PROFESSOR: In the last class we were talking about the parasitic birds that lay their eggs in the nest of another bird, and I asked you a question. Now how-- why wouldn't these other birds evolve means of opposing that? Why don't they just learn to recognize the eggs of the other bird?

You can see here that in many cases you can see that much larger egg there, and yet they, generally, will raise it. Raise the chick. In fact, it's often at the expense of their own chicks, because the cuckoo is an aggressive chick. Often you know pushes the other, the smaller chicks out of the nest. And sometimes the foster mother, and in this case, is raising only the cuckoo. But at least her reproduction is considerably diminished by this problem.

And one of the reasons they do it has been investigated in a study of the spotted cuckoo and magpies in Spain. At a time when the cuckoos moved into an area the magpies were living-- or the magpies moved in, I can't remember which. I think the cuckoos came in later. OK. And so they started laying their eggs in other birds' nest.

But then they found out that the birds often do destroy the cuckoo's egg. But when they do, there's sort of a mag-- a cuckoo mafia that comes around and destroys their nest, so then they don't reproduce at all. And it's better to reproduce even a few than none. So that was the mafia hypothesis, and it was verified in Spain.

But there have been reports-- and I don't know of any really quantitative description of this, but were cases when the song bird would build a decoy nest above his real nest and lay eggs in both. And the cuckoo generally will lay the agony-- the conspicuous nest, the nest at the top, and the next below is more hidden.

But I don't know just how often that happens. But they have to do it in a way that this is group of cuckoos couldn't force them, or couldn't destroy their nest, because they destroyed their egg. So we saw this last time.

Well so the cuckoo is exploiting the innate releasing mechanism of the song birds that they use to raise their young. It's because they can't resist that big gap of the cuckoo chick. It elicits feeding behavior, so they get fed.

But this kind of thing happens in humans, too. We discussed earlier how the food industry and restaurants add extra fat, including saturated fat, to foods-- especially the fast food industry-- because people prefer the taste. They wanted to be fat. Think of all the people that are eating the high fat potato-- what do they call them?

STUDENT: French fry?

PROFESSOR: --the French fries. I never eat them, so I don't even remember their name. All right. When you're diabetic you know you really pay if you eat stuff like that. The high fat, because fat digests very slowly and it raises blood sugar for many hours afterwards. It has more than double the number of calories of protein and carbohydrate.

But what-- I mentioned here the doll industry. These are pictures from-- [INAUDIBLE] one of his papers-- and some of these properties of infants were pointed out by Lorenz and how you find it in many different species-- that babies have a relatively larger head, relatively larger eyes. They have short limbs-- short usually chubby limbs, and that appearance of the baby elicits care giving.

You know even a big, aggressive male will respond to babies showing these properties, especially if the baby's submitting the cute little sounds they make. We call them cute, because of these stimuli that they have, and even men are affected by it. And the doll industry uses that also in creating dolls. The cupie dolls normally made with the, again, relatively larger head and large eyes.

But if you overdo that, what happens? There's a line between what's cute and what's grotesque. OK? So obviously they simply use human reactions to shape the way they design those things.

OK. Now we talk about key stimuli, and we say that they can release fixed action patterns. But we don't call all key stimuli that engage the innate releasing mechanisms, we don't call them releasers generally, because that term is used somewhat differently. A releaser is a stimulus property that has evolved for the purpose of communicating, for the purpose of eliciting behavior from members of the same species.

So this is the way it's defined. "A structure or a movement, most often a combination, that's evolved in the service of sending a signal." So it is they emit key stimuli. So in nature whenever you see release showy color patterns or structures, in any vertebrate. And they don't have to be invertebrates, they can be invertebrates as well. And also any louder or regular sound utterance, any regular complicated and rhythmically perform movement, like evolves in the rituals of courting. It functions as releaser.

And I'm showing you the cover of Smithsonian's-- of a Smithsonian publication there that shows the hamadryas baboon face. But let's start with humans. Describe two releasers in human, one involving a motor pattern. Well that's easy, smiling. Smiling is a movement, but it's evolved because of the way it-- the stimuli it that cause a reaction in others. OK? Almost all of us respond positively to smiles. OK? And we smile whether we're aware of it or not in order to, you know, get those positive responses.

