Advanced Cognitive Processes
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Lecture – 02
Knowledge – I

Hello and welcome to the second lecture on introduction to Advanced Cognitive Processes. I am doctor Ark Verma; I am an assistant professor of psychology and cognitive science in the Indian Institute Of Technology, Kanpur. I will be talking about Knowledge today. In this course, out of the various topics I have chosen knowledge to be one of the first topics that we discuss.

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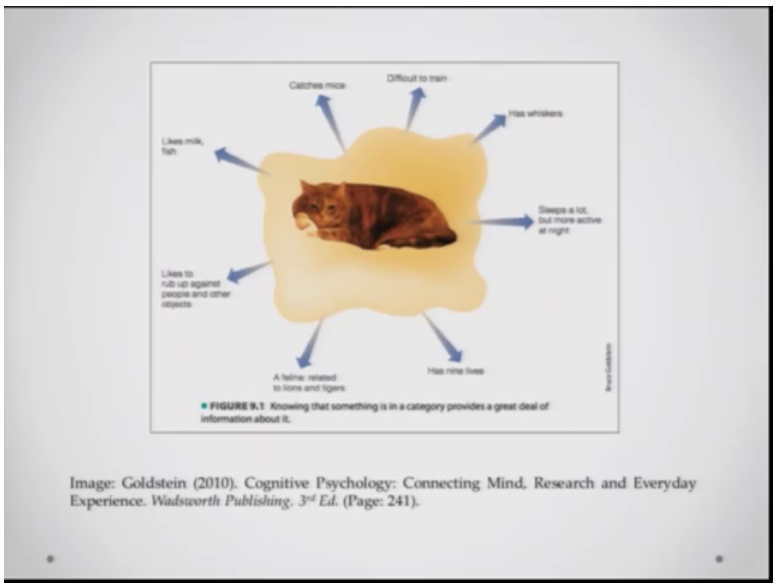

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Now, what is knowledge? Knowledge is probably anything you know anything that comes to mind or let us say if I give you an example if I am showing you the picture of a cat here, what is it that you know about the cat and everything that you can think of and that you know about the cat is basically your knowledge about the cat. So, in this week we will try and understand various aspects of what knowledge is supposed to be? What are the various aspects of knowledge and what do we say constitutes knowledge, where do we get this knowledge from? What are the various categories of knowledge? Also, we will try and see what knowledge helps us to do. How does knowledge determine our

behaviour. Is our behaviour then determined by knowledge at all, is also one of the questions that we try to ask.

Now, look at this picture of a cat and give yourself a couple of minutes and think of everything that you know about the cat. How much of that is something that you know about this specific cat? How much of the things that you know about cats that you know of or cats in general or let us say not only cat, but living things or all the animals etcetera. Is everything that you are thinking of being brought up because you see in the picture of this cat? This is pretty much what knowledge comprises of.

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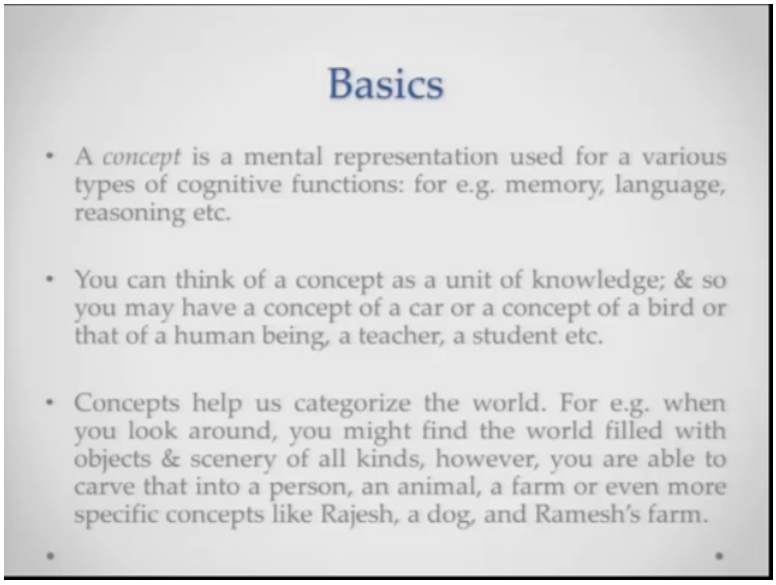

So, one of the first currencies of knowledge or one of the first aspects of knowledge that I would like to talk about is a concept. Do you have a concept of a cat? What is a concept? The concept is a mental representation that is used for various types of cognitive functions. So, whenever you look at the picture of the cat you think of you have a mental representation of that this is a cat and this mental representation is what you will use to talk about the cat to think about the cat, if you recognize that this is a cat that one of my friends has, to have affectionate feelings or say for example, you know that this is a cat I do not know about might be aggressive in nature. So, you try and maintain a distance from this cat. All of these specifics and their generals all of them comprise, what is your knowledge.

What is a concept, you know, what do concepts help us do? You can think of a concept as one unit of language; see for example, if there is all the money in the world, a coin is just a unit of all the money that is there in the world. A concept can be seen as similar things say, for example, a coin is to money as a concept is to knowledge. So, you have a concept of a car, you may have a concept of a bird or you may have a concept of human beings in general or you might also have concepts for specific roles teacher, a student, shopkeeper, you know a minister etcetera.

Now, concepts what do concepts help us to concepts help us structure our world they help us look at the world in a way that we can understand more about the world that we can know more about this world say for example, you know if you look around yourself you might be in a particular room the room might be having particular objects or let us say you might you know there might be different people in the room and you might know different things about these people one of them could be a friend or say, for example, family member or you know different things.

Now, concepts basically help you to think about the world, in a sense that you automatically look at the world and you draft or carve out this world into particular concepts say, for example, these are animals, these are human beings, these are birds, these trees, things like that or this is a car and all of that is basically your way of saying that I understand what this world is about. How are you understanding world? You understand the world through these concepts and these concepts can or are capable of giving you information of all sorts you can think of the cat.

Now, and these are all the things that you might be reminded of when you looking at this cat. Somebody might think that I know that the cat likes to drink milk and the cat eats fish or somebody might think that yes, the cat and the cat is what catches mice, you might have different representations of that kind of thing. Also, if you have pets at home you might wonder that you know as compared to a dog a cat is a very difficult to train pet. You know it is very difficult to make them do anything actually very difficult to make them do the kind of stuff that we do you know we train our dogs to do.

Then, you can have concepts about the structural features of the cat. So, it has whiskers, it has a tail, it has 4 limbs those kind of things. Somebody might know that you know cat basically belongs to the Felidae family it is related to lions and tigers and leopards and

you know a variety is found in homes which are the pet cats, but then most of the Felidae family is you know tied to the jungle and are carnivorous and dangerous animals. If you lived with the cat rather closely if you ever had a pet cat or somebody, you know might have had a cat you know that the cat sleeps a lot, but it is more active at night during the day the cats like to sleep they do not like to get disturbed, but they are very active during the night.

Also, you might have some knowledge about stereotypical things myths about cat say, for example, there is an old Egyptian myth which says that cats have 9 lives. So, if a cat dies it can actually die in you know come to life again at least 9 times. So, that is again one of the myths that you might have come to know from somewhere maybe some book you read maybe a movie you saw all of that. All of these things you see will stick to your concept of cat and the will tell you and keep guiding your behaviour towards cat in the days to come somebody might know that you know cats like to rub up against people and other objects and that is just part of what they behave part of their behaviour.

