Today we will begin a journey through the spectrum diagram. It will be organized around a historical journey in deep time: from our primate origins to the present.

The reason is that many of the most important complex, complicated and wicked systems around us are indeed anthropogenic, and as a species we've made a long journey developing the capacity to build and use these different types of organization to our advantage.

This is why we will be our own guides!

We will begin by going rapidly backwards in time to get an idea about where we come from and the different forms of relatives that we will visit.

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We are primates.

More specifically, we are the only living member of the ***Homo*** genus, which is about 2.5 million years old.

The lineage that we belong to is older, however.

Molecular clock analysis tells us that our lineage diverged from the ***hominini*** - which contains ourselves along with chimpanzees and bonobos – between 6 to 8 million years ago

It is known that until around 2,5 million years back, our ancestors remained very chimp-like.

The *homnini* belong to the **"Great Apes"**, which emerged some 14 million years ago, which today contains also the gorillas and orangutans.

The Great Apes, in turn, belong to the broader group of **"Apes"**, which includes also Gibbons – which look somewhat like Great Apes, only they're smaller.

The earliest apes seem to have diverged from the other so-called **"higher primates"** around 25 million years ago.

At this time our ancestors were similar to the Old World and New World Monkeys of today.

In other words, quintessential monkeys: usually small, smart, and with long tails.

To find ancestors similar to today's **"Lower Primates"** we end up at the time right after the demise of the dinosaurs: in the lush, warm rain forests of the Paleocene, populated only by small animals – which pretty much was what survived the K-T mass extinction 66 million years ago.

The very earliest basal primates have not been found, but molecular clock analysis predict that they arose in the Cretaceous some 80 million years ago.

Likely they were small and similar to lower primates today… and likely they shared with us some interesting features of primates!

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Now let's reverse the arrow of time to see how we have journeyed through the complex, complicated and into the wicked… although today we will come no further than to the *trans-complex.*

Some 80 million years ago we were "ordinary animals" nothing particular in the sense that we didn't have any of the unique traits that set us apart.

What's so different with primates?

Well, one thing is that primates have a complicated cognition: they have very rich behavioral repertoires, good memory and powerful problem solving faculties.

They have invested greatly in brain tissue.

Doing that may seem like a good idea in general, but central nervous systems are expensive to maintain and unless you can turn them into an equally big advantage, it's better to remain stupid.

Primates are usually said to be complicated – or intelligent – in two ways: **social and technical**.

In other words:

- How they interact with each other
- How they interact with their environments.

There is a long-standing debate about what drove this development.

Was it *technical* or *social* intelligence?

The answer, many think today, is probably that both factors drove intelligence and brain size.

It has turned out that intelligence is quite domain-general: if you gain high technical intelligence, that intelligence works for social behavior too, and the other way around.

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Early primates – which have similar modern counterparts in similar biotopes – are likely to have lived in rather small groups. Probably in family units, as similar primates do today.

Large social units are hard to maintain in dense forests environments.

So there seems to have been little need for social intelligence at this time to begin with.

Many think, therefore, that the first thing that got our brains growing was selection for technical intelligence.

This technical behavior does not imply tools yet: it is behavior backed up by adapted physiology.

But this is clearly what technology later grew from, since these are precisely the tasks that tools later came to complement.

Why would early primates have needed technical intelligence?

It may sound odd, but **fruits** may have something to do with it!

80 million years ago, the supposed origin of primates, happens to coincide with a strong diversification of fruits-as-we-know-them**.**

Fruits are peculiar food resources.

They are very rich in nutrients, but they are also complicated resources.

They are seasonal; they have a patchy distribution in the forest; they go through maturation; they are rather large…

They are also today monopolized by intelligent arboreal primates.

Specifically, some of the hallmark adaptations of primates, not least humans, come in very handy:

Stereoscopic vision to be able to handle the fruits and move through the 3-D forest: orienting the fruits for manipulation, browsing through them, and so on.

Nimble hands: to be able to carry and manipulate the fruits by peeling them, removing seeds, getting past their defenses.

Color vision: to be able to tell the difference between different species of fruit and fruits in different stages of maturation. Color vision is highly developed in few species except in primates.

High intelligence: to be able to figure out how to handle a large range of different types and instances of fruits without the need to specialize strongly in certain types.

Good memory: to be able to memorize the locations of fruit patches in 3D and the paths between them.

This battery of adaptations – body and cognition – is what earns rain forest dwelling fruit eaters a living also today.

That also means that the capacity for Complicated technical behavior seems to have evolved first.

Let us now turn to social intelligence.

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Herds are, as we discussed briefly last time, archetypic complex systems.

They are based on local interactions: each member reacts to the behavior and demeanors of those around it.

This means that herds can be very large. They can fission and fusion as it happens.

Why would you want to be in large numbers?

Well, large groups have certain emergent functions.

Not least, a large group can defend against predators, and it lessens the individual predation risk for its the members.

But a herd cannot do very many things.

It's not a very cohesive whole and has a poor Simonean Interface to build features upon.

A herd will for example not have a differentiation of tasks within it, and it will not share resources.

It will not be able to tell who is a member and who is not: it is mainly just a congregation of animals reacting locally in time and space.

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As we mentioned, large numbers are in any case not as beneficial in forests as they are in the open.

But as it happened, as we approach 20-30 million years ago, in the Oligocene, temperatures began to drop and another important type of landscape constructor starts to spread: **grasses**.

Increasing tracts of grass covered open land and around the same time primate species similar to modern Old World Monkeys emerged.

These had everything to gain from living in groups!

But there is a problem: Old World Monkeys are smart, resourceful and have very good memory. They can, and do, keep perfect track of each other.

In other words: they cannot form a herd – they are not stupid enough to do that.

Large monkey groups have to be organized in a radically different way, and that form of organization is referred to as a *troop*.

A monkey troop is most commonly formed around matrilineal dominance hierarchies; these in turn are often organized in yet another level with a dominance hierarchy of dominance hierarchies.

Kinship determines the place that a monkey gets in the dominance hierarchy; within its genealogic lineage, and then the rank of that lineage itself relative to other lineages.

These positions need to be constantly worked out and verified, and the tools of maintaining these relations are **violence and grooming**.

Grooming is a very specific activity that all higher primates, including humans also engage in – gossip, not least, is an example of a human behavior with functions very similar to grooming among monkeys and apes.

This means that the troop represents a move from the complex along the complicatedness axis and into the trans-complex.

In other words, it is a system that *begins in* complexity but that adds complicated organization in order to maintain cohesion and function.

This complicatedness is directly based in a capacity for technical complicatedness.

What it gains in function over the herd is that we now have a herd consisting of highly capable individuals