What other-- Can you think of anything else? Think of babies and their parents. They've evolved not just the larger head and the short limbs-- I mean there could be various reasons for that-- but they've evolved these chubby cheeks. They actually have fat pads in their cheeks that disappear later on.

They've evolved specifically to elicit a certain reaction. And there's no doubt that human breasts have a similar function, that is breasts don't have to be as large as they are. They evolved in order to elicit response. OK? So these are what releaser are. And there's of course many others you can think of, various emotional expressions and things that also have evolved as these signals, social signals of various sorts.

Now when we talk about mimicry, we're usually talking about something that's evolved to affect the behavior of another species. Like the monarch butterfly has mimics, because the monarch tastes terrible. Other, you know, birds won't generally attack monarchs, because they taste bad. So they quickly learn, you know? It only takes one experience of a really horrible taste and animals won't do it again. But so other butterflies and moths have evolved to mimic the bitter tasting ones, and the same thing happens in some insects.

But in some cases a species evolves some way to mimic-- a mimic that affects its own species. And these are the two examples, I like the mouth breeder fish. Let's look at that here. The mouth breeder fish. Here's the male. And if you look here at the anal fin you see the little spots. What are those orange spots? Well they look just like the eggs of the female mouth breeder.

Well what does the mouth breeder do? She lays her eggs and she takes them up in her mouth. She breeds them in her mouth. So she tries to get these, too. Perfect for the male.

He comes after-- she comes after the male, her mouth is there trying to get at those eggs, and what does he do? He injects semen right into her mouth. So he fertilizes her eggs. So that's why the mouth breeder fish has evolved that way. The mouth breeder male.

Now let's take baboons. Here's a female olive baboon, and notice this pink patch on her rump. It's used as a signal. It's evolved to affect the male. But then look, males evolve a patch, too. And some of them-- I couldn't find a really pink one, but this one's pink only at the edge. But the hamadryas baboon, it's even more obvious.

You know here's a male hamadryas baboon, and look at the pink rump on that animal. And here are two females actually presenting to a male, and you can see. You know that's what's being imitated. Well why would they do that? Why would a male do that?

Because if a female appears and presents to him it totally inhibits his aggressive response. These are pretty aggressive animals. OK? And they need ways to turn off the aggression, so the males have taken advantage of that. They evolve a signal where they can turn off the aggression of a more dominant male, and it protects them.

And many rodents-- many of these things are a little more subtle. You know a hamster a normal Syrian hamster-- has evolved these white patches on his chest. OK? If those are exposed it reduces the aggression of a male. OK. If he wants to attack, he actually covers them with his feet. OK? Because of the signal property that they have, and similarly their white underbelly. If they expose that, because they're defeated in a fight, it generally works pretty well to inhibit the attack so they won't get killed.

The only time I've had hamster males kill or females-- they both are pretty aggressive-- kill another animal is when it's an artificial situation in a cage where the animal gets caught and he can't expose the right stimuli. Like he's caught in the wire mesh or where he's not-- they're in such close quarters, he can't, you know, actually expose those signals.

All right. Just a couple of other things, and we'll get onto the next class here. I want you to know what the dummy rule is. The rule is that if you can make a simple model-- like those models of the stickleback female-- that elicits a fixed action pattern-- like following response of the male-- then we're dealing with an innate releasing mechanism. Something that has-- on the sensory side-- that's evolved to respond to those stimuli.

But if you can't find a dummy stimulus that works, it doesn't mean there's no innate releasing mechanism. And the reason is this, learning. The usual role of learning in animals, it does affect instinctive behavior.

And the way it-- It usually doesn't affect the motor side very much. Different motor patterns can be linked in specific ways as we've talked about with the attack behavior, predatory attack in cats. They do have to put the various individual fix motor patterns together. OK? They learn that. But the selectivity of the stimuli that elicit the fixed action pattern can be increased with learning. OK?

So in imprinting you see that happening. It can change with the experience of the animal. But even an animal that doesn't have to imprint, he responds innately to something. Like a novel box moved overhead above turkeys can elicit the anti-predatory response of crouching and freezing, but that can become more specific with experience.

OK. Now this will take us the rest of this hour and Monday. I want to go through the theoretical models of fixed action patterns, and the innate releasing mechanisms of Lorenz and Tinbergen, which have been the major ones. And you can easily see how their models can be put into computer models using information flow. And that has been done fairly successfully. The second thing is the hierarchy and chains of behavior. The hierarchical organization of instinctive behavior.

