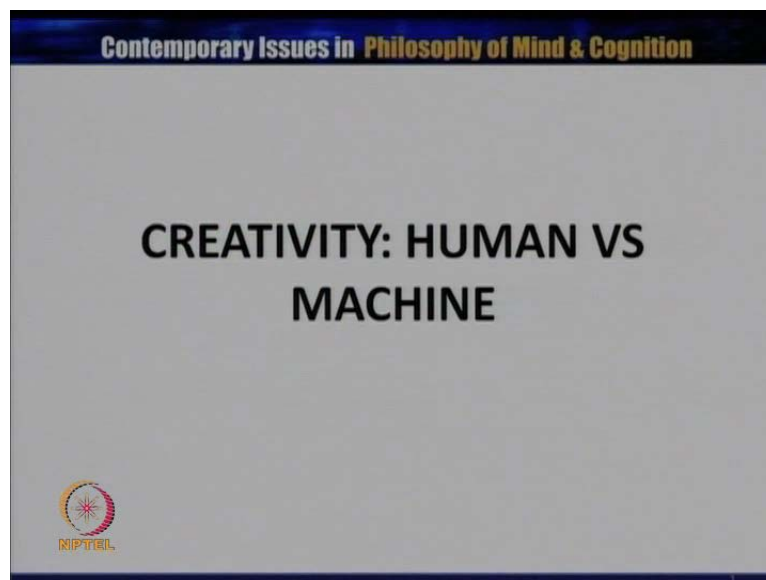


**Contemporary Issues In Philosophy Of Mind And Cognition**  
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**Department of Humanities And Social Science**

**Indian Institute of Technology, Bombay**  
**Lecture No. # 41**  
**Creativity: Human Vs Machine-I**

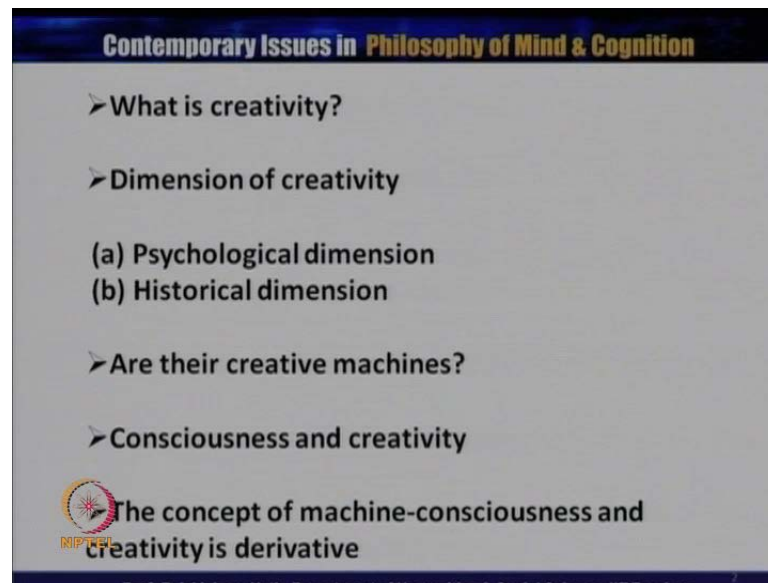
Hello everybody. Today I am going to discuss on human creativity and machine creativity whether machine creativity is possible, whether a human creativity is equivalence with machine creativity.

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These are the problems I am going to discuss in this lectures. This section deals with the problem of creativity and consciousness also, because creativity and a consciousness are two of the most **possibling** features of the human mind. Both the concepts, creativity and consciousness are logically linked, because a conscious human being

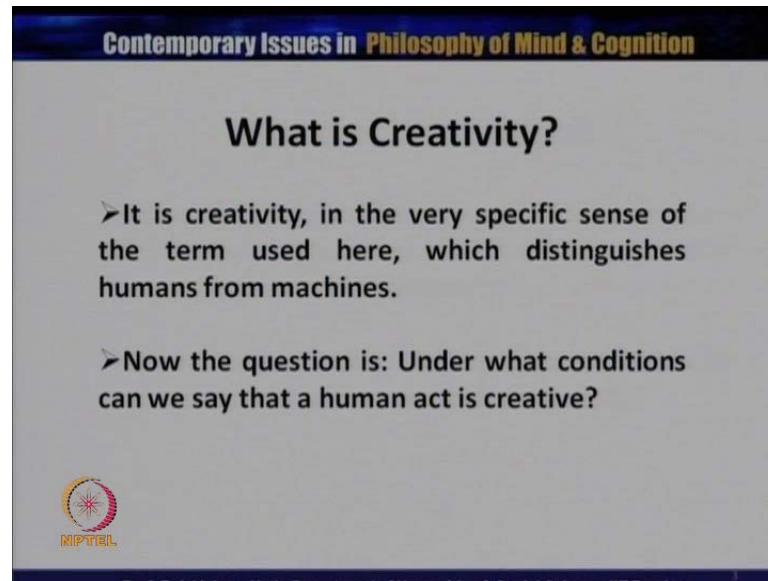
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alone has the power of creativity. Creativity is one of the least understood aspect of intelligent and is often created as intuitive and as not susceptible to rational incur. How a recently there has been a reappearance of interest in these area, principle in artificial intelligence and cognitive science? This section address a range of issues: The first section of this lectures, the question of what is creativity. In the second, my intense is to explore the features of creativity and how creativity related to different cognitive faculties of the human mind and the second sections explores dimensions of creativity especially in the psychological dimensions of creativity, and historical dimensions of creativity. The psychological dimensions of creativity because the creativity is also related to human psychology. The third sections critical examine in the questions, are their creative machines. The fourth sections deals with consciousness and creativity. The fifth sections will become concerned about all either that this machine-consciousness and machine creativity is derivative or not.

