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**PROFESSOR:** All right, this is 920. I'm Schneider, and this is the first class. I will just talk briefly about the organization of the class, the procedures, and the assignments. And then the last part will just be a talk about various approaches to study of animal behavior and the main ones we'll be using in this class.

So why did you sign up for 920? Maybe because it's a HASS class. But there are other HASS classes. Maybe it's your schedule. I make it at 4 o'clock to decrease schedule conflicts, but a few of you still have them, especially with the lab on Friday.

How many of you have a lab at this time on Friday? Because of that, I will be posting the slides if not before class, at least after the class. And I will try to remember to record the classes so I can post an mp3 file of the audio. There won't be any video, so you won't know what I'm pointing at in the slides, but you should be able to make out what we said.

You probably won't hear student questions. You will miss out on some of the discussion that way, but you should still be able to keep up with the class.

So there are various practical reasons. Can anyone give me a non-practical reason for taking 920? Why should you be interested in animal behavior? Yes.

**AUDIENCE:** [INAUDIBLE].

**PROFESSOR:** OK, it might help you with human behavior. Well, we're animals. That doesn't mean I will stress animals, but particularly when we talk-- actually in both parts of the class when we talk about ethology, that is fixed action patterns and instinctive behavior. And when we talk about sociobiology-- adaptive behavior, especially social behavior-- humans will come up many times.

All right, anyway, why do I teach it? Well I think animal behavior is fun. I have done research in animal behavior, though that's not been the main thrust of my career. I am a neuroscientist, and I have done a lot of work on brain anatomy and anatomical changes after brain damage.

But I like animal behavior, and I hope that will be evident as I talk. I will use examples from my own work as well as from other people's work. So it's sort of an undergraduate survey class at the beginning, but in the second part it'll become more and more a special topic seminar, and that's especially true for the last part of the class, when you guys will be giving your reports.

I've already posted on the Stellar website an assignment. It's not due until the Wednesday before the Thanksgiving break. So you have a lot of time.

You will make a PowerPoint slide presentation, and then you will prepare yourself to give that presentation orally. Your slides will include notes that will give me more detail about what you would like to talk about, even if you don't get to talk about all of it. In the notes section-- whenever you do PowerPoint, there's a note section that is not shown during a presentation. But you can make lots of notes, and that gives me a better idea of the research you've done.

OK, so read that assignment. We will let you know if we decide to make any alterations after talking with students and with each other.

Make sure you check that Stellar site regularly. I will try after every class to make sure I post the slides, but before the class, I will usually post study questions. Those questions cover class sessions, and they cover readings that will be assigned.

Usually they don't cover readings that are listed as supplementary readings. If you don't have time to do the supplementary readings, it's all right. If it's of particular interest to you, you should do them, and it will help you understand the material.

OK, so there's just two small textbooks. I choose a smaller book in animal behavior

so that we have time to do other kinds of readings. And you'll be reading quite a bit of Konrad Lorenz and a little bit from Niko Tinbergen, two of the classical great ethologists. And I think you'll appreciate their observations when you get them directly. We also will see-- especially Lorenz-- in videos that we show in class.

There will be quizzes and homework. And almost always, these will be on Wednesdays. That is if it's homework, it will normally be due on a Wednesday-- once in awhile on a different date, but the quizzes I will try to keep limited to Wednesdays.

We don't always have a quiz. That is, in a week where we have homework, I might decide not to give the quiz, but we'll always let you know in advance.

OK so first we'll be going through key concepts emphasizing ethology. And we'll talk about what that is today. The readings will be in the Scott textbook, but they'll also be, as I mentioned, from other readings.

And then we'll see some videos relevant to ethology. And then, after mid-term we'll be talking about sociobiology. That will be mentioned today as well.

And we'll have readings. The readings will mainly be a small book by John Alcock. It's called *The Triumph of Sociobiology*, which is a very apt title. It was written a few years ago, but in fact, it does express well how sociobiology has become a major force in studies of animal behavior.

And I will go over some of the key ideas of E. O. Wilson, some of them directly from his writings.