And then spatial orientation by reflexes, and an internal model. We'll talk about that. And then finally what happens when there are multiple motivations arise simultaneously? And that happens very commonly. And sometimes two motivations can be almost equally strong. How does an animal handle that?

OK. So Lorenz' model we call-- it's sometimes been called a psycho-hydraulic model. It's really a sort of hydraulic mechanical model of the motivational state, the action specific potential in his terms. And he had two models. He changed it after awhile.

On the left, there you see his old model. The action specific potential was represented as reservoir. The endogenous stimulus-- that is an internal stimulus-- is always there, and so it's gradually building up that level until its released. And he has the release there by the-- he throws this mechanical thing where the spring there represents some kind of inertia of the system. But the releasing stimuli there caused the discharge of that fluid.

But then his observations on animals made him realize that it's not accurate enough, so he revised it. And he realized that there's not only this endogenous input that's gradually building up-- like our tendency to blink our eyes gradually builds up until we blink. And we do it spontaneously, and we don't even think about it. Unless right now I'm conscious of it, and I realized that I've now blinked twice since I started talking.

OK. But he's got other stimuli there, too. And these are, he calls, readiness increasing stimuli. They are stimuli that don't act quite like the releasing-- they're not adequate to actually release the movement, but they do increase the motivation. OK? And you can think how many of those could be learned.

But then the releasing stimulus-- the key stimuli that caused the discharge of the fixed motor pattern-- is like just pouring more fluid rapidly into the cup. So he sees the releasing stimuli as just something that raises the motivation to a high level, and it does so rapidly. And I've defined the various things there below. Now the major difference, of course, is the way the releasing stimuli are acting, as I pointed out. And the--

Where these things are in the CNS-- this is very far from any kind CNS model. It's an analogous model. OK? It's a hydraulic mechanical model that unfortunately looks more like a flush toilet than other things you can think of, and so sometimes Lorenz was made fun of for this.

But in fact the model was useful in that it pointed out properties. He's basically summarizing properties that he observed for many different fixed action patterns. And the one on the right does a better job than the one on the left.

Now if we talk about where these things are in the brain, it's interesting. Because if we go here-- Now let's say you're stimulating the spinal cord or the hindbrain. You can get various components of fixed motor patterns. OK? But generally only when the stimulus is on, you get them. So it's not acting at all like the action specific potential in the reservoir here where you get the whole sequence. OK? And when you suddenly take the stimulus away, the action doesn't just suddenly stop, just like in the model.

So I just summarized that here. For low levels, the behavioral changes occur only during the periods of stimulation, then they stop. And in fact if you have an animal that's had a transection of the higher of the brain-- they've been totally separated. They're no longer influence-- the hypothalamic region, the whole forebrain is cut off from those lower regions-- you can still stimulate fixed action patterns, but only the motor component. And they just stop immediately, just like the effects of electrical stimulation of those lower levels.

But when you stimulate in the caudal forebrain there, the hypothalamic area, then you do elicit moods that are very, very hard to distinguish from the mood that would occur normally. And that's been done for both the quiet, biting attack-- the predatory attack-- of a cat, and for the more aggressive defensive attack.

And you are all familiar with that. The cat that arches its back, you know and extends its claws and makes a lot of noise. OK? We call the other one a quiet biting attack, because he does not make noise. It's designed specifically to kill prey.

So I'm just pointing out I want you to give examples of the effects of the inertia of excitation in animal behavior. Think of an example from human behavior, but it occurs with animals, too. You suddenly remove the stimulus-- you elicit the whole-- you increase the level of motivation that-- remember Lorenz' model on the right there. You cause the motivation to go way, way up. If you just suddenly remove that stimulus, the behavior doesn't just go away. OK?

I like the example from a Disney movie of a bear. They show the bear that's high on a hill, and he's trying to get something in a log-- a big log. And he crawls in to the log as far as he can get, and he gets stuck there. And then the log starts rolling downhill. Bonding downhill until finally it crashes against a tree and breaks open the log. And the bear comes out angry as can be. And he starts swatting. He pulls little trees. You know just like an angry human, that you don't get over it suddenly, even if the stimuli are gone.