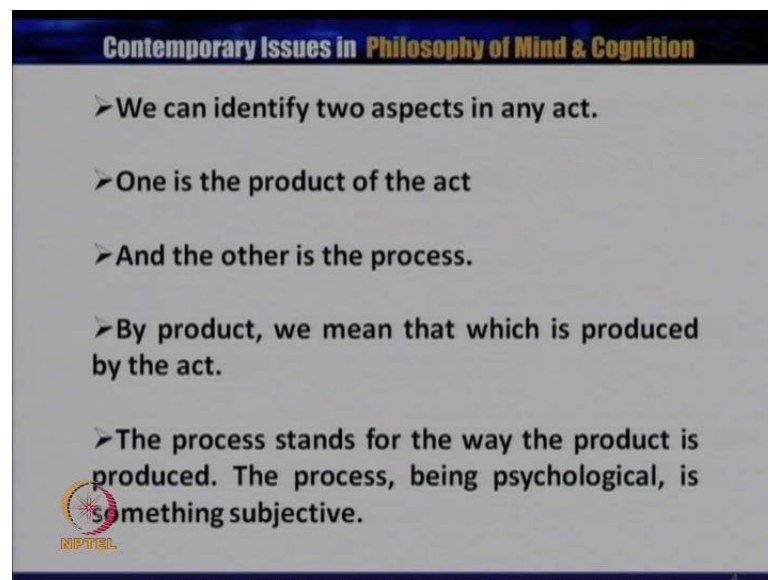
The question first is: what is creativity? The creativity is one of the most important aspect of intelligence and is the most important features of the human mind.

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It is creativity, in the very specific sense of the term used here, which distinguishes humans from machines. Now the question is: Under what conditions can we say that a human act is creative? We can identify two aspects in any act.

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One is the product of the act and the other is the process. By product, we mean that which is produced by the act. The process stands for the way the product is produced. The process, being psychological, is something subjectivity. Therefore, in order to judge

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- The judgments on creative act is objective
- What are the characteristics features of a creative product in terms of which the act that produced it is judged to be creative?

whether an act is creative. It is not possible to depend only upon the features of the psychological process in order and act can be judge to be creative, on the basis of some of the objective features than the product processes such as artistic creations, OAT compositions and etcetera. Therefore, the question is: what is creativity comes down to, what are the characteristic features of the of a creative product in terms of which the act that produced is to be creative?


Features of creativity, now we have to see some of the important

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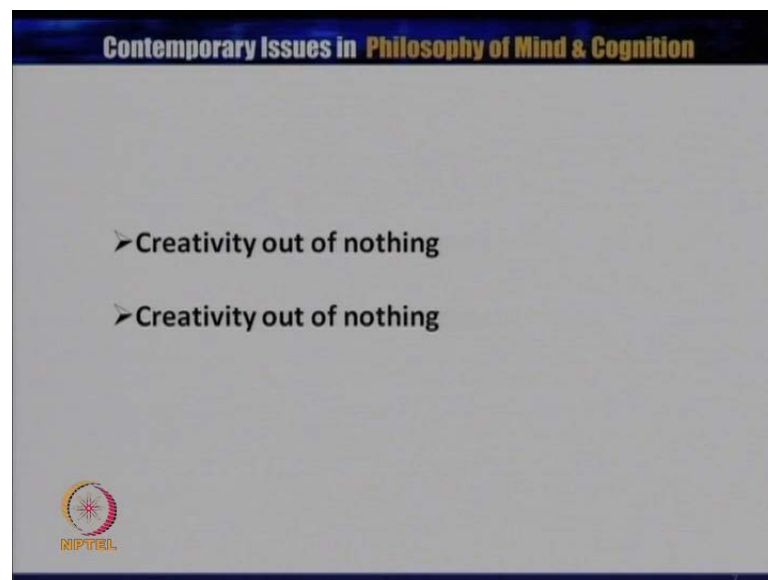
**Features of creativity**

- Novelty
- Originality
- Scientific value
- Aesthetic value
- Social value



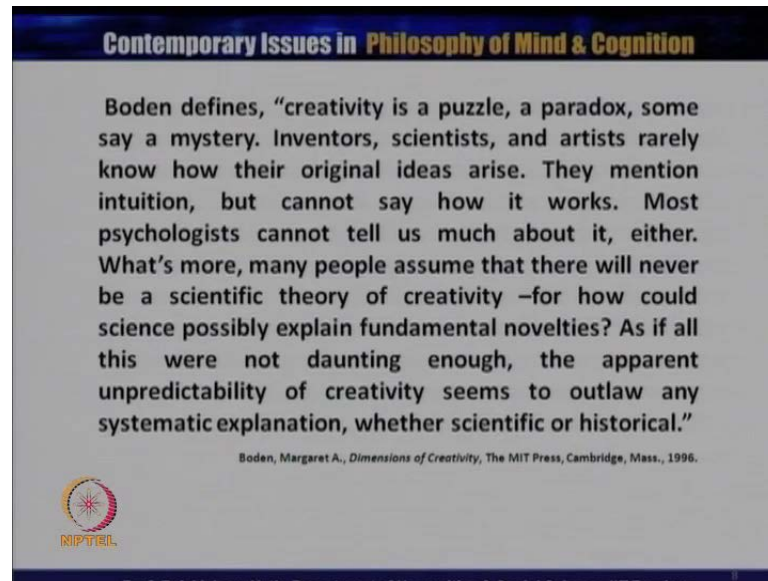
features of the creativity. One of the most important features of creativity is novelty. By the term novelty, we mean that the product did not come in to a distance before the act in questions performed. The novelty of the creativity of the product lies in the fact that it is different from other products already existing in the same domain. We come to know this only after the object is produced, nor prior knowledge of the (( )) processes, or the circumstances that laid to production of object can help us to know in advance, what features the product rule we have? It has been defined by many philosophers and they say that persons creativity to produce new or original idea in sight, in mentions or artistic product, which are accepted by expert has being of scientific, aesthetic, social or technical value.

