PROFESSOR: OK, most of the hour we'll be watching the first half of the video on chimpanzees, but I wanted to finish, revise, revise a little bit on motor learning to try to make it clear what I'm trying to get across. So let's just go through motor learning again.

The acquisition of path habits I talked about, the main point here is the movements acquired independence from sensory input. So it's not that they're continually responding to things all along their path. If it becomes learned in the motor system, they just run it off like a fixed motor pattern. You remember when we talked about fixed action patterns in birds, the geese and ducks, the way you roll the eggs in. If you interrupt it, they just have to start all over again if they're going to do it at all. It's a single pattern. That's what this path learning amounts to. It becomes encoded in the cerebellum.

OK, so, it's like when you recite something from memory or learn to play a musical instrument. You probably have all had the experience of you're reciting something and you don't quite have it learned perfectly, so you get stuck. And then, to remember it, you have to go back to the beginning or to some chunk, beginning of some chunk, before you can do it. That's because you've learned it. If you memorize something it often becomes motor learning.

OK, so, and it acquires some similarities to the motor component of fixed action patterns. As I mentioned here. And then it gets very resistant to change. And perhaps most interesting is that in many cases it seems to acquire its own action-specific potential. That is, it requires a motivation for the animal to do it, or the person. It usually requires a lot of repetition. Like when you learn skills, sport.

We talked about the difference in locomotion between these different ungulates and what sure-footedness is. It's an example of, the more sure-footed animals, simply, there's more separate elements in their action pattern. So more subject, we would say, subject to voluntary control. We can decide to use it. And so I've reworded this just a little bit to help you understand what that's all about. But I think it's clear enough with that.

I wanted to add this about the exploratory-- sorry, what did I do here? Oh, this got out of place. OK, this belongs with the discussion of voluntary behavior.

Animals that have evolved direct axonal projections from the neocortex to the motor neurons. There aren't all that many, but higher primates have that. Raccoons have it. A few other species. Then the unit of movement is just the digital movement. That's the smallest unit you can get. And animals that have that, like us, yes, we have voluntary control for individual digits. Someone can tell you, could you move just your little finger, and you could do it. We can't do it very well for the fourth finger, but. In general, we have that kind of control, but most movements are not that. We can't control just individual sets of muscles like that. Most movements we don't have that kind of voluntary control over. And that is true for other animals, of course, even more.

And I mention here that I talk about these projections from motor cortex and the motor areas of cortex in a mammal, but if you talk about birds, they don't have a neocortex, but they have equivalent structures. Especially this hyperpallium region. And it becomes so well-developed in the more advanced birds, like the corvids, parrots. It forms a bulge. And they actually have a motor wulst, they have a somatosensory wulst, visual wulst. That's the equivalent of those areas. And they also have these direct projections to the spinal cord. I'm not sure if they go directly to motor neurons as they do in the higher primates, but that's possible. So OK.

Although I reworded this a little bit, we talked about exploratory behavior and curiosity before, so I don't think we have to go through that. I just want to point out here in the functions of play he actually introduces what amounts to three additional types of learning. All learned in play. So they amount to a different kind of learning than learning in other situations. So I list them there. And then we talked about research on art and humans. But that's where we ended yesterday. You can go through all these different kinds of learning, and neuroscientists can relate them to specific structures. For example, the habituation and sensitization, these learning without association. It can even happen in spinal pathways. So all the sensory motor pathways can be subject to that kind of change.

The other things of interest are the-- not just the cerebellar mechanisms for motor learning but for the simple habit formation, including avoidance responses learned through trauma. They involved the corpus striatum responsible for many habits. It's especially true of this type of learning affected by the consequences of behavior. And here's what we were going through before.

But one more thing I wanted to go through in just a little bit. And that is another way to classify learning is to begin with the brain mechanisms. And here I just focus on the forebrain. I've not tried to do it for-- because we don't know enough really about the various kinds of synaptic mechanisms, various kinds of anatomical changes. This field is still pretty young. But we do know quite a bit about involvement of forebrain pathways and the kinds of learning they're involved in. So we can separate, then, learning object location in the sense of an egocentric localization. So if I glance at this group here, I can retain in my memory, at least very briefly, a working memory of where various things are in this room. In fact, some people can actually see it if they shut their eyes. I can't. I was talking to one of the students in this class about this. Probably 5% to 10% of you could do it. But you all have that ability. You could remember briefly. And we call that working memory.

OK, the egocentric position, meaning where from the position of my head and eyes something is. The door's over there, and there I know that's a wall, so on and so forth. And some of these, even if I've seen it only briefly, I will retain. So that's a very simple kind of learning. And we know about the pathways involved in that.

As for object identity, we know it's another kind of learning. But we also now have another kind of localization. Namely, allocentric localization. Where am I in this environment? Where am I in this building? Where am in Cambridge? And so on and so forth. And we're learning that all the time.

And then I had listed other things, like learning and sensory motor coordination, movement patterns. That's easier to relate to the things that Lawrence is talking about. What about the formation of plants? That's a kind of learning. Because we're changing them all the time in our brain. OK? Involving prefrontal areas of the cortex.

And then I go through this a little more, expanding the object location to include objects associated with places. So the places are kind of-- we remember those, but in a kind of allocentric orientation to place. That's with respect to the environment, not with respect to where we are at the moment. But that's a kind of association learning. We associate objects with specific places. And we're only in the last few years learning how that is done in the brain.

And of course we know a lot about learning about identity. I just mentioned some of the characteristics from a behavioral point of view. And then ways to classify them according to potential uses, which neuroscientists don't pay a lot of attention to. Here's the thing about learning knowledge of place. Besides a very rapid assessment of where we are, what we call seeing perception, we learn where we are with respect to visual landmarks. For primates, that's probably the major one. For many animals it's olfactory, the smell of a place, it's more important.

But we also have many animals we know learn where they are with respect to a more global map. Magnetic cues, infrared, infrasound patterns. We even learn place in a time cycle, but we know least about that.

And I also want to point out that we have this knowledge we've acquired anticipated positions. Because every time we move our head around, our eyes, we're activating we're activating long-term memories. But in the spatial system, putting it in anatomical terms, we're activating a system connected with our head, head direction, that's activating memories. We're aware of what's in that direction, what's in this direction, and so forth. That's how we know which way to go. So it's connected with our motivational system as well as the highest systems of the brain. Hippocampal formation is involved in learning those things.

All right. So we need to fill out a lot of gaps in the Lawrence types. And I count about 19 separate types in Lawrence descriptions. And if you include those [? Ibulitiz ?] [? filled ?] types he describes, that hasn't been fully integrated with the other means of classifying learning.

OK, I'm going to stop there and turn on the video. Some of you may have seen this.

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