These are just examples of specific topics. Most of you have seen these kinds of things if you've had any encounter with animal behavior. Some of them might sound a little bit-- we use specialized language to talk about behavior, and it's a little different from what you're used to from just talking about human behavior.

We talk about eating in animal behavior-- talk about feeding, and foraging, and stalking, and prey capture, and things like that. We talk about anti-predator

behavior. Do humans show anti-predator behavior? You bet they do, but we don't usually call it that, OK, since we don't have too many tigers and lions roaming the streets around here anymore.

Terms for sexuality are used, of course, in human behavior and in animal behavior, and that will be a little more familiar to you. But more specialized terms will occur there. These are examples. You can read those other things I listed.

These are examples of questions and concepts that will come up. We'll talk about what instinctive behavior is, what a fixed action pattern is. Fixed action patterns is an ecological term for instinctive behavior, but it's actually fairly complex. But there's a regular pattern in most of these behaviors. They're not the same as reflexes, and we will make that very clear in the class.

Why do some animals migrate halfway around the Earth just to mate and raise young? What is the evolutionary origin of kissing? Do animals kiss? Yes, they do. And it has its origins in animal behavior, and it's been traced pretty convincingly.

Why do animal behaviorists engage in gene counting? Why would they have to do that? It's related to a question down here-- the last one-- why might a worker ant behave differently depending on whether its mother, queen, is promiscuous or monogamous? It makes a difference. They behave differently. The question is why?

That why question has different levels. It can be an approximate question-- that is, what stimuli is he responding to? What are the mechanisms of the behavior? Or it could be what we call an ultimate question, which is not a theological term here.

Ultimate question in this class simply means, what is the evolutionary significance? What makes it adaptive for the animal to behave in the way he does? So it's the major issue in sociobiology.

What's a Darwinian puzzle? Behaviors appear that are difficult, at least at the beginning, to explain in terms of Darwinian evolution. We can't figure out how they're adaptive, so they're a puzzle. We call them Darwinian puzzles.

Why is the killing of infants adaptive in some animals? How could that ever be adaptive? You should be able to explain that, and we will do that in the class.

Some of your projects will be on topics we cover in the class, but not all of them. In fact, most of them will not be directly on any details that I bring up in the class. But I do expect you, when you're dealing with the animal behaviors that you want to discuss in your reports-- I expect you to interpret them in terms of the principles and concepts of ethology and sociobiology that you learn in the class.

What do I expect outside of class? Readings, study questions-- I will post these study questions for every class. I want you to try to answer them, if possible at least some of them before the class.

I might just ask you, sometimes, some of these questions, and I might not tell you who I'm going to ask. Otherwise you might say, well I might as well be passive. I can read it later.

But I find that when you say that, it means usually you won't read it. You'll try just to get it, what I say in class, and hope that gets you by. No, you will do much better if you read.

So read just for key concepts. There will be a lot of examples, details of animal behavior. But at least try to get the key ideas, and that's what I'll be emphasizing. I will try to. If you think I'm talking about some detail that's not a key concept, you let me know. Maybe some aspects of animal behavior I just find fascinating.

OK, I posted, and some of you seen this-- you've been looking at the Stellar site. I posted, quite a while ago, the first reading from a book by Jim Corbett. Corbett was not an ethologist, and he was not a sociobiologist.

He was actually a hunter. He was often hired to track down and kill man-eating tigers and lions in Asia and Africa. He was probably the best of hunters that did that kind of thing. And he was also an amateur naturalist.

And he's written some things about his hunting methods. And I've posted some

things that display his knowledge about what he calls sensitivity to the jungle, the signs of the jungle. A good naturalist learns those kinds of things. So please read that. You'll be asked about it in the first homework.

I've written the first homework, but I will wait for feedback from the teaching assistants before I finalize that. It won't be due until a week from today. So for the next session, I posted the first chapter of Graham Scott, in case you don't have it, but I won't be posting later Scott readings, since you're supposed to get that book. But I did post Chapter 11 from Tinbergen's book-- his semi-popular book, *Curious Naturalist*. And I posted study questions already on those readings, as well as some for today's session.