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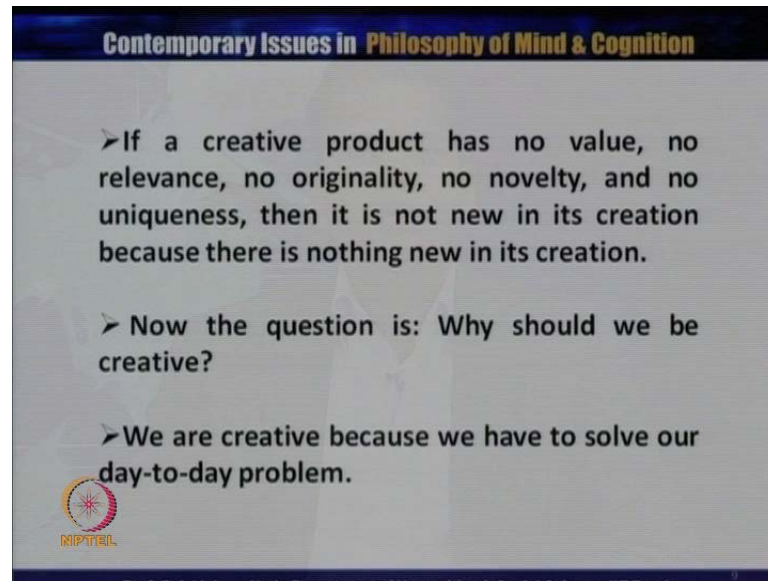
Therefore, the creativity is which one of the most important things in the human society, because is that aesthetic, social, technical and scientific values. If it has no values, it is not a creativity. In a similar manner, Boden points out that if we takes seriously, Dixon definition of the creativity to get something from out of nothing and to get something out of something and it is a hardly surprise that the some people have explained it in terms of divine inspirations that is creativity out of nothing and many other in terms of some romantic intuitions or insights. What Boden is trying to show is that if the creation is out of nothing then it is God's creation, because God alone can creates something out of nothing.

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But we are concerned with human creativity has this is because human creativity arises out of intuition or out of those combination of whole ideas. Once the product has come in to existence, we may enumerate or list the features it possesses. For this features, cannot be showed under a law or a rules. That is statement describing the features of the object cannot be deduce from the rules or laws along with certain **ancient** conscious. Thus creativity is, according to the Boden, "the creativity is a puzzle, a paradox, some as a mystery. Inventors, scientists, and artists rarely know how their original ideas arise. They mention intuition, but cannot say how it works. Most psychologists cannot tell us much about it and important assumption is there will never be scientific theory of creativity- for how could science possibly explain fundamental novelties? As if all this were not daunting enough, the apparent unpredictability of creativity seems to outlaw any systematic explanation, whether scientific or historical". Thus Boden's definition of creativity begins out the features such as novelty, uniqueness and originality, which are essential to any creative at

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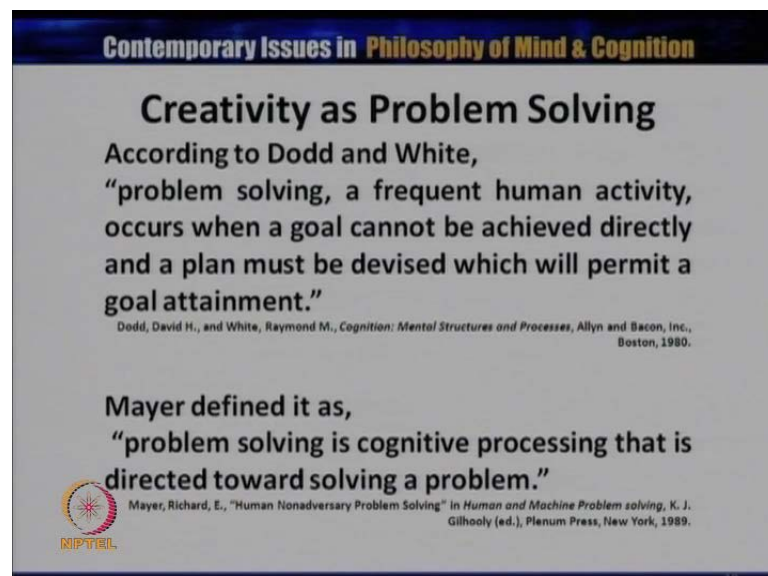
- If a creative product has no value, no relevance, no originality, no novelty, and no uniqueness, then it is not new in its creation because there is nothing new in its creation.
- Now the question is: Why should we be creative?
- We are creative because we have to solve our day-to-day problem.



if a creative product has no value, no originality and no uniqueness, then it is not new in its creation because there is nothing new in its creation, whether a creation is out of something or out of nothing. These minimum features are essential to any creative act. Now the question is: why should we be creative? We are creative because we have to solve our day-to-day problem; that is to say, we are creative in most of day-to-day activities of problem solving. Hence creativity is manifested in problem solving.

Now, we have to see that

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### **Creativity as Problem Solving**

According to Dodd and White,  
“problem solving, a frequent human activity, occurs when a goal cannot be achieved directly and a plan must be devised which will permit a goal attainment.”

Dodd, David H., and White, Raymond M., *Cognition: Mental Structures and Processes*, Allyn and Bacon, Inc., Boston, 1980.

Mayer defined it as,  
“problem solving is cognitive processing that is directed toward solving a problem.”

 Mayer, Richard, E., “Human Nonadversary Problem Solving” in *Human and Machine Problem solving*, K. J. Gilhooly (ed.), Plenum Press, New York, 1989.

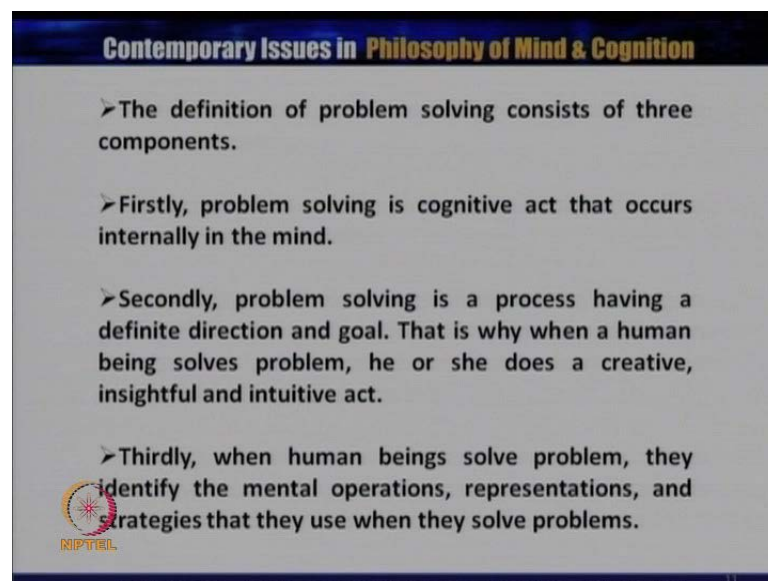
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whether creativity as problem solving. We may understand creativity as problem solving, thus a novel communication of ideas he said to be creative, if it constitutes a solution to a problem. Problem solving is associated with many human activities; however, many questions arises such as, are all problems well defined, do we always know what the problem is, or goals always clearly established. In many cases, the answer is known. So, problem solving is not a mechanical affair, it is a creative react and thus creative problem solving is different from the routine or mechanical one.