Now, all of these things and again this is just one example you might take other examples as well say, for example, if I draw an apple and right here you might think of different things about the apple, that it is a fruit, that it is sweet, that is generally red in colour, also green colour is found. However, it is found more in Shimla, it is found also in places like California and we import apples from California and say for example, if one of you have ever been to Shimla you have been to an apple orchard you might know that is a very beautiful place to be, the smell is very good.

Its a healthier thing you know you might remember things like you know an apple a day keeps the doctor away. All those kinds of things are basically tie to your concept of an apple. Now, whenever you see an apple wherever you see an apple all of these things will automatically be activated, let us say and we will talk about what activation means as we go ahead in this course, but let us say all of these things come to life. If you start thinking about and the apple or if you start thinking about the cat for the present example you might one by one or all at once come across these different kinds of facts that you know about again and again these are just a small subset of so many things that people might know about cats.

So, this is basically what a concept is and this is how a concept helps you structure your world this is how concept helps you understand the world. Now, again concept is just one part of whatever knowledge that you would have about the world.

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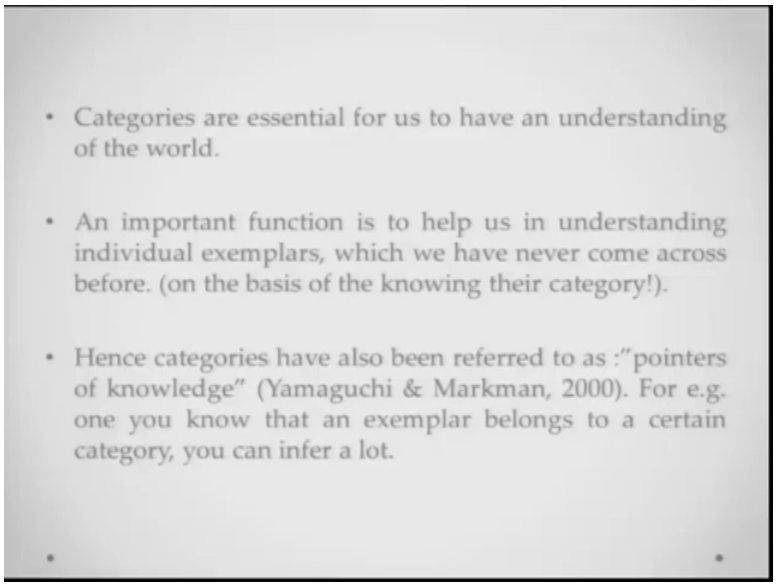

So, another aspect about this world is categories. So, you not only have concepts, but you divide different concepts into particular categories. So, you might have a concept of a cat, a lion, a leopard, cheetah, a jaguar all of them come under one particular category. So, they come into the category of Felidae animals they might come under category of carnivorous animals if you might want to put them like that.

So, what are categories? Now, categories are very essential for us to have an understanding of the world. I was saying this about concepts, suppose there are you know 10000 or 100000 or 500000 things in the world and you have concepts of all of those 500000 things. Then, the world becomes a little bit hard to manage because you have a different concept for every specific object in the world say, for example, if you know a few cats and you have a concept of a cat you will know the generals as well, but then you might have concepts about specific things this is Ram's cat, this is Sita's cat, this is Ramesh's cat and you might have a special knowledge about each of these things as well.

So, then the world becomes slightly hard to organize. So, then how do we organize the world, we have categories. Now, categories are essential for us to have understanding of

the world because you do not need to know every specific detail about every specific object in a particular category. You would know about the category in general and that categorization will help you say something off meaning about all the members of that category. See, I was talking about cats, tigers, leopards, jaguars, panthers, and etcetera. You at least know that all of them belong to the cat family, all of them are putting are carnivorous, all of them you know run very fast, can climb trees etcetera.

So, you might on the knowledge of this category on the basis of the knowledge of a particular category say something meaningful about all the members of this given category this is one of the reasons why categories have also been referred to as pointers of human knowledge by Yamaguchi and Markman, in 2000. They say it is will once you and they kind of say are saying the same thing which are trying to tell you now, that if you know about one exemplar of a whole category you might know something about the whole category even or the other way round. So, let us move to the next question.

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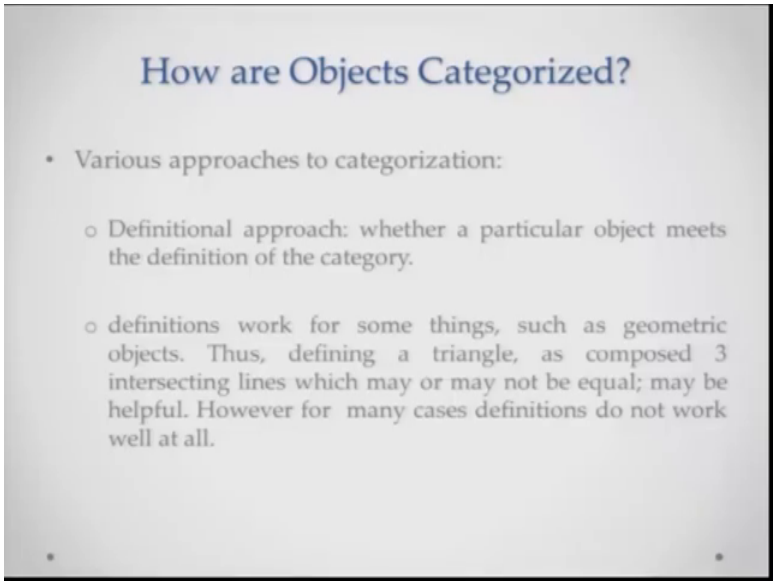

The next question is about if there are concepts and if there are categories how do we form categories how do we you know put things into similar boxes how did I for example, put a cat and a leopard and a tiger in the same category. So, there have been various approaches which have been used to study categorization and we will try and cover some of them in this lecture today and we will try and see what are the which are the more logical ways or which are the different ways and so, we will talk about that.

One of the most important approaches to categorization has been the definitional approach. So, the idea is if you want to carve something into a particular category you come up with a definition. So, you say that I will define a particular category in so many words and every exemplar should kind of confirm to this definition or let us say all the objects in the world that conform to this definition will for me become part of the one category.

Things like say, for example, I have a definition of a triangle. So, you know a triangle is something that is composed of three intersecting lines at particular angles and these three lines may or may not be equal. So, I am not talking about equal sided triangles, but I am talking about any you know three intersecting lines which might which because they are intersecting at particular angles are going to form a triangle.

Now, this may or may not this definition may or may not cover all the exemplars of this particular category. So, we can talk about definitions that might be all encompassing or definitions that might be covering aspects of this, but a definitional approach works as a good heuristic to actually carve out the world into particular categories. But, obviously, there will be cases that will not fit.