If something on the TV makes you very angry, some people have been known to break their TV. This is the inertia of excitation of a fixed action pattern by this change in the motivational level here on the right. You can remove that stimulus there, but the reservoir is so full that the action continues for some time. All right.

So you see that with fear, with aggression, with sexual excitement, certainly. These are the areas certainly in human behavior, but also in many animals that you see that the most.

How can we explain the fact that the urination activities of a male dog often don't depend on the amount of urine in the bladder? You say, well, why do we urinate? Well we have an urge to urinate, because the bladder's full. But in the case of a dog, urination has other functions. So there's two very different motivations that make, at least, the male dog urinate.

In the case of female cats-- in the case of cats-- I don't know about-- I don't think dogs-- But what are they doing? Why do they hold back? They don't discharge all their urine. They need it for scent marking behavior, so that's a separate motivation. OK? And cats do it, too, both male and female, because of the odor.

These are very olfactory animals, and their whole world is very different from ours. It is visual and auditory, like ours, but much more olfactory. They come into an area, they know which other cats, which individual cats have been in that region, and whether they were male or female. OK? And they leave their mark. Humans sometimes do that, too. They write on walls and things like that. OK.

Let's talk about chains of behavior, and then the hierarchy of the systems of fixed action patterns. So as an example here I'm asking for a description of the chain of behavior patterns shown by newborn kittens in nursing behavior. It's very interesting. It's a consistent chain of behavior that they show. And normally one behavior leads to the next, because it leads to the stimulus that elicits the next. And I've listed them here.

If he's awake, and he's not suckling, he shows this constant to and fro sideways sweeping movement of the head and foreparts of the body while he creeps forward.

I know, of course, he's normally near the mother.

And if he touches a solid vertical surface, even if it's not the mother, he snuggles up to it and maintains contact while he continues that sweeping motion. It's designed, of course-- even though it's a fixed motor pattern-- it's designed to find the teat of the mother. So if he contacts fur, he stops his forward motion. OK?

But he continues the sweeping motions, his nose pressed against the fur. If he touches a bare spot, then he ceases the sweeping motion, and initiates a different behavior. He's kind of snapping. He's trying to get the teat in his mouth. So he finds it, he stops his other movements, and that initiates the suckling behavior. Sucking behavior. And also milk treading while he's sucking. You see this movement of the front paws.

So each motor pattern serves as appetitive behaviour for the next fixed action pattern. Or I would say the next component of the sequence, because these are always linked. But Lorenz sees them as a very different fixed action patterns, because, in fact, you don't have to have the whole sequence. If you put the animal right next to the mother, the he won't show the earlier components. He does not have to go through the earlier ones, because they're all somewhat independent fixed action patterns. But they're normally linked because of the situation.

And Tinbergen had described these kinds of things as examples of the hierarchical organization of instinct. And he has some very well known diagrams that you should be familiar with.

He shows a view of innate releasing mechanisms that are quite a bit different from Lorenz. They did work together some, but they had a different way of picturing it. And you can see that he doesn't explain some of the aspects that Lorenz was dealing with. All that stuff about the inertia behavior and so forth, he didn't try to deal with. But he did deal with the hierarchy. In this case we just take one component of it. OK?

And this is just for example. We're dealing with an aspect of reproductive behavior.

Hormones provide a major input. The higher level could be coming from the visual system that signals the time of year. Other input that increase that motivation.

And then, unlike Lorenz, he has a block preventing the continuous discharge of the motor patterns. And the innate releasing mechanism-- and then the stimulus that activates the innate releasing mechanism-- its function is simply to remove that block. And then the block, once it's removed, can elicit a whole series.

And which one would be first? Well the one with the lowest threshold, and normally that's appetitive behavior. OK. And these different components of the fixed action pattern are normally inhibiting each other.

And this shows a more complete model where he shows a male stickleback reproductive behavior. Basically the whole hierarchy starting with hormones with the spring migration. The nature of the water has an influence, the plants in the vicinity, and various internal factors.

And then there's the block. The innate releasing mechanisms that can remove the block and start these various behaviors. And note he has the mutual inhibition shown by the double arrows here. He has fighting, nesting, courtship, and parental behavior, each with somewhat different stimuli. And so depending on the stimuli there, these will be discharged.