According to Dodd and White, “problem solving, a frequent human activity, occurs when a goal cannot be achieved directly and a plan must be devised which will permit a goal attainment”. On the other hand, Mayer defined it as, “problem solving is a cognitive processing that is directed toward solving problems”.

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- The definition of problem solving consists of three components.
- Firstly, problem solving is cognitive act that occurs internally in the mind.
- Secondly, problem solving is a process having a definite direction and goal. That is why when a human being solves problem, he or she does a creative, insightful and intuitive act.
- Thirdly, when human beings solve problem, they identify the mental operations, representations, and strategies that they use when they solve problems.

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Here, the definition of problem solving consists of three components. Firstly, problem solving is cognitive act that occurs internally in the mind. Secondly, problem solving is a process having a definite directions and goal. That is why when a human being solves problem, he or she does a creative, insightful and the intuitive act. Moreover thirdly, when human beings solve problems, they identify the mental operations, representations, and strategies that they use when they solve problems.

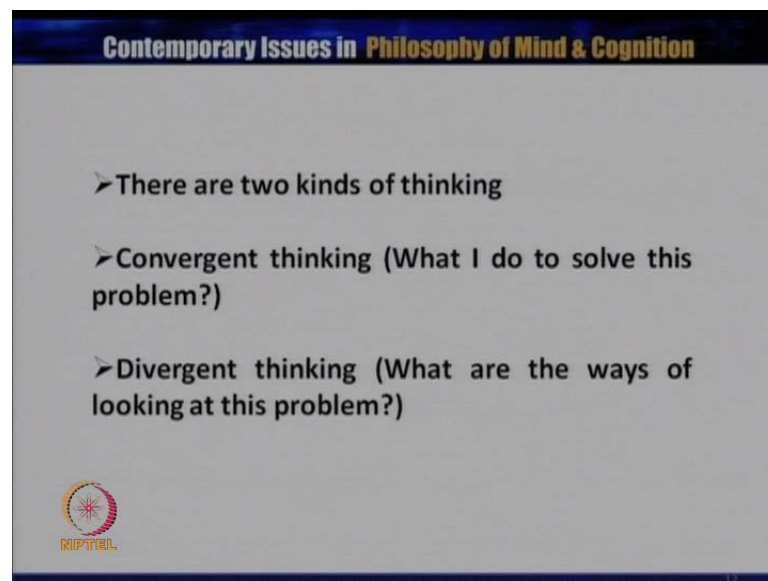
Problem solving consists of search in a problem space, which has initial state, a goal state, and set of operations that can be applied in order to reach the goal. But everyone



needs flexible, critical and creative thinking skills to cope with these problems and find solutions that can improve the physical and social environment. For creative problems solving, intelligence is necessary and intelligent mind is a good think or besides a sense of humour helps in creative thinking, because it relays, trace, intentions, and monotony. It is switches the mind into unexpected task. In order to solve problems, human beings should be creative, intelligent and conscious. A conscious human being can solve the problem easily. Though creativity is more likely to be observed among those who are more intellectual capable, such capabilities not a guarantee of creativity. The ability assisted by IQ test is not a slowly responsive for creative problem solving.

Now, the question is: what abilities distinguish creative from routine problem solving? Before attempting to identify the abilities responsible for creative problem solving, we must examine a model of intellectual function and distinguishes between forms of thought and the abilities underlying in those forms and there are different models, different scientist, they have said. But in the case of human abilities,

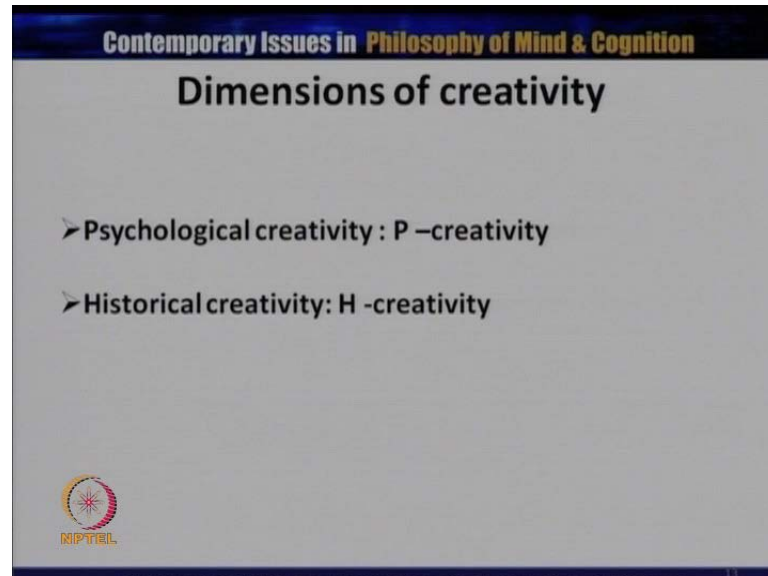
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we will generally find there are two kinds of thinking. One is divergent thinking and the second one is convergent thinking. Divergent and convergent productions, a person conducted on memory. The convergent thinking might say, what I do to solve this problem? The divergent thinker might say, what are the ways of looking at this problem? Therefore, these convergent and divergent a thinking plays a vital role in the case of

human mind and this kind of thinking you is always we have been a practicing and we have been using in our day-to-day affairs.

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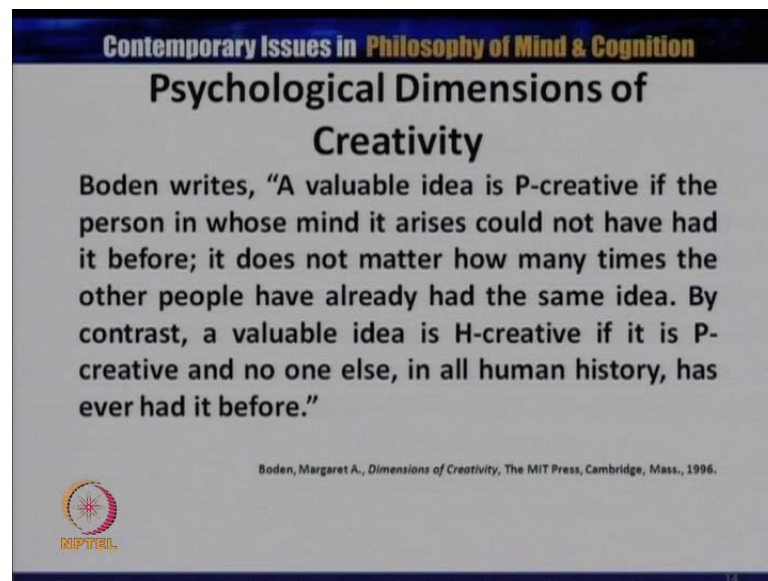
Now, we have to see the dimensions of creativity. There are various aspects or dimensions of creativity. The dimensions are psychological and historical or social. A product or criterion, for example, may be new in a psychological sense in the product is new to the creative agent. A product has special significance, a with the object tracks as new to the **concedes** community of experts. A product is new from an objective point of view. If the product did not exist in the domain before its production, it was not possible to bring the product into existence by following the available rules and practices, prevails in the domain.