OK, these are things we've talked about. So how have we learned about animals? Of course, many of you have pets, and some of your hobbies concern animals. You've encountered animals in the natural world or you've gone to zoological parks. You've certainly encountered them in some films.

But we also pick them up from common beliefs, what we call folklore about animals. There's a long history about that. You can pick up in a library these books that appeared in the Middle Ages that are called the medieval bestiaries. They portrayed animals in a fantastic way, and the reason was they heard stories that came from observations of African and Asian animals, that they didn't have in Europe. And these were stories in Europe, and they-- because they were second, third, and fourth-hand stories, they were often greatly exaggerated and distorted.

And it was commonly believed that in the Middle Ages, people just didn't have any accurate ideas about animal behavior at all. But recent scholarship in that field has shown that even though that may have been common folklore, it was not generally representative of what was known to people who were really interested in details of animal behavior-- even in the Middle Ages. And there was a lot more known.

Why would you expect people to know about animals in some realistic terms, even a long time ago, even before the Middle Ages? Why would you expect it? Well, think of farming.

If you're going to raise animals, or use animals for work, you have to understand something about their behavior. Dogs have been domesticated probably well before people could write. OK, so it really goes back into pre-history. And certainly people knew a lot about the domesticated wolves that we call dogs.

Stories and folklore that still abound, especially in cities, concern rats. And whole books have been written about that. I have one of them here, called *More Cunning Than Man*. It's basically stories about rats.

It's not written by a scientist. He's interested in reports, newspaper reports, what people say, the stories they pass on. And the stories about rats are most amazing. They're stories about giant rats that when you hear the story, you'd swear the rat must be as big as a dog at least, and stories about the incredible harm. And the fact is they have caused incredible harm. That's one reason rats are often hated and feared.

Now, of course, in a department like this, they're used in the laboratory. We don't look at rats that way at all. But if you're in New York, and you're in a poor area, and your building is infested with rats, then it's a different story.

They have attacked people, damaged them at night. But probably the things that have made rats the least popular is the diseases they have spread or have been in some way responsible for the spread of diseases, like Chagas' disease. The book covers a lot of that. And there's quite a few diseases like that that rats have been involved in spreading.

The one that is commonly attributed to rats is the diseases that caused the worst pandemics in human history. What am I talking about? What were the worst pandemics that killed a third of the population of Europe, that killed probably more than 30 million people in Asia, large numbers in Africa? What do we call that disease? The plague-- bubonic plague-- it was a horrible disease, and there was no way to cure it.

So people tried various ways. They had great fear of it. Many people thought the world was coming to an end during that period, when they saw everybody in a building die.

Children invented nursery rhymes in their play, singing about Ring around the Rosie, a pocketful of posies. Why were they putting flowers in their pocket? To counter the smell of death.

We make it a game now with children. You know, the game ends, "We all fall down." That was dying, but children turned it into a game.

So how were rats involved? What really-- now we know it's a certain organism that causes it, but what was the vector? Was it rats?

**AUDIENCE:** Was it their fleas?

**PROFESSOR:** Excuse me?

**AUDIENCE:** Was it their fleas?

**PROFESSOR:** Yes, it was the fleas on the rats. And rats died. And when they died, they lost body heat. Children would sometimes play with the dead rats.

And as the body heat dropped, the fleas would leave the dying body, and jump on anything-- any warm, live body which often was children or other human beings. And it was the fleas that were spreading the disease. But people didn't know that.

And so they blamed various things. Some areas, they killed every dog, because they blamed dogs, or cats, or they blamed-- if you're in one country, you blame the neighboring countries. Or in many cases, it was blaming an ethnic group, or blaming Jews. It was horrible, because they were desperate and ignorant.

Of course, the way that disease has been controlled is through better hygiene and better knowledge.

Anyway, I just point out here not all rodents are hated as much as rats. We still have

hamsters and gerbils, which are cute, little rodents and used as pets, as well as in some research. And we know we use animals for various things, so we know about them that way.

We use them for meat. We use them to make leather. We use them in sports-- for hunting and to help us hunting.

We don't hunt dogs. We use dogs to hunt other animals. They're used in some religions, as you know. But we use them in science.