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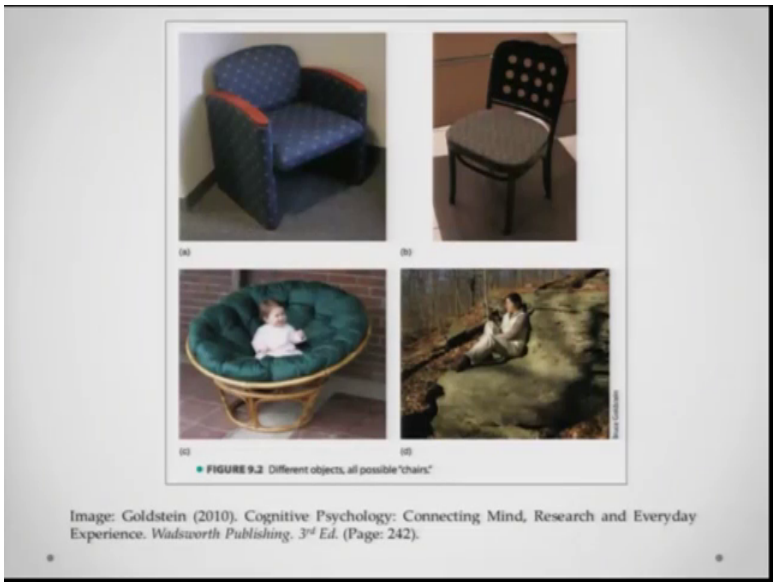

So, I have a definition for a chair. Now, you can see if I define the chair as something which has a horizontal and a vertical section and which can afford you to sit. Now, you can see there are four exemplars of the category chair, none of which are resembling

each other in any which way although there is; obviously, something common that all of them can afford sitting you can sit on this arrangement of rocks in this way or you can sit on this nice beanbag kind of set up this way or say for example, you can say it on a very traditional sofa that is there in the top right.

So, you can see that a definition might not necessarily encompass or cover all members, but it certainly points out to one of the most common characteristics that will lie across all members of a particular category.

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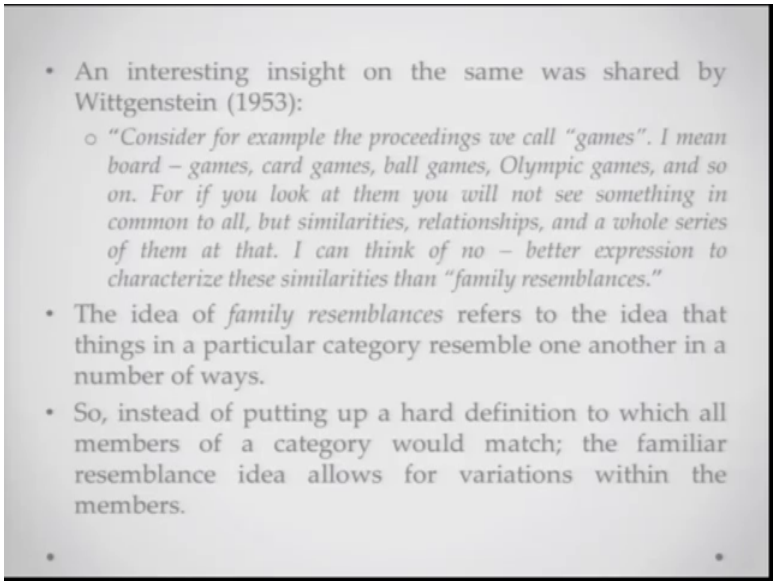

An interesting insight into how definition approaches to categorization may work I was given by Wittgenstein and he said they did not consider for example, all the proceedings that we call games or sport for that matter and you could think of many things, you could think of board games, card games, ball games, Olympic games or different kind of games. Now, if you look at all of them, if you will see nothing in common you will not see something in common to everything. So, there is not a single character it is common to each of the things.

So, if you are comparing card games or if you are comparing a game like cycling or swimming there might be nothing common between them, but then there are relationships there are broad resemblances, that here in you also compete you might also be able to compete here, you might get some joy doing that because it is a play after all anyone gets enjoy doing, some of the people might not enjoy these things as well.

So, you can actually not think of a definition as that you know everything will fit to it, but say, for example, you can look at this entire group and you can say there are these similarities and how do you try and define those similarities Wittgenstein says that I can think of no better word than family resemblances.

You know in a family there are people who are actually coming from the same you know genetic background etcetera and they might all look slightly similar, slightly different from each other might have very different personalities might be you know living closely together or living far apart, but you can actually have a look at them and you know infer sometime that these people belong to the same family.

Similarly, if you look at this picture here again you might be able to infer that all of these four objects belong to the same family and that family is of chairs. So, this is pretty much what the definitional approach to categorization talk about. Now, this idea resemblances refers to any other things in a particular category they resemble one another or this resemble one another in a variety of ways.

Instead of putting up a hard definition to which all of these members of the category would certainly match the family resemblance idea allows for certain variation amongst group members. So, if I were to give a definition of a chair based on let us say only one of these four examples I would not be able to include all the others in the same family.

So, what I do is I talk about family resemblances as says Wittgenstein and I can say that this is also a chair, this is also a chair, but, obviously, there are certain differences. So, there is a variation from the definition that variation is permitted because all the members cannot really fit to just one definition that is the definition approach and it basically tells you that you cannot have a strict definition, but, obviously, you can have a loose definition or you can have some variation with the definition that will define the entire category.

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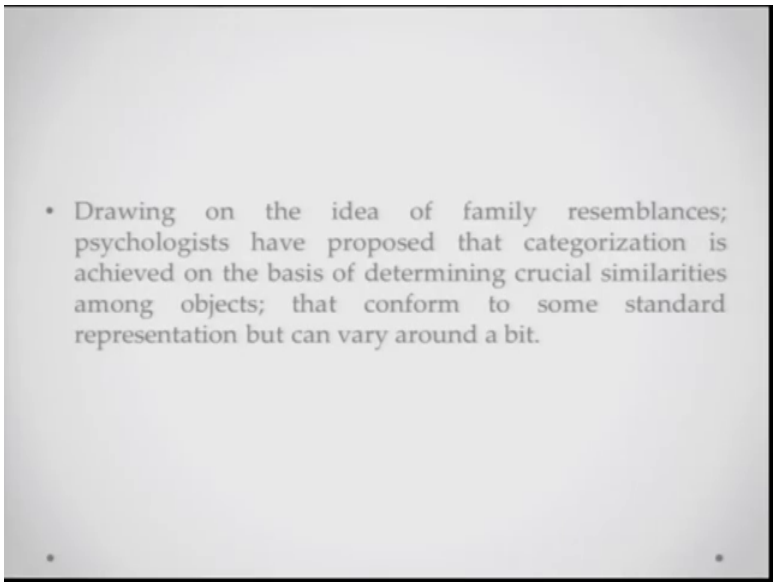

Now, drawing from this idea of family resemblances; number of psychologists have proposed that categorization is achieved on the basis of determining crucial similarities among objects, that would confirm to some standard representation and obviously, can vary around a little bit.

So, you look at all the chairs in the world and you come up with some crucial similarities that most objects will confirm to or say for example, you can average all of that out come up with a standard representation that a chair will have at least these 2 things and everything that confirm. So, at least these 2 things is made a member of that family.