What is new objectively or socially must be new, psychological as well. From the point of view of the agent, whose actions brought the product into existence. But the converse is not true, what is psychological new may not be socially or historically, because the object considered as new by the agent may already be present in the domain. Therefore, we have two sense of creativity: psychological and the social, or historical. The psychological sense is not the most from the social sense of creativity, because as explained above what is social is also psychological.

By creativity in the social sense, we mean **primary** the evaluation of the product as creative by a community of experts as already noted. Such evaluation as subjective to

social, culture, real factors and thus depends on many accidental factors. Since, we cannot have a theory that deals with accidental factors, responsible for the productions and positive evaluation of the creative product. It is not possible to have a systematic explanation of creativity in the social sense, but we can think of psychological factors and processes involved in creativity and underline the historical aspect of creativity.

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First of all, we have to see the psychological dimensions of creativity. As we have discussed above, there are two sense of creativity, firstly psychological and historical. Boden characterize them as P-creativity and H-creativity respectively. He has quote, "A valuable idea is P-creative if the person in whose mind it arises could not have had it before; it does not matter how many times the other people have already had the same idea. By contrast, a valuable idea is H-creative if it is P-creative and no one else, in all human history, has ever had it before" on quote.

According to this definition, it is not possible to have a theory that explains all and only H-creativity or historical creativity. What in principles a psychological explanation of P-creativity idea is possible? Now, he examines psychological sense of creativity with the frame work of cognitive science. Cognitive science is a systematic study of human cognitive capacities like thinking, perceptions, memory and many other cognitive acts. The processes responsible for the instance of these capacities are said to be internal to the system in questions. The impacts of the social, cultural and physical environment on

these processes are not denied, but it is assumed that the internal processes may react such impacts.

Therefore cognitive science, consider on a systematic study of the internal processes involved. The internal processes themselves are said to be sort of computations and computation is understood as ruled govern symbol manipulations and these things we have already explained what is symbol governs in manipulations. Accordingly, if we are able to identify the symbols, systems and the rules that govern the transpiration of the symbols, we may be in a position to account for the internal processes involved in cognitions. In the psychological sense, creative processes may be considered as internal cognitive processes that are varies (( )) in nature and may be understood as rule governed symbol manipulations. So, the key to cognitive modeling of creativity consisting in identifying the symbol system involved and the rules that governs them. Since, we are concerned with creativity in the psychological sense, we shall understand symbols as a system of ideas.

Our main attempt would be to understand how new ideas arise in the mind of the creative agent. One way to understanding, it would be to conceive of new ideas as a result of the permutation and combinations of old ideas, though this process of permutations and combinations entirely unexpected. New and (( )) non existence combination of ideas are emergence. Therefore, creativity is, this shows that is one of the important aspects of the human mind. However, this permutations and combination of ideas are not random processes, rather they are rule governed processes. All this combination of ideas must result in the generation of new ideas, which we are not already there, then only exist and these only can be called as the creative idea. All the novel ideas are thoughts by themselves would not mean that they are creative.

We would consider the new combination of ideas to be somehow improbable and yet relevant. Boden suggest that there must be novelty in the creative ideas in the sense that the combinations did not occur before. A creative idea for hour is one, that did not and could not have occur before. Such ideas, according to Boden are **identically** novel, where as ideas that did not, but could have occur before and nearly novelties in a relative sense.

In Boden's words, Boden say that many creative ideas a surprising in a deeper way. The concern novel ideas that not only did not happens, but that in a sense of clarified things

and that could not have happened before. The key understanding radical novelties like in getting to know the meaning of could not in this context. But Boden says that before we considering the just what is this could not means we must distinguish two sense of creativity. One is psychological creativity, he calls it as P-creativity and the other is historical creativity and Boden calls it H-creativity. A valuable idea is P-creativity of the person in whose mind it arises could not have had it before. It does not matter how many times others to pull have already the same idea. By contrast, a valuable idea is H-creativity if it is P creativity and no one else in all humanity had it to be before.

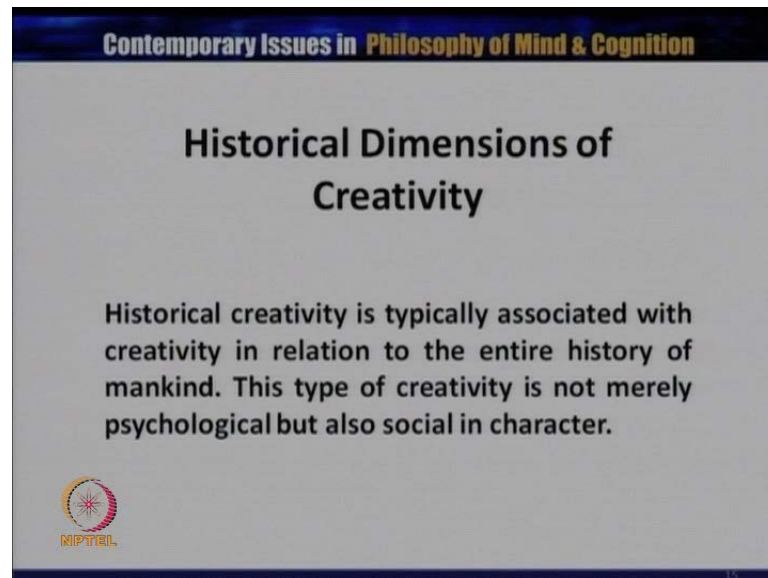
Boden clarifies with the help of some examples. Suppose a person's comes with an entirely new English sentence. Yes, suppose which has not been (( )) by anyone in the history of mankind. These sentence could have occurred before to a person who has interise the grammar of English language and is familiar with its vocabulary. That is the same sentence could have been produced by the same set of genitive rules that produce other English sentences. In the same way, a new idea that could have been produced by the same set of genitive rules that produce other familiar ideas is nearly a first time novel ideas. On the other hand, if you see a radical novel idea or a creative idea is one that could not have been produced by the same system of genetic rules that produced other familiar ideas. The above sentence statement shows that there are two kinds of creative thinking, one is divergent and convergent thinking which we have already explained.