What are they in science? They're stand-ins for humans, usually. We use them as models. Of course, the most popular animal now for that is the mouse, because of the genetic variance and the ease of creating specific models of pathologies by altering genes.

But when we're using animals, we're often depending on behavioral tests. And what are we studying? We're studying a human disease, but to understand what we're really doing, we need to know something about animal behavior.

And unfortunately, a lot of people using animals all the time don't know much about animal behavior. We also know about them from groups like the Humane Society, and the Animal Rights Movement. It's human oriented in a very different way, sometimes with very anthropomorphic thinking.

Sometimes it's more anthropomorphism-- thinking that their thinking must be like our thinking. Their feelings must be like our feelings. I'm not arguing that they're not. We know they have nervous systems, if they're mammals, that are very similar to ours.

But we think of them commonly as being conscious, and I would argue that that's probably the case. It's not the same as our consciousness, but we know it arises in nervous activity. I'm not saying we can explain it by nervous activity, but it's correlated with it, and animals have that, too.

Different religions have very different attitudes, so I'm sure some of you that follow different religions, if you do know some of these extremes-- on the one pole, you

have Judaism and Christianity that believe in control of Nature, dominance of Nature, and so forth. And then you have examples like Jainism, where they are totally pacific and don't believe in harming any life. And we've had examples of that in West, too, like Albert Schweitzer was like that.

But in this class, we take a basic science approach. It will be descriptive and experimental. And we will use the perspective of evolution throughout most of the class.

Scientific work has focused on individual organisms. We'll talk about that first. It's focused on societies, so we'll talk about that next. But it also has other focuses, like on the habitat and species in the habitat, and the interactions of all living things, with the nonliving things in that particular habitat-- interactions with the climate, the topography, and so forth.

And then there's sciences that focus on a single species or group of species. You have mammalogy, for example, that deals generally with all aspects of mammals, including behavior-- behavior, anatomy, physiology, and so forth. Or primatology-- dealing with primates as a group-- a major field. But we don't call it primatology within, say, experimental psychology, generally. But it's used that way among anthropologists and others.

And then, of course, we have the amateur naturalists-- disciplined hobbyists. And that's important in this field, just like it has been in astronomy, because they've made major contributions. In fact it was amateur naturalists that led to the initial discoveries that led to the whole development of ethology.

So first of all, focus on the individual organism-- in America it was called, in the last century, comparative psychology. It's sometimes still called that. The real focus was on humans, but they used animals. The main type of study in the heyday of the field, the middle of the last century, was studies of learning. And it still is in many labs.

The animals used are mostly rats and mice as models for studying learning. And it's

interesting that that was not the approach to animal behavior in Europe at that same time. Why do you think that was?

Well, think of what was unique about what was going on in America. What was our approach to education? The idea was that we start life with pretty much a blank slate. And by education we can create individuals, we can influence individuals and various ways. Our children can become whatever they can become, just through learning, through making the effort.

You can do anything if you just put your mind to it. How many of you have heard that from your parents? Most of us.

Did you ever hear, "Well, you behave that way because you've inherited that behavior and that's your instinct?" No-- if you were in Europe, it was very different. But that was the belief in America.

It was wrong, but it was also very beneficial, because what did it lead to? It led to universal education-- arguably the best in the world. The country that tried to educate everybody regardless of origins, regardless of wealth-- and at the time that developed, it was unique. And we're not the only country that does that now, but at that time it certainly was.

And it was encouraged in its popularity by ideas of educators. I use John Dewey as an example. His dates are 1859 to 1952. He was very influential.

The emphasis was on practicality-- on shaping the individual through learning-- very important in the development of educational systems in America. And either implicitly or explicitly, they believe that we start life with a blank slate. And that was what came out of that in psychology-- including this comparative psychology I'm talking about-- is that same idea. They focus their whole effort on learning, almost nothing on instinctive behavior, unless they wanted-- that was the realm of the physiologist, who studied reflexes.

They didn't study more complex, instinctive behavior that we'll be talking about in this class. And so theorists arose who tried to come up with a system of learning to

explain all human behavior. You've all heard of B. F. Skinner.