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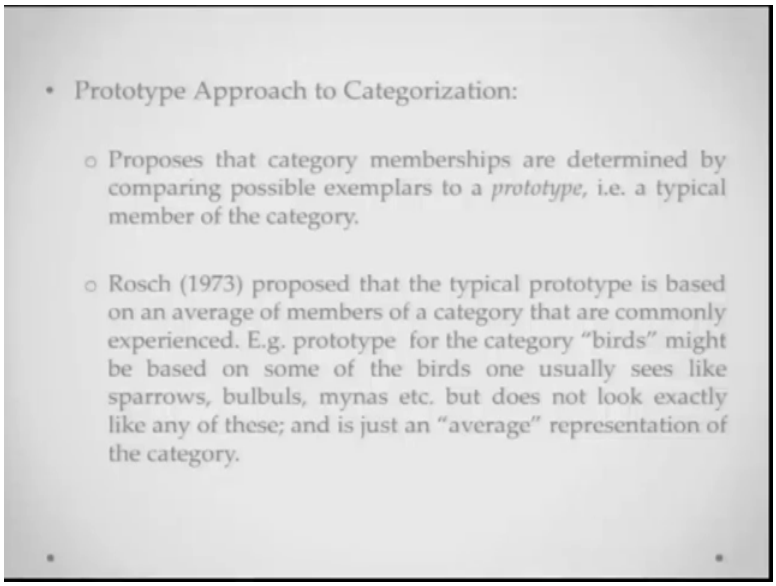

Now, this approach has been referred to as the prototype approach to categorization. The prototype approach proposes that category memberships are defined by comparing exemplars new members to prototypes. What is the prototype? Prototype is a typical member of the category. So, you can kind of average out. So, many characteristics that you want and you can basically say that you know and this is the prototype most members in this category should confirm to this or kind of just be a variation of this.

So, Rosch basically, she did a lot of work about knowledge and categorization and other things and she proposed that typical prototype is based on average of all the members of the category that are commonly experienced. So, if you seen let us say 500 chairs or 5000 chairs or 500000 chairs in the world and you can average all of their characteristics down, then you can actually come up with what is called a prototype of a chair.

Say, for example, a prototype for the category of birds might be based on some common knowledge about birds or some common birds that you usually see. In our Indian context you see sparrows, mun mun, bulbul, myna other kind of birds you can kind of come by cruise you can combine all of their characteristics, write a description and that could be a prototype exemplar and that could basically define that what all the you know what are all the characteristics birds have.

So, you are talking about an average representation of the category.

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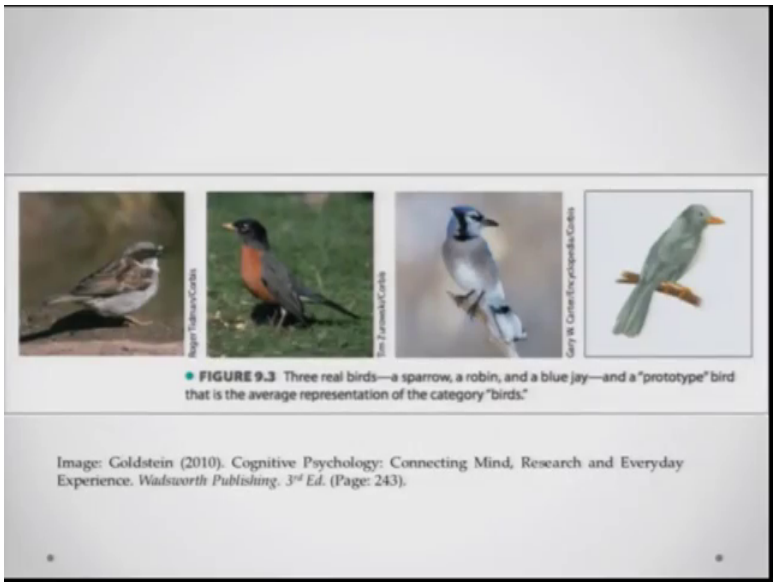

Let us take this example. Here, you see sparrow and you see the other 2 kind of birds a robin and a blue jay and you see the force is basically an average of the characteristics of the sparrow and blue jay and the robin. So, you could do this with other you know birds that you might come across and the one on the extreme right is basically the prototype. So, the prototype is that a bird should have a beak it should have a tail it should be able to fly.

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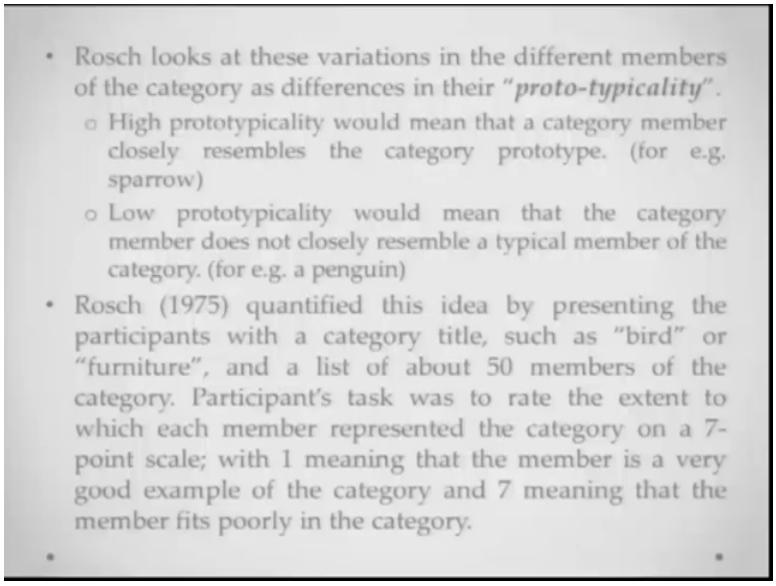

There is also a bit of a problem with this I come to the problem in a bit, but let us explore this idea of prototypes a little bit more. So, Rosch basically she looks at the variations between the different members of a particular category and she talks about these differences as differences in proto-typicality. What are the differences in proto-typicality? Some members of the group will be highly prototypical, they will be highly close to the prototype or some members will be slightly less prototypical. So, they will be slightly further away from the prototype. However, both of these will confirm within the definition of the group.

So, what is high proto-typicality? High proto-typicality would mean that a category member closely resembles the category prototype; say, for example, a sparrow very well resembles the prototype member that we saw right away; however, low proto-typicality means that the category member does not closely resemble the category prototype if I talk about the penguin. Now, a penguin does not look anything like the prototype shown here. So, even though we know that penguin is also a bird, but it is not the prototypical bird.

Now, Rosch tried to quantify these variations between members of the category and she quantified this idea up she did this study where she presented participants with these category titles such as bird, furniture etcetera and a list of 15 members of a category was also presented.

Now, the task of the participants was to reach the extent to which each member represented the category on a 7 to 1 scale; on a 7 point scale, where 1 means that a member is a very good example of the category and 7 means that the member is a very poor example of the category. So, in the example you are talking about right away penguin probably could be somewhere under 6 or a 7 which is it is a poor member of the category bird where as a sparrow or a bulbul or a myna might get marks up to 1 or 2 because they have very good members of this particular category.

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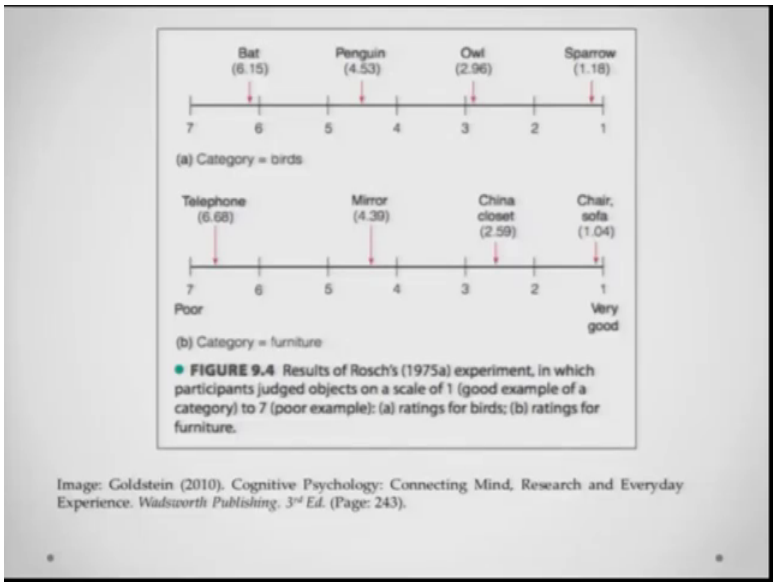

Image: Goldstein (2010). Cognitive Psychology: Connecting Mind, Research and Everyday Experience. *Wadsworth Publishing. 3rd Ed.* (Page: 243).