The productions generally original idea suggested that a specific and a new generative system is available to the creative thinker. The generative system is not the production of random thinking, but it is a response to certain constraints on the kind of ideas that could be produced by the application of the generative systems, available to the creative agent before he came off with new generative rule. This shows that creativity is possible because of the constraints improves by the availability of genitive system of ideas, the instance of constant demand that the creative agent comes off with specific systems of genitive rules and primitive radical novel and combination of ideas. This shows that the convergent creative thinking is a supplement to the divergent creative thinking because in the case of divergent creative thinking, it oppose many aspect to have a creative ideas. Therefore, the divergent thinking opposed to the convergent thinking and diverse thinking is involved usually association of the ideas changing prospective under novel

approaches to permission constant to problems in constant to convergent thinking which involves linear logical step.

Now we have to see

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historical dimensions of creativity or historical creativity. As we have already seen, Boden has made a distinction between P-creativity and H-creativity. The historical dimension of creativity is opposite to psychological creativity because historical creativity is new to the human history. As Boden says that a valuable idea is H-creativity if it is P-creativity is no more, no one else in all human history has had it before. That is H-creativity is typically associated with the creativity in relation to the entire history of mankind. This type of creativity is not merely psychological but also social in character. Again Boden says that there cannot be no systematic explanation of historical creativity, no theory that explains all and only historical creativity ideas. What Boden is trying to show that

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- P-creativity or psychological creativity depends on H-creativity because by definition all H-creative is P-creative ideas, but not all P-creative ideas are H-creative.
- The psychological creativity (P-creative) is concerned with the individual psychology of the person concerned, where as H-creativity is a matter of social evaluation and collective judgment.

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P-creativity or psychological creativity depends on a historical creativity because by definitions all H-creativity is P-creative ideas, but not all P-creative ideas are H-creative. The psychological creativity or P-creativity is concerned with the individual psychology of the person concerned, where as historical creativity is a matter of social evaluation and collective judgment.

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Following this Brannigan writes, "Such value judgments are to some extent culturally relative, since what is valued by one person or social group may or may not be valued -praised, preserved, promoted by another."

Brannigan, A., "The Social Basis of Scientific Discovery" Cambridge University Press, Cambridge, 1981

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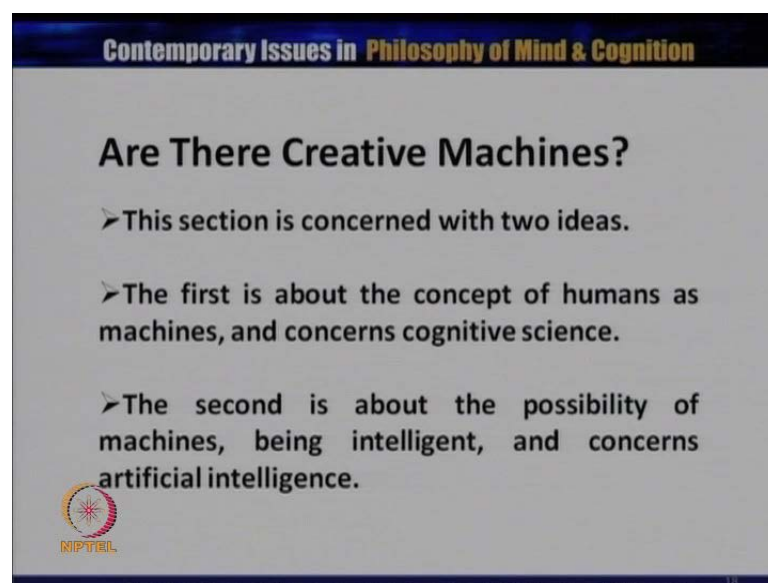
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Following this Brannigan writes, "Such values judgments are to some extent culturally relative, since what is valued by one person or social group may or may not be valued-



praised, preserved, promoted by another”. As we have seen in the beginning of this section, historical creativity is offer to psychological creativity in this sense, any historical creativity is more relative than any merely P-creativity ideas in the strict sense, we may not regard P-creativity as creative at all. Any case, P-creativity cannot be on far with H-creative because the later alone guarantees novelty in all the P-creative actions. Therefore, this is about the historical creative value. Therefore, there is a strong distinction between P-creativity and historical creativity even the historical creativity is P-creativity because there is a particular psychology is concerned in that creativity.

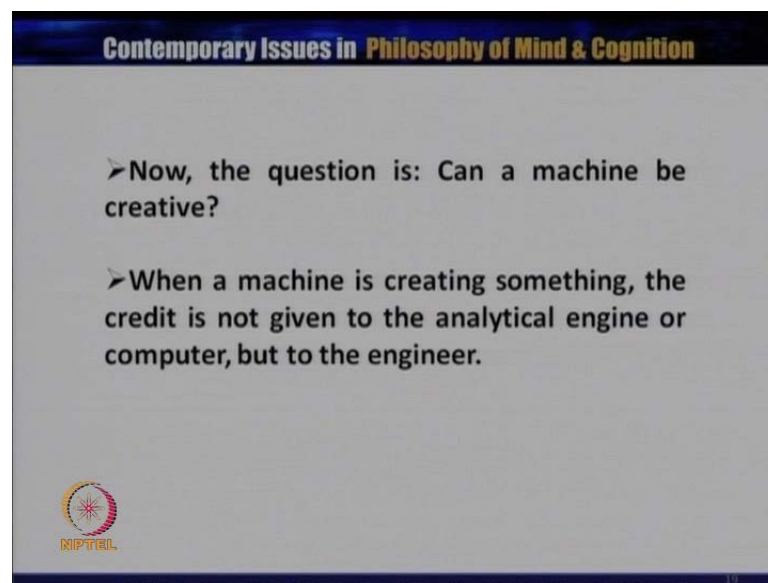
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Now you have to come to see, the another sections on, are there creative in machines? This section is concerned with two ideas. The first is about the concept of humans as machines, and concerns cognitive science. The second is about the possibility of machines, being intelligent, and which concerned in artificial intelligence. Cognitive science try to provide the computational model of mind that is computational stimulation of human cognitive processes. If creativity is now take computational processes, it might still be possible to simulate it computational just as it is possible to stimulate or he can or digestive process without the stimulation it is being digestive process respectively. It might be possible to have machines, models of human creativity processes even if machines themselves cannot be creative.