You've probably heard of Thorndike, inventor of various puzzle boxes and describer of instrumental learning. So for a long time, you pick up a book on learning, and it was about instrumental learning and classical conditioning-- the two main kinds of learning. Are they? Hardly-- but in fact, that's what was taught, and it was a major part of psychology in the middle of last century. In fact, that persisted for some time-- the second half of the last century, 20th century.

But in Europe, it was very different. In Europe, you had the development not within psychology, but within the field of zoology-- part of biology. Zoology is the field wherein ethology, the study of natural behavior patterns, developed.

I will take Conrad Lorenz, leader in that field, from his book, *The Foundations of Ethology*. He defined ethology this way-- it's the discipline which applies to the behavior of animals and humans, all those questions asked and methodologies used as a matter of course in all the other branches of biology since Charles Darwin's time. Ethology, or the comparative study of behavior, is based on the fact that there are mechanisms of behavior which evolve in phylogeny-- that is, among different animals of different types-- exactly as organs evolve, so that the concept of homology can be applied to them, as well as to morphological structures.

The origins of this approach was in ornithology, and in fact, in amateur ornithology. And these are the two people that we attribute the initial discoveries to-- Charles Otis Whitman in America. These were the dates of his publications. He kept a collection of doves and pigeons in aviaries, and he studied them.

And then Oscar Heinroth, director of the Berlin Zoo-- his publications 1910, 1928, 1930. He studied the rich collection of waterfowl kept at the Berlin Zoo. So they were both studying captive animals, captive birds, but very different kinds of birds.

And they independently discovered that motor patterns, just like morphological characteristics, can be inherited, can be homology across different species. But Darwin knew a lot of this already. And in his book, he talks, for example, about dog

behavior.

If you look at this picture, compare this picture with this picture. What's different about these two dogs? You can tell right away this is a friendly dog, and this is not. This is an aggressive dog.

How many of you can recognize that immediately? Oh, come on. Surely you have pet dogs and you know that difference. This was what your dog looks like when he's greeting you when you've been gone for a long time. And he's greeting you-- especially his master coming home.

This is a dog-- usually when they act like this towards humans, it can be dangerous. OK, but they certainly act like this when faced with other dogs. And Darwin saw these patterns, because he could recognize them in one dog after another.

These were inherited patterns of behavior. They were instinctive behaviors. And he applied that concept to human behavior as well.

For example, in his book-- this is from his book, *The Expression of the Emotions in Man and Animals*, as were these pictures. Here he's showing various pictures of human emotional expressions. Our emotional expressions are instinctive-- patterns that are the same across all of us, across various races. All Homo sapiens show these same patterns.

Yeah, you say, oh, but the Japanese don't make the same expressions when they're happy, or this or-- oh yes, they do. But then in addition, of course, we develop certain ways of using expressions for different meanings. Well, ethology has been applied to humans, and not just by Darwin.

But as Lorenz pointed out, the proof that humans really had instinctive, inherited behavior patterns-- though it was suggested by Darwin, and he was accurate in his descriptions-- but the real proof came from Eibl-Eibesfeldt. Irenaus Eibl-Eibesfeldt wrote a large book called *Human Ecology* in 1989. It's available in the library. I have a copy in my office, and if you're interested in how these ideas apply to humans, you will find them described there.

I'll say a little bit more about human ethology next time, just so you'll know how Eibl-Eibesfeldt went about proving to anybody who studied his book that he was right about this. More popularly, we know about body language, which became a really popular craze for awhile some time ago. Now it's sort of entered the common parlance, but that is all based on these instinctive patterns.

We know about neuroethology. We'll say a little bit about that in class, but it's not primarily a class on neuroscience, so I won't stress it. But I will say that studies of the brain have led to studies of how instinctive behaviors are controlled.

And brain studies have been used to distinguish different kinds of aggression, for example. But they're all things already known to ethologists. Obviously, if patterns are very different, then they're expressed differently in brain activity.

OK, now if the focus is on societies and social behavior, then we're usually not talking about ethology-- though I should say there's a lot of overlap between ethological studies and sociobiological studies. But the main emphasis of the work in sociobiology has been different.