And then he shows the lower levels, too. The level of the actual action. So here for fighting behavior he has the displaying, the biting, and the chasing. OK? And if you get the display purring, then you get whole fins, raise of one fin, muscle fibers of one ray, and motor neurons. For when the muscle fiber--

So he shows the whole hierarchy here. And this is often reproduced, because-- Neuroscientists like it because it sort of fits the hierarchical organization of the nervous system. And this shows a functional picture of that. OK. And I'm--

This is the level of ethology up here, and you are at the level of neurophysiology. They study different aspects of it. But in fact the physiologist working on hypothalamus have also studied many of these things.

So the major difference then between the Lorenz model and the Tinbergen model I've listed for you here. Obviously Tinbergen's view was the broader one. It looks more like an information flow scheme. But Lorenz by focusing on the dynamics of the drive state, the action specific potential, and the innate releasing mechanism it's showing very different aspects of the properties of innate behavior. And here I just point out the strengths and weaknesses.

And I also note that Tinbergen's model has been more popular among the neural people. But it was the Lorenz view that was actually used in the modeling of real behavior patterns in animals. In the work of Bruce Blumberg here at MIT when he was doing that in the media lab. OK.

So let's go to the discussion of Lorenz-- of the work of [INAUDIBLE]. And this is his work on the female digger wasp, because it points out another aspect of innate behavior that I think is quite important. And this-- We're going to come back to the digger wasp next week when we read a little bit from Tinbergen and his studies of orienting behavior in that wasp. How does he find things? OK.

So he's doing experiments on the influence of inspections of the nest by the wasp. It's a behavior that has a lot of plasticity. OK? And this is what the digger wasp is like. And note there's a hole in the sand. And she's made that hole, and it's basically a nest. She makes nests in the sand, little holes in the sand. And she digs a separate hole for every egg she lays. And she has to--

The egg will hatch. A larvae comes out. And when the larvae comes out, they have to have food right away. So she catches insects. This wasp is catching little insects and worms. And brings them-- killing them and bringing them, putting them in these nests.

But she doesn't have just one nest. She has a bunch of them. And so when she comes to a nest she inspects-- Her first task is just to inspect it. And if it's already got some food there, then she goes on. And if it's empty, then she will fly off, and she will bring food back. And she has to remember which nest it was, and she does.

She does it pretty accurately. OK?

And she can have a lot of different nests. So when you look at the whole situation it seems like quite complex behavior that obviously involves some learning. And yet the whole structure is innate behavior, but with these specific things she has to remember in order to carry out the whole sequence.

So what she detects in a nest determines her next behavior. Looks like my words didn't all copy there. So the behavior sequences are complicated by the fact that she digs and uses multiple nests.

And that led in general motivational states underlying the feeding behavior of chicks and geese also show this relative hierarchy of moods. And a good example is the feeding of ducks, which we talked about that a little bit. But we didn't describe this behavior, the upending behavior of ducks and geese.

What's upending? Have you ever watched ducks or geese feeding in a pond? Much of the time you only see their tail. They're upended. They're looking for something down below. OK? And that's how they feed.

If you feed the geese, or the ducks, on the ground then they wouldn't have to do that. Right? Ah, but they're highly motivated to do upending. See it's a separate motivation. So if you deprive them of food, they will go out and upend. OK? They're not-- They're feeding because they want to upend. They're not upending in order to feed.

And that's similar to what we talked about before when we talked about the starling poking into things. He's so highly motivated to poke, that even if he's well fed, he will do it. And similarly the cactus finch would still find a cactus spine and poke into things. Because he's highly-- even if he's well fed, because he's highly motivated to do that.

So well fed birds deprived of upending-- we'll do that. Here's the picture of what it looks like. Two ducks upending. And I just point out here that the action specific potential for that behavior is separate than for hunger. So to deprive them of it, they will show the behavior.

Lorenz has this interesting little discussion of why the head-- which he says contains the locus of superior command-- had to be invented in evolution. So how is the function-- I'm asking, has the function of the head ganglion changed in higher vertebrates with respect to fixed action patterns? And that's an interesting question. Lorenz says the head had to evolve to limit behavior to one motor pattern at a time.

It was to embody the innate releasing mechanisms also, because most innate releasing mechanisms involve stimuli coming into the head. And the stimuli come in through the cranial nerves. Most of them do not come in through the spinal nerves. OK?