Here, is what you finds in the data actually penguin gets around 4.53 because it least has wings, a bat is even less prototypical and it gets a rating of around 6.15. You can see telephone and mirror are considered least prototypical examples of furniture. So, this is how exactly the participants in Rosch's, 1975 experiment performed and this is how you can see that you know participants do have a consciousness of which are high prototypical members of a particular category and which are low prototypical members of the category and this might you know in some ways govern your behaviour towards looking at these different members also looking at these entire categories.

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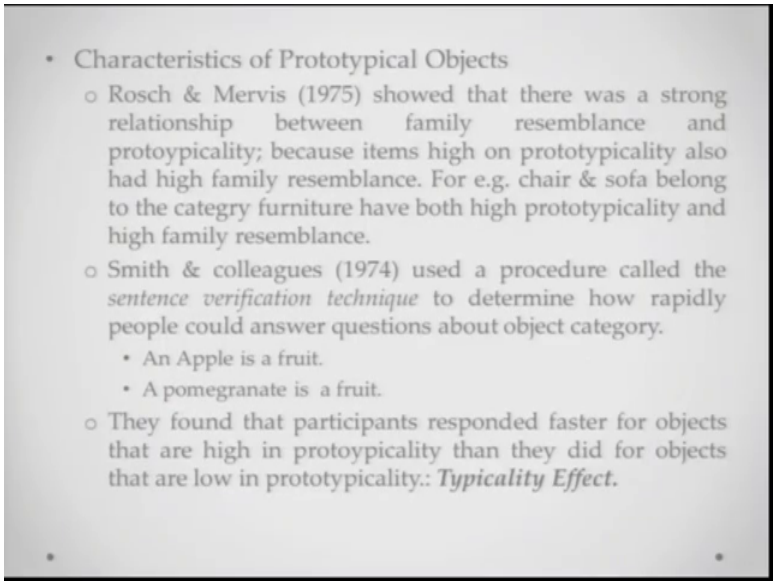

What are the characteristics of these prototypical objects that we are talking about the different characters we can talk about various experiments that have been done with these objects. So, Rosch Mervis in 1975, they showed that there was a strong relationship between family resemblance and proto-typicality because those items which are high on prototypical or also high on family resemblance here and so far belong to the same category and both have high proto-typicality and both are high both have high family resemblance. So, those ideas kind of you know fuse into each other at some point.

Smith and colleagues, they used a procedure called the sentence verification technique and they wanted to determine how rapidly people would answer questions about particular object categories. Well, they would give participants a sentence like an apple is a fruit, a pomegranate is a fruit and they would ask them to respond in yes or no to these sentences.

Now, the amount of time people take in responding to these sentences basically determines whether these sentences are about prototypical things or less prototypical things. This is pretty much what they found and they found that participants would respond faster for objects that are high in proto-typicality and slower for objects that are low in proto-typicality. This was referred to as the typicality effect and has been shown to occur in a wide range of for difference across a variety of experiments.

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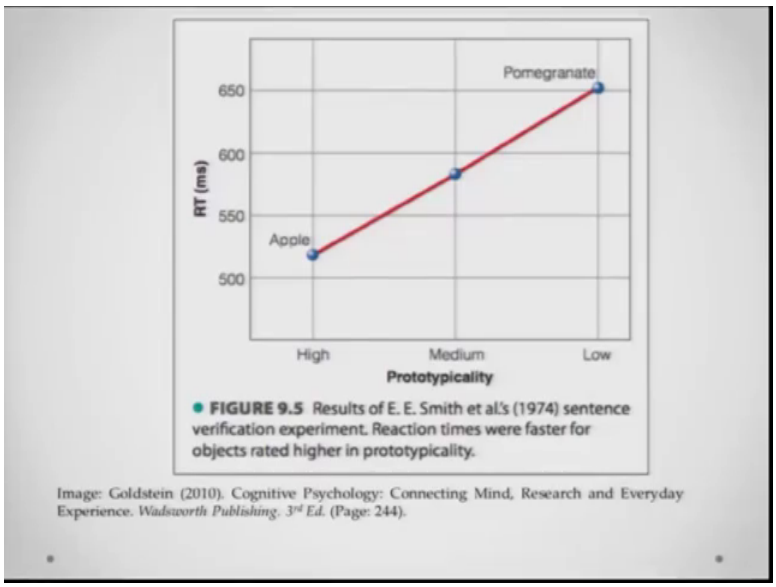

FIGURE 9.5 Results of E. E. Smith et al's (1974) sentence verification experiment. Reaction times were faster for objects rated higher in prototypicality.

Image: Goldstein (2010). Cognitive Psychology: Connecting Mind, Research and Everyday Experience. *Wadsworth Publishing*. 3rd Ed. (Page: 244).

Here, you can see the on this reaction times typicality. So, people take more time in reacting to pomegranate as a fruit versus apple as a fruit because apple is the more prototypical member of the fruit category. Anyways there is a huge variation in this category fruit, anyways.

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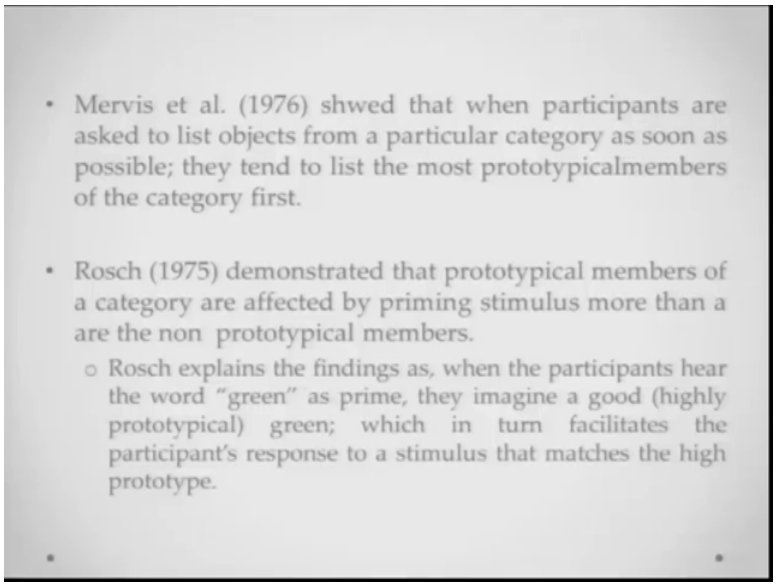

Now, Mervis and colleagues in 1976, they showed that when participants are asked to list objects from a particular category and they are given particular time constraints they tend to list the most prototypical members first and then the lesser prototypical members.

Rosch demonstrated that highly prototypical members of a category are also affected most affected by priming stimulus more than the non prototypical members.