The main point is that simulation is not duplications nevertheless if machines cannot be creative. The divine post behind cognitive science will be lost. Cognitive science is driven by the field that it is cognitive processes that matter that these can be performed by silicon computer as well as by carbon brains. It is not clear of whether cognitive science could survive, the loss of its central metaphor of the mind as a computational device which we have seen already.

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Now, the question is: Can a machine be creative? When a machine is creating something, the credit is not given to the analytical engine or computer, but to the engineer. This is because the engineer already predetermines the result and here the conscious being is there and engineer is a conscious being, but in the case of engineer is an automata. This kind of a huge and gap as well as separate kind of explanations are there. Boden says that the analytical engine has no pretensions, whatever to originates, anything I can do only whatever we know how to order to perform.


For example, if a program manages to play a modern judge then the musical structure in that program must be capable of producing those musical expressions. It does not follow that the machine playing much is creative. The human musician create new forms of music which machine cannot, the machine providing music according to design tool the job of mechanical.

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- Boden addresses the following questions regarding whether machines such as computers are creative. These questions are:
- Can computers help us to understand human creativity?
- Could computers do things which at least appear to be creative?
- Could computers appear to recognize creativity?
- Can computers really be creative?

➤ The first question focuses on the creativity of human beings. The next two questions are psychological. The fourth question is a philosophical.

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Boden addresses the following questions regarding whether machines such as computers are creative. These questions are: Can computers help us to understand human creativity? Could computers do things which at least appear to be creative? Could computers appear to recognize creativity? Can computers really be creative? According to Boden, the first question focuses on the creativity of human beings. The next two questions are psychological. The fourth question is a philosophical. Here Boden is concerned with the first questions to which our answer is yes, because computers concepts and theories can help us to specify the conceptual structure and processes in peoples mind.

In response to the above four questions, she says that computers can do things that appear to be creative, but whether we regard them as actual creative will depend on, whether we are prepare to allow them a moral or a intellectual respect comparable with the irrespective, we feel for all human beings. It is debatable whether machine can be ascribed those that as of moral being at all. Boden still remains negative. While Boden is concerned more with the way in which computers can help us to understand human creativity, but in the case of Terry Dartnall is concerned with the fourth questions more straight forward.

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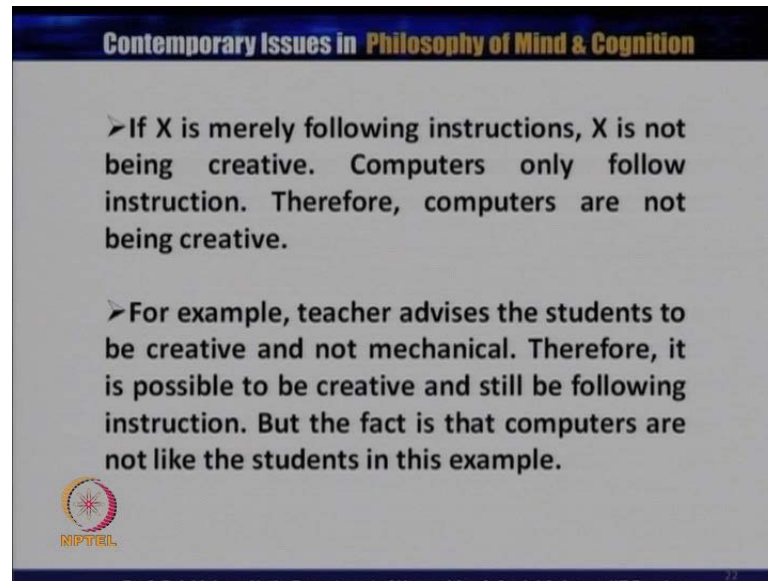
**Contemporary Issues in Philosophy of Mind & Cognition**

Dartnall writes, "If machines cannot be creative then I doubt there is any significant sense in which they can be intelligent, for they will never 'have minds of their own'. I do mean this in the weak sense that they will always slavishly do what we tell them, but in the strong sense that they will never be able to generate their own ideas. And I take it as axiomatic that if they cannot generate their own ideas they cannot be intelligent."

 Dartnall, Terry, *Artificial Intelligence And Creativity*, Terry Dartnall, Kluwer Academic Publishers, London/Boston, 1994.


Dartnall writes, "If machines cannot be creative then I doubt there is any significant sense in which they can be intelligent, for they will never 'have minds of their own'. I do mean this in the weak sense that they will always slavishly do what we tell them, but in the strong sense that they will never be able to generate their own ideas. And I take it as axiomatic that if they cannot generate their own ideas they cannot be intelligent". Therefore, creativity is related to skills and abilities and also to ideas, which are novel and original. The ability to generate ideas and believes effectively **xneil** either core of creativity. The most common reason would for us to support the claim that computers cannot originate any thing is that linearly follow in instructions.

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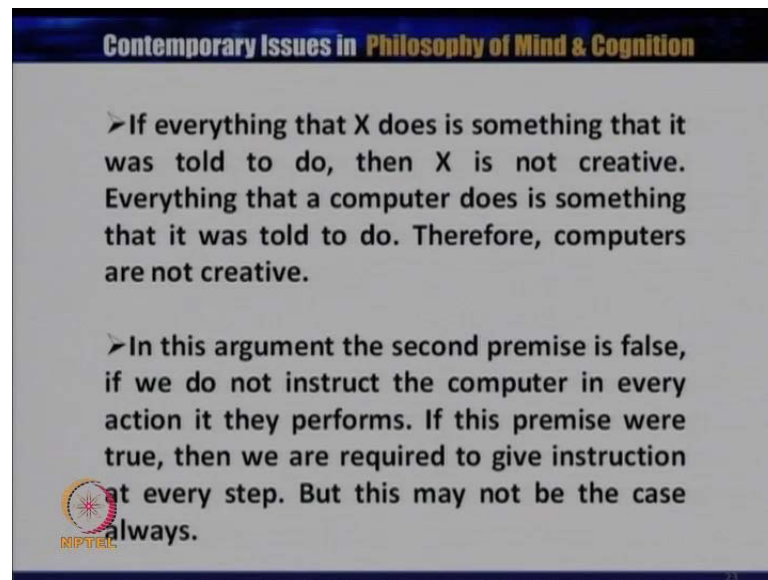
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- If X is merely following instructions, X is not being creative. Computers only follow instruction. Therefore, computers are not being creative.
- For example, teacher advises the students to be creative and not mechanical. Therefore, it is possible to be creative and still be following instruction. But the fact is that computers are not like the students in this example.