There are some components, for example in that nursing behavior of the kitten looking for the opportunity to nurse that do come in through the spinal cord. But most of them are coming in through the head.

And I'm asking here how the function has changed in higher vertebrates? I would say that the main thing that's been changing is increased linkage between innate and learned aspects of behavior. And that reaches a peak in humans, but it's very prominent in other animals. And the other is initiation of behavior patterns by learned motivations. Motivations can be learned. OK?

And acquired motivations are common. We all know about, of course, some of the bad ones, the addictive behaviors. But there are many different motivations. We become highly motivated to do certain tasks. OK? Well that was not-- we didn't carry that with us from the uterus. OK?

But also our cognitive level, we contain a model of the world. And in that we make-- embodies choices we make and so forth.

I just point out here that the cognitive level is at the top of a neural hierarchy. But it doesn't mean just because it's at the top that it's always dominant. And we all know that for sure. People can be totally dominated by the drive to enact revenge, drive to feed, drive to acquire things. These are innate behavior patterns.

And that cognitive level that's often not at the top. Maybe in true intellectuals it is. I define a true intellectual as somebody who, by what he knows and what he learns-- the cognitions that he acquires-- actually affect his behavior in a major way. It's not true of most people.

In fact when one student working with Bruce and with me here at MIT was simulating human behavior, everything in it, except for some very simple spatial things, was not learned. It was all built into the software. And yet you show the results of simulations where you see people moving around, making choices, and this and that, it looks like pretty normal human behavior. So a lot of times when we're observing human behavior, we're just looking at fixed action patterns.

All right. Next topic here concerns what we call taxis and reflexes. This involves spatial orientation. And that leads to a discussion of thinking in higher animals.

First of all-- and we won't have time for too much more than this-- explain how the mantle of reflexes-- the term I've used from Fromholtz and Lorenz uses it, I believe. It tends to conceal the rigidity of fixed motor patterns. You know?

When we walk, for example, we know that's a fixed motor pattern. It appears at a certain age when the neural mechanisms of the spinal cord mature. And the various gaits are walking and running. The various gaits of a horse, which are multiple. They're all inherited.

And yet at least, especially for humans, when we're walking around it seems to vary a lot. It depends on what we're walking on. It depends on the terrain. Even horses change the way they walk, even though-- much less than, say, the more sure footed animals like goats and donkeys. But it's being adjusted by the reflexes. You know?

If I'm walking along here, I'm responding visually here, too. And I don't even look here, but I can see the edge of this table. And I will walk around it without even thinking about it. This is just an example of simple spatial orientation reflexes that alter the way the locomotion is expressed.

And there's much simpler examples. Like the egg rolling behavior of the graylag goose. Every time you see a graylag goose rolling an egg back into the nest, it looks a little different than other times you see it. Because the egg is rolling this way and that. It's meeting little stones and he has to keep adjusting how he's getting his beak over the egg and pulling it back towards the nest.

So it looks like it's complex, and yet it's a fixed motor pattern. That's basically the same motor pattern, but it's working at a higher level than all these reflexes that are constantly adjusting it. And the reflexes never stop. Remember they don't depend on the motivation. They always act.

So it looks variable and complex, because it's superimposed on the behavior of these various reflexes. They're vestibular. They're tactile. They're visual, and so forth.

Last topic. A goldfish behind a barrier. Let's say these are thick weeds. He can't swim through, but he can see through it well enough to see that there's food on the other side.

How does he solve that problem? And actually goldfish do pretty well. Better than dogs actually.

Here's what he does. He swims right for it. And as soon as he touches it, he's got another reflex. OK? We call it a negative thigmotaxis. A negative response to touching with his snot, and that causes him to pull back.

Now of course the algorithm can vary among fish, and it's very different in dogs. But normally he will keep trying to get at the food, but he will keep moving like this until he can get at the food.

So just two reflexes are enough. Positive telotaxis is what we call his moving towards the food. It's just a technical name for it, positive telotaxis. Telo means the end, taxis movement. OK? Directed towards the prey, or towards the other food that he was trying to get to.

And then the negative thigmotaxis causes him to avoid the obstacles, branches, plants, so forth. So it looks like intelligent behavior. He seems to figure out how to reach the food, but in fact it's just two reflexes running on. OK?

So now think about how a dog does it. And we'll come back here next time.