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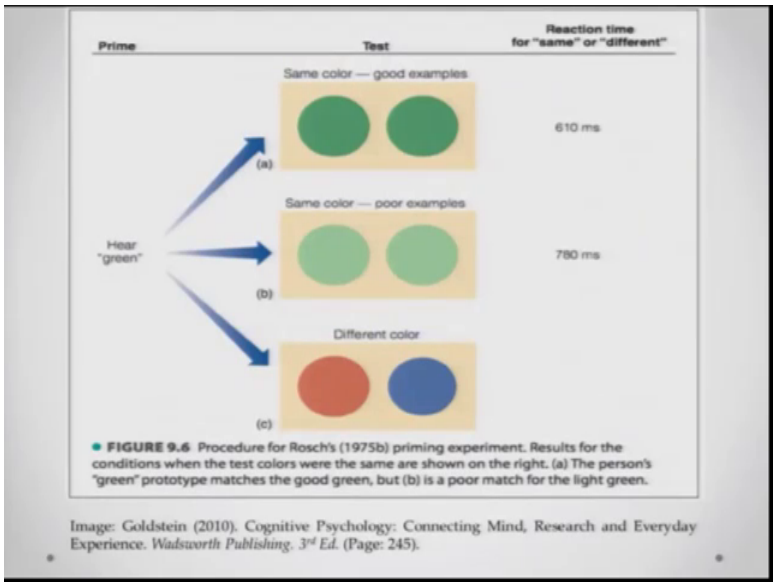

Say, for example, they explained the findings such as because the participants hear the word, I will show you their experiments what they did was, the participants were hearing the word green and they were supposed to choose these you know choose out of these options. So, if you seen green in your screen there you will see that the in panel a, there are very good examples there are very good examples of green; in panel b, they are slightly poorer examples of green and in c there again different colours, there is a red and a blue.

Now, when people were hearing the word green they were more prone to choose the first category as prototypical members of green and their reaction time is lower you can see it 610 milliseconds and when they are actually even the less prototypical members the reaction time you know decidedly higher.

So, Rocsh and Mervis basically kind of explains this in a way they say that when p participants here the word green is trying they imagine a very good or highly prototypical green which in turn facilitates reaction times to the first pair of stimulus, the panel a here and because the panel b does not really represent a very good quality green they kind of take more time to react to this.

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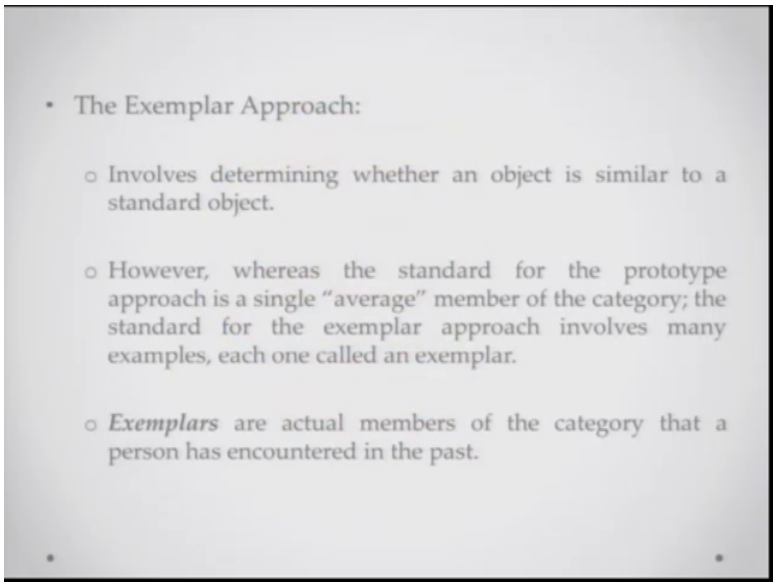

Now, let us talk about a different approach let us talk about the exemplar approach to categorization. The exemplar approach involves determining whether an object is similar to a standard object. So, we are talking about a prototype which is an average of all the categories all the characteristics that these group members will have and here we are talking about exemplar. So, we actually take a real exemplar and you try and compare all the new members to this exemplar you can come up with any examples that you are experienced you are a child and the best exemplar of a bird that you are seeing is a sparrow or a parrot or something like that.

Now, to a child when you actually you know make the child aware or bring the child in contact with a penguin which is again a real example the child might compare the penguin and the sparrow and decide that it is not a very good representation of the bird family. Here, we are not talking about averaged representations we are talking about actual example. So, the way in which exemplar theory differs from prototype theory is that exemplars are actual members of the category that a person has experienced in the past.

So, you basically carve out the world in an increasingly more sophisticated way, because your knowledge gets you know keeps on improving you come across different kind of examples and you kind of you know keep including them in your knowledge base.

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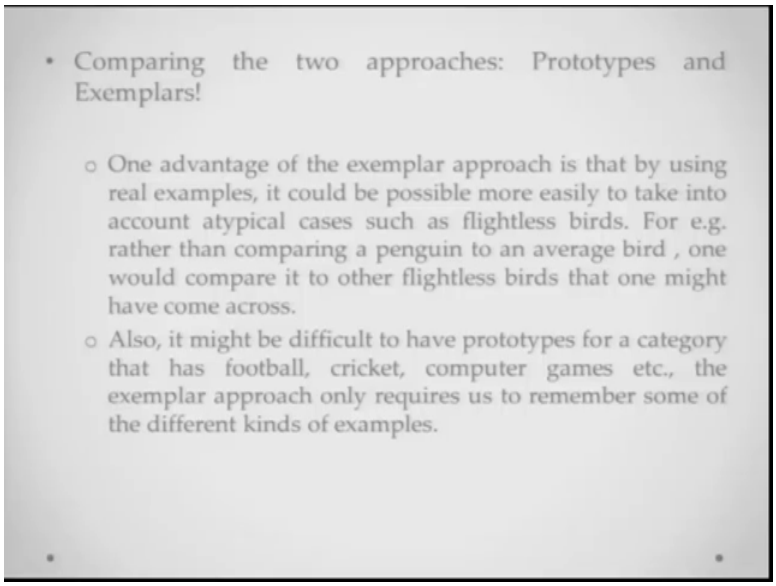

So, let us compare the prototype and exemplar approach a little bit more. One advantage of the exemplar approach is that by using real examples, it could be possible more easily to take into account exam tip an example such as flightless bird say for example, when would you know rather compare a penguin to an average bird, one would also like to compare penguin to other flightless birds. So, the thing is if you have no idea of that flightless bird exist and you have never been across come across any of these words, you will find finding you know you will find categorizing the penguin as a bird slightly difficult. But, say for example, if you take a real example of a flightless bird and then you compare the penguin on it you might be you know more easily be able to categorize the penguin as a bird.

So, that kind of you know you are not depending upon a prototypical average representation, you are actually taking real example, say you are actually measuring the new example is asked opposed to these real examples. So, it kind of becomes slightly easier to classify penguin as a bird. Also, it might be difficult to have prototypes for a particular category that has you know football, cricket, computer games etcetera, but if you go using the exemplar approach you will basically require to just you know get you know all these different kind of examples and you can actually just take them as a new example in same category again. So, you can say that cricket is also a game, football is also game, judo or karate is also a game and you kind of just try include them as new examples of the same category.