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The first argument is like this. If X is merely following instructions, X is not being creative. Computers only follow instruction. Therefore, computers are not being creative. In this argument, the first frame is seems to be false. For we sometimes instruct people to be creative, for example, teacher advises the student to be creative and not mechanical. Therefore it is possible to be creative and still be following instruction. But the fact is that computers are not like the students in this example. Computer merely follows instruction and cannot make a move on their own. Everything that a computer does is something that it was told to do. Hence, it cannot be said to be creative. The argument can be revised as follows:

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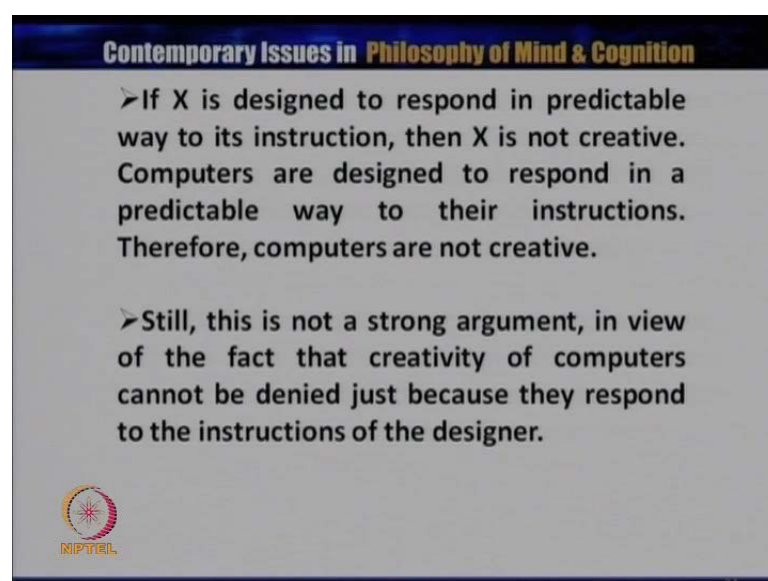
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- If everything that X does is something that it was told to do, then X is not creative. Everything that a computer does is something that it was told to do. Therefore, computers are not creative.
- In this argument the second premise is false, if we do not instruct the computer in every action it they performs. If this premise were true, then we are required to give instruction at every step. But this may not be the case always.




If everything that X does is something that it was told to do, then X is not creative. Everything that a computer does is something that it was told to do. Therefore, computers are not creative. In this argument the second premises is false, if we do not instruct the computer in every action it they performs. If this premise were true, then we are required to give instruction at every step. But this may not the case always. What Dartnall mean is that the machines do not literally follow the instructions, but that the computers is build a design to respond in a predictable way to its instructions. So, the argument can be further reformulate as follows:

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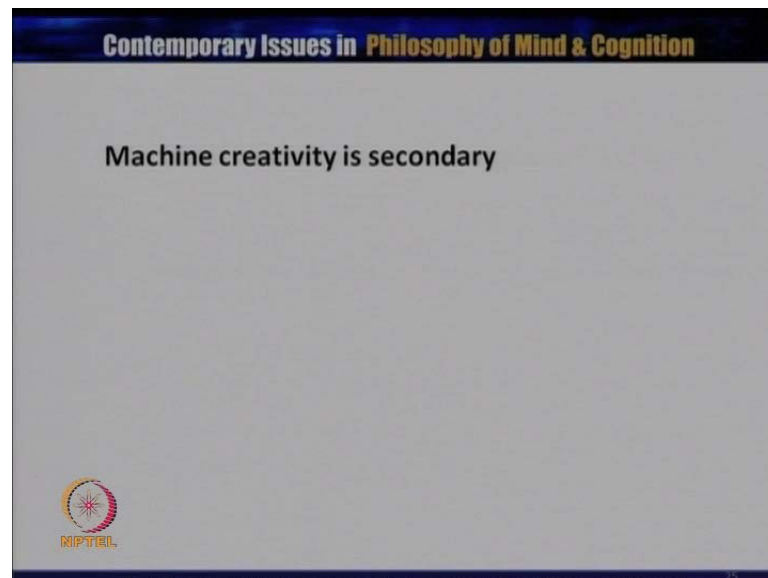
**Contemporary Issues in Philosophy of Mind & Cognition**

- If X is designed to respond in predictable way to its instruction, then X is not creative. Computers are designed to respond in a predictable way to their instructions. Therefore, computers are not creative.
- Still, this is not a strong argument, in view of the fact that creativity of computers cannot be denied just because they respond to the instructions of the designer.



If X is designed to respond in predictable way to its instructions, then X is not creative. Computers are designed to respond in a predictable way to their instructions. Therefore, computers are not creative. Still, this is not a strong argument, in view of the fact that creativity of computer cannot be denied just because respond to the instructions of the designer. In this connection, one may appeal to Boden's distinction between P-creativity and H-creativity. Something is P- creative, if it is fundamental novel for the individual and it is H-creativity, if it is fundamental novel with the respect to the whole of human history. The computer can be claimed to be P-creativity, if they can creates something novel because they are not H-creativity at all. But yet Dartnall's argue that there is there no obvious reason, why they cannot have minds of their own. The final argument that creativity is not predictable is little more than a trick of the light. Dartnall's argument cannot prove that computers have creativity like human beings. Since, machine creativity is a secondary phenomena in comparison to human creativity.

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The human creativity is a fundamental fact of the intelligence. The P-creativity of the human being is supported and strengthen by a H-creativity. Therefore, H-creativity plays vital role in the case of human mind. In the next lectures, we will see how the human creativity and human mind plays vital role than the machine creativity and mechanical mind. Thank you.