GOAL-DIRECTED AGENCY AND INTENTIONAL AGENCY

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Lizards

Lizards are a representative of the first category of agency according to Michael Tomasello in his book *The Evolution Of Agency*. As with the other categories, Tomasello focuses on the way lizards forage for prey. C. elegant, the nematode we looked at in the last post, moves and food either does or doesn't go into its mouth. That obviously won't work for lizards. Most species survive largely on a diet of insects, small creatures that move and flit about unpredictably.

So lizards have a different strategy. They have a goal, finding food, but they have to do several things to reach that goal. They have leave their hiding places and move to a place where there are insects. They have to spot a specific insect and then catch it and eat it. At the same time, they have to make sure they don't become prey for other creature.

Here's a video of a guy feeding crickets to his pet crested lizard. The lizard is in a special feeding cage. The crickets must be alive or the lizard won't eat them. Bonus: you learn a new term: gut-loading crickets.

Following Tomasello here's how I read this video. The lizard stands still orienting itself to its surroundings. The guy throws a cricket into the cage. The lizard sees the cricket. It takes a few steps forward. It pauses. It charges and grabs it and eats it. The guy throws another cricket into the cage. The lizard sees it, turns to chase it, misses, and pursues it in short bursts. It catches and eats the cricket. The guy throws a bunch of crickets into the cage. The lizard singles out one, chases, catches and eats

it. The other crickets run around. The lizard spots one, chases, catches and eats it. This is repeated.

In this video we see a frilled lizard, a native of Northern Australia and southern New Guinea. It's about a meter in length, and weighs over a pound. This video is heavily edited but again following Tomasello, here's how it can be read. The lizard descends from it's hiding place in a tree. It forages for prey, meaning any insect it might find on the ground. It sees one, approaches, catches and eats it. While chewing it looks around. It spots a predator, a black-headed python. It's frill blows up. The snake approaches. The lizard runs really fast (also amusing). It eventually runs up a tree, making a full escape.

Tomasello says that the lizard has hard-wired goals: including eating and avoiding predators. Both it's prey and its predators are quick and unpredictable. It has evolved to deal with that unpredictability by paying attention to the crucial aspects of the situation it perceives at any moment. It then acts to achieve a goal applicable to that situation. In both videos, the lizard eats while checking the situation. In the second it detects danger. It freezes its eating, then flares its frill, then runs. It achieves its goals by a series of go-no go decisions. That's a clear step up from C. Elegans.

Squirrels

Squirrels are Tomasello's example of intentional agents. He gives an example of a squirrel on a tree branch spotting a nut on a lower branch. The problem is whether to jump to the lower limb or retreat to the trunk and run down to the lower branch. He says the squirrel looks at the nut then at the tree trunk and then back at the nut. He interprets this as the squirrel cognitively considering two alternatives, then forming an intention to act, then acting. This two step process is evidence of an executive tier of mental control of behavior.

I have a young cat who does something similar. Winston knows there is interesting stuff happening on the counter when I'm making coffee. I see him looking at me, then at the counter as if contemplating jumping up. Am I paying attention to him? If I say No in a loud voice, he won't jump. Maybe. But if I do nothing or am not paying attention, he works out an answer and acts.

Winston also knows how to open a door. Here's a video of cats opening doors. Note that in several of the scenes the cat stares at the handle before acting. Tomasello interprets this as the cat forming an intention and then acting on the intention. Again, that implies an executive tier of mental activity.

Here's a video of squirrels hiding nuts. Nut-hiding is a hard-wired activity, but it's a complex problem. The squirrel has to decide where to bury the nut, and it has to be able to find it in winter. There are other squirrels waiting to steal the nuts, and predators. There are obstacles, including roots and hard soil. The squirrels stop and look around several times. In each case it looks like the squirrel makes a choice.

This is a 20 minute video of a guy operating a squirrel maze in his back yard. It's not exactly relevant, but it looks like the squirrels are playing, something we don't see lizards do. Also I enjoyed it.

The difference

Tomasello says that when lizards perceive a change in the situation, they freeze their current behavior and then respond to the new situation. He contrasts this chain of go/no go decisions with

> … an either-or process of decision-making in which the individual simultaneously considers more than one behavioral option simultaneously (which mammals arguably do….) Pp. 33-4.

Tomasello says squirrels and other small mammals have an executive tier in their psychological processes that controls their operating behaviors, like running and burying nuts. This is a function of their larger brains, especially a larger pre-frontal cortex, more complex neurons and neural connections, and increased memory. Larger brains and longer time spent as juveniles increase the possibility of learning about the environment and experimenting, including play, which we might see as rehearsal. Mammals seem to have whet we would call emotions that also provide input to the executive tier.

The executive tier of the squirrel brain coordinates all these inputs. It considers alternative courses of action, "weighs" the costs and anticipated benefits of each and chooses one. That choice is communicated to the operant systems. The executive tier monitors the outcomes. It can inhibit one choice in favor of another if the situation changes or if the initial choice meets an obstacle or fails. Small mammals don't use words, so it does this with some from of remembered perception.

Here's Tomasello's version of an executive tier:

> The executive tier oversees the operational tier, as it were, and attempts to facilitate behavioral decisions via action planning and cognitive control. … It requires individuals to cognitively simulate in an organized way their own potential actions, the potential obstacles and opportunities for those actions, and the probable outcomes of those actions. They do this by perceptually imagining all these action elements in the common cognitive workspace and representational format provided by an executive tier of operation. P. 49.

It is this executive tier that gives mammals a wider range of choices of action, which presumably increases the chances of survival of

individuals.

Discussion

1. Tomasello says that there isn’t any way to find mental processes in brains, so scientists infer the mental processes from the overt behavior of the creature. I think this raises the potential of anthropomorphism, leading people to ascribe human characteristics to other kinds of creatures. The executive function in humans is a defining feature of our species, so this is a real possibility.Of course, here we’re talking about a simple form of executive control.

The videos seem to provide at least some reason to think Tomasello is on the right track in ascribing an executive tier to small mammals. The empirical studies he cites may also be persuasive evidence.

2. I have described only a small part of Chapters 3 and 4 for this post. It’s allfascinating, especially the discussion of the executive tier, but it’s not relevant to my purposes in reading this book. As a reminder, this series is aimed at thinking about the origins and roles of rights in our society. I’ll get there, I promise.