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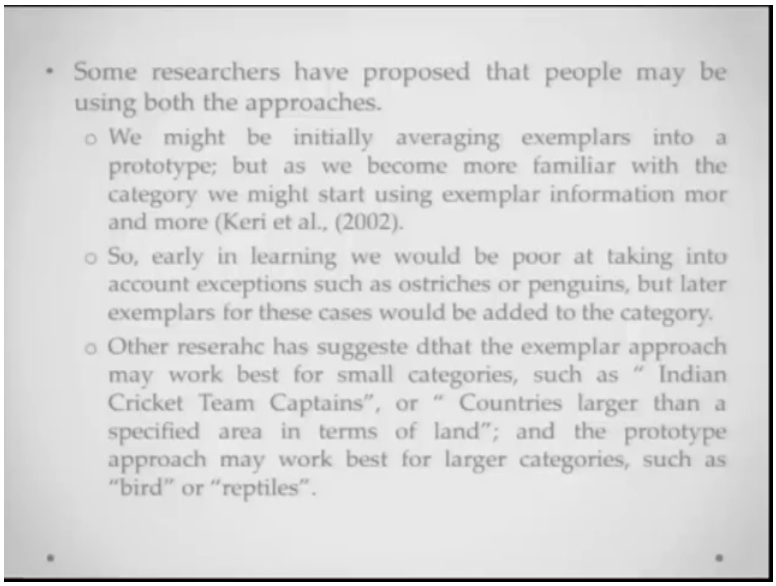

Some researchers have proposed that people may be using both approaches; the prototype and the exemplar approaches. So, they are saying that initially we might be a averaging exemplars into a prototype, but as we are becoming more and more familiar with that category as in when we are coming across more and more examples of the category then we start using the exemplar information, then we start using these different information.

So, early learning we would be poor at taking into account exception such as ostriches or penguins. When you come across these real examples you can include them into the category as exceptions and other flightless birds when they come, you can actually compare them and then be able to categorize them correctly. Also research suggest that the exemplar approach may work best for smaller categories, such as Indian cricket team captains or countries larger than a particular area and the prototype approach may work best for larger category said all birds, all reptiles etcetera.

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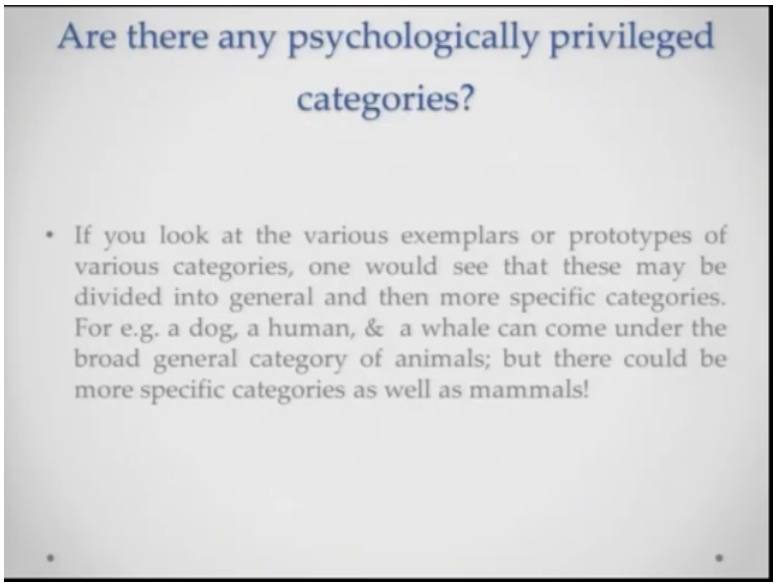

Now, are there any psychologically privileged categories because we were talking about categorization as an important tool of organizing the world into a question may be asked that are some categorizations better or some categorizations psychologically privileged do they afford a certain advantages. Now, if you look at the various exemplar all prototypes of various categories one would see that these may be divided into slightly general and slightly specific categories; for example, a dog, a human and a veal can all come under this larger category of animals, but it could also be come coming under a specific category of mammals.

So, there could be some categories that are more general in nature say for example, dog human whale everything can come into your broad category of living things versus nonliving things then they could come under the category of animals and trees say for example, or they could come under a slightly more specific example of mammals versus other species in the animal kingdom.

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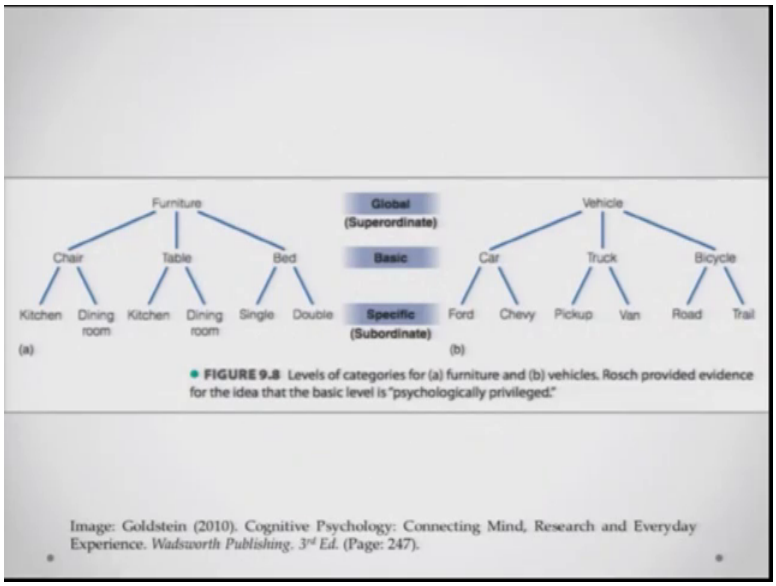

So, because this kind of categorization is possible, Rosch kind of talks about these three levels of categorization. So, she says that there are a super ordinate or global categories and there are basic categories and there are specific categories.

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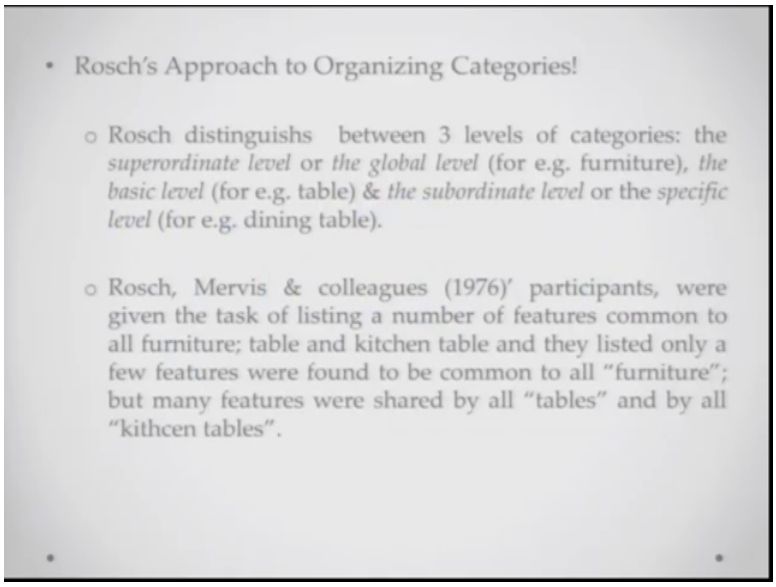

So, for example, you can talk about furniture as a global level category and chair in table as basic level categories and then if you go specific like kitchen table, kitchen chair or dining table, study table etcetera you are talking about more specific categories. So, Rosch, basically says again three categories super ordinate level, global level, basic level

and which is the subordinate level and the specific level which is there for each specific object.