Edward O. Wilson at Harvard was the one who invented the term sociobiology, though it had been used before, for example, by C. Judson Herrick, a comparative anatomist who wrote a book on human nature and behavior. But it was very speculative, and if you read what he actually says about sociobiology, it was very different from E. O. Wilson, because he never even refers to Darwin. So it was really Wilson that brought-- he wrote basically a review of many different aspects of social behavior in many different species, and in his last chapter, it was about humans. And that is what caused him so much trouble.

There was actually a revolt among humanists and even scientists here at MIT, that tried to-- they wanted the whole field suppressed. I know that's hard to believe, that in recent years that actually happened. But I was already at MIT when that was happening. I met E. O. Wilson. I like Ed a lot, and I had also, like he did, trouble understanding why people were getting so upset.

Konrad Lorenz has been attacked, also, because he applies ethology to human behavior, too. You see a lot of people who do not want any of this stuff that we apply to animals to apply to humans. It becomes a political thing. And I will just urge you to keep politics separate from the science. But that's what people were doing.

And at the time this came out, ideologies were being argued a lot. Socialist ideologies, communist ideologies believe strongly in not anything inherited. And for very different reasons than, say, what we talked about in the development of education in America-- very different approaches. But it led to a more vehement opposition to sociobiology, and we'll go through that history in the middle of the class when we start talking about sociobiology.

It's very different from cultural anthropology. It's very different from sociology. In fact, sociologists have been very resistant to applying to the application of Darwinian ideas and evolution to social behavior of humans.

Many cultural anthropologists are the same way. It's culture that determines our behavior, not biology. That's almost a quote from some of these people.

I hope you don't end up believing that. But anyway, here's-- from E. O. Wilson's book, I just wanted to show you how he conceptualized this, just so you can see it. Here was the way he conceptualised these fields of study of behavior in 1950.

He has ethology and comparative psychology in America. Ethology in Europe is quite separate, which they were at that time. Here he has the beginnings of sociobiology, but the word was not being used in 1950. It was part of behavioral ecology, just part of ecology, and that was closely connected to population biology. So that was the close link, just like over here on the other side, you have integrative neurophysiology closely linked to cell biology. In the middle you have these behavioral fields-- ethology and comparative psychology.

OK, so then 1975 is when the term sociobiology originated. The ties to population biology were made explicit by E. O. Wilson. Ethology and biopsychology or physiological psychology-- it went by various names-- now it's often just

neuroscience and behavior, or behavioral neuroscience-- had become a little more closely linked.

But I think he's overly optimistic, because in 1975, those two fields were still largely separate in the way they were carried out-- the work being done. And here's the way he envisioned it back in 1975 and '80 when he published his books-- he saw sociobiology increasing, these fields decreasing. It hasn't actually happened quite like that.

What has happened is that both ethology and experimental studies of animal behavior in America, including a blurring, have become much more integrated with ideas of sociobiology. In fact, the most recent books in animal behavior-- I was reading them this summer-- they go to great lengths to integrate, almost discuss in a pretty seamless way, sociobiology and ethology, for example. What I didn't like about them is that they start out with all this gene counting, and you feel like you're studying not animal behavior but some mathematical field.

It's a little hard to describe, but I didn't feel that it was very successful. If you don't know much about animal behavior in the first place, you'll find it really dull. So I don't take that tack, but you will learn the same things.

OK, if you focus on the habitat and the species a habitat supports, then you're talking about ecology, and you can find the field of behavioral ecology talking mainly about behavior. If you focus on a single species, then-- we've already mentioned this-- you can talk about primatology or cetology if you're just studying cetaceans, entomology if you're studying insects. If you're looking in mammalogy, though, you'll find topics you simply don't find in ethology or physiological psychology.

Running speeds of land mammals, submersion times of aquatic mammals and amphibians, tunnel structures of burrowing mammals, the composition of milk in various mammals, the biomass of animals, the total mass of all animals in a habitat or in a region, or the mass per unit area on the Earth's surface-- you don't find those in these other behavioral books, but you do find them in mammalogy books. And then we discuss the amateur naturalists, and that's where I end. And I will tell

you a little bit more about these topics at the beginning of the next class.