to missing rudiments. Many psychologists who extended the argument that creativity act as a process not as a 'singular event', in which several interactive cognitive and affective (emotional) elements interplay. So, two phases work in creativity act i.e., generative and exploratory phase (Finke, Ward, and Smith; 1996).

(i) Generative Process: In generative process a person can have a potential solution to a specific problem with a set of novel mental model.
(ii) Exploratory phase: During the exploratory phase a person can evaluate the multiple / different options and select the best one out of multiple.

The early researchers of creativity like Guilford; (1950) and Torrance; (1974) also divided creativity into two phases;

(i) Divergent thinking, and
(ii) Convergent thinking.

Guilford while defining 'divergent thinking' said that it is an ability in which broad range of associations were given to stimulus so that it can reach to multiple solutions to one problem.
(Amabile, 1996; Banaji, Burn, Buckingham, 2006; Sawyer, 2006). In neurocognitive terms, divergent thinking refers to associative richness of ideas (Gabora, 2002; Simonton, 2004), in which the number of words generated by memory of an individual in reaction, are experimentally measured with the help of word association tests. In contrast convergent thinking means to promptly focus on the finest answer to a given problem.

On the basis of above view there are two stages of creative process, but cognition research indicates that there are two distinct thoughts about i.e., first is associative and second is analytical (Neisser, 1963; Sloman, 1996). According to Burton (2008), in the association manner, thinking is suggestive, intuitive, defocused, revealing distant, slightly connected and no causal relation between items, even may not be correlated.

Analytical mode is opposite to associative mode of thought being more focused and more conducive to analysis and to relationship of cause and effect (Runco; 2004). Science educators associate the analytical mode to higher levels of 'Bloom's taxonomy' ('analysis, synthesis & evaluation') and 'critical thinking' (Crowe, Dirks, Weneroth; 2008). Critical thinking refers to the process in which a person thinks purposefully, self regulatory judgment which leads to problem solving or decision making (Quitadamo, Faiola, Johnson, Kurtz, 2008).

The overall main point is that all of these ways of thinking come under creative control which is executed by functions of brain. According to Blair and Razza, (2007) all planning, problem solving techniques, reasoning and inhibitory control works as underlying core of executive function and 'working memory control' holds & retrieve the information mentally. 'Cognitive flexibility' considers many ideas and examines in diverse perspective. Inhibitory control involves resisting quite a few thoughts and focusing on a single action. Many neuroscientists called the creative process as cerbrocerebellar theory in which mental activities are neurophysiologically described which arise through interaction of different parts of brain.

Thus, in the end it can be said that the main point from all this work shows that creativity is more than a solitary solid measure property or act. Here, ample evidences are given which show that both convergent and divergent thinking work under creative process play an important role (Vandervert, Schimpf, & Liu, 2007).

A basic question about creativity is "What factors produce it?" Several contrasting answers have been proposed. Cognitive psychologists, for example, have tended to focus on the basic
processes that underlie creative thought. Research findings indicate that processes such as retrieval of information from memory, association, synthesis, transformation and categorical reduction (mentally assigning objects to basic categories) may all play a role in creativity and call attention to the fact that creativity is a part of our everyday life. Each time we utter a new sentence or understand a new concept we are showing creativity. Thus, a key task in the study of creativity is that of distinguishing between this kind of everyday creativity (termed mundane creativity) and exceptional creativity-the emergence of something dramatically, new, such as the idea of integral circuits, which made modern computers possible.

What differentiates these two kinds of creativity? According to Perkins (1997), the difference may lie in the fact that everyday creativity occurs with respect to problems for which our past knowledge and experience give us valuable clues; one knows where to look for a solution. In contrast, exceptional creativity may arise in what he describes as Klondike spaces-in areas where, like the miners of long ago who searched for gold in the Klondike, we don't know even where to begin looking. When we do find a solution in such situations, it is likely to be dramatic and require thinking that is "outside the box"-thinking that breaks out of what often described as "mental ruts".

The cognitive approach to creativity has been dominated in psychology, but other approaches exist as well. For instance, social psychologists have often focused on the personality traits that make people creative and environmental conditions that either encourage or discourage creativity (e.g. Simonton, 1994). Still, other researchers have focused on the motivation behind exceptional creativity.

While all of these approaches have certainly added to our understanding of creativity, a view known as confluence approach has gained considerable acceptance. This view suggests that in order the creativity to occur, multiple components must converge (Amabile, 1983). For example, according to Lubart (1994) creativity requires a confluence of six distinct resources (Figure- 1):

- **Intellectual abilities:** Seeing problems in a new way, which idea is worth perusing, and influential skill- convincing people of new ideas. That is known as intellectual ability.
- **Knowledge:** Knowledge of the problem and beyond to move it onward.
- **Certain styles of thinking:** To think locally as well as globally, preference for thinking in original and fresh ways.

![Diagram showing the confluence of resources of creativity.](image)

- **Figure-1:** Shows the confluence resources of creativity (After Lubart, 1994).

- **Personality attributes:** Risk taking, tolerating ambiguity.
- **Task-focused Intrinsic Motivation:** Innovative person typically feel affection for their work and find inherent booty in that work.
- **An environment supportive of creative ideas:** Environment where creativity has full freedom to flourish and full support.
Only when all of these conditions are present, Lubart and others argue, there can be high level of creativity.

**Theoretical perspective for the present research problem**

In cognition, problem solving is often considered as a search process, entails a trade-off between exploiting old solutions and investigating new ones. A wide range of decisions is influenced by such trade-offs in our daily life. Problems like purchasing and vending stocks, maintaining or abandoning relations and having your usual eating or seeking “the special” are all examples of a decision between persevering with precedent actions and attempting something novel. Our daily routine activities require frequent shifts between simple or complex cognitive tasks. **Laboratory based experiments on tool use task has become a very popular means for studying creative problem solving.** Affordance and dialectical reasoning are mental processes involved in simple cognitive tasks. Profound knowledge of such processes will ultimately contribute to an improved understanding of cognition and creative problem solving.

Hence, after describing the three basic aspects of cognitive process, creativity, affordance and dialectical reasoning the present study funnels to discrete statement. **The present research aims at studying/understanding the process in that Affordance, Dialectical Reasoning and Creativity affect tool use in human adults.** Though affordance may appear as a function of physical properties of the tool (material (s) available in the environment), it is the perception of the user (or problem solver) which shall support the creative ideas with the material/tool may be used to achieve desired outcome in a situation. All such ideas then put to a host of cognitive/thinking processes such as reflection, judgment, analysis, evaluation by thesis, antithesis and synthesis taken together to be dialectical reasoning. The way physical features trigger perceived affordance from external environment to mental environment of the problem solver, the creative ability of the solver (creativity) may also effect the perception of affordance through their unique perceptual style by tapping different features of the tool. Dialectical reasoning at the end put together all the relevant ideas possible with the tool and the knowledge/experience available with the user to further the tool use to solve the problem. Whereas creativity of the user shall be further regulated by the interaction of the perception (affordance) and experience (dialectical reasoning) to solve the problem. People varying in
creativity and dialectical reasoning shall be engaged in tool use/solving problem in situations with varying affordances.

Before involving into methodology or technology aspects of the study it would be desirable to arrive at semantic certification of the studies conducted in the area. The chapter-2 deals with review of literature and stating the problem and hypotheses.