Rosch Mervis and colleagues in 1976, they basically show showed participants and they gave them a task of listening to a number of listing a number of features common to all the furniture and tables and kitchen tables etcetera and they basically counted whatever number of features these people are listing for each of these. So, which are the features that are common to all furniture, which all the features are common to all tables and which are the features are common to all kitchen tables.

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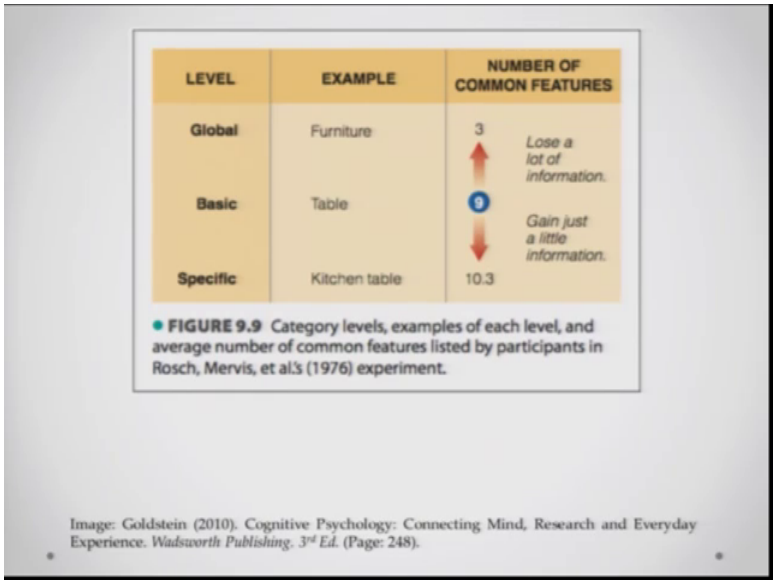

You can see here in their experiment they basically show that if you are talking about a global level example you might be just talking about three or four features at best which will fit all furniture. If you are talking about a specific level example, then you have to specify more number of common features say for example, are almost ten. But, in general something that kind of encompasses all these two levels in a better way is the basic level category.

So, if you are talking about tables in general. So, the point is that if you go up from the basic level you are losing a lot of information you do not be able to include so many members, but if you are moving away or you are moving one level up from the basic level you are kind of not gaining too much information as well this is what Rosch talks about.

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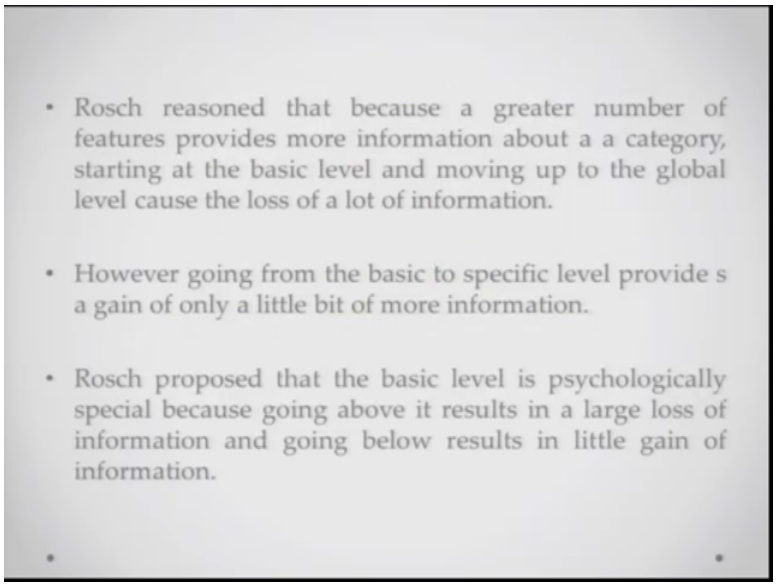

So, Rosch says because a greater number of features provides more information about a particular category and it starts almost at the basic level and then because you move up the one level global you lose a lot of information, you move one level down specific you again do not get so much information. So, that is why Rosch says that basic level is the level of categorization that needs that probably is more psychologically special, because it is the one that kind of probably you know helps you understand or help the you know gives you a better picture of the entire category at once.

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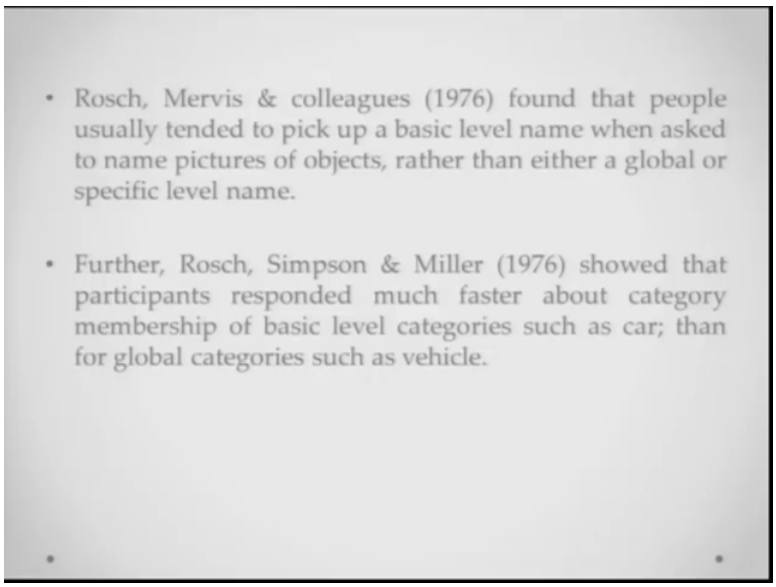

Rosch Mervin and colleagues found that people usually tended to pick up a basic level name when they were asked to name pictures of objects, such as furnitures, they will generally name, let us say a table a chair etcetera then going very specific and saying say for example, a dining table or a study table etcetera.

Also Rosch, Simpson and Miller they should part that participants would respond much faster about the category membership of basic level categories such as car that it belongs to vehicle than global level categories.

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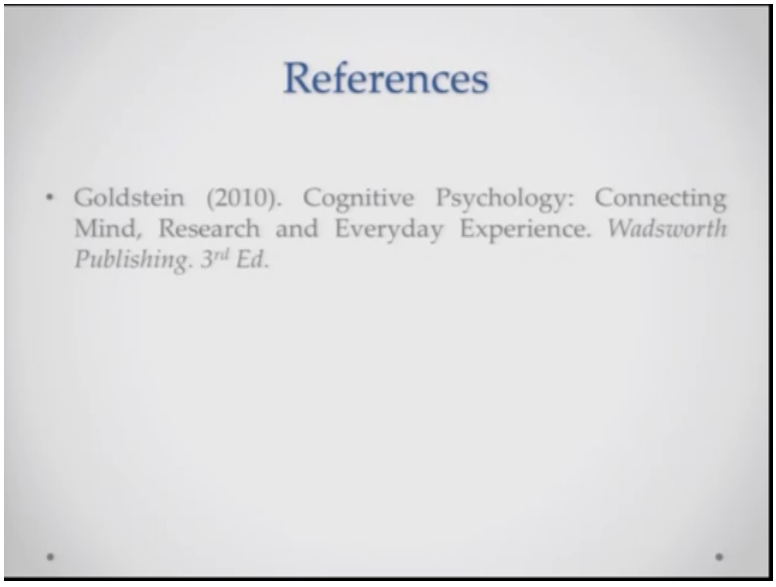

This was all about categorization, knowledge and concept and in a next lecture I will talk about more different things again under the same topic knowledge.

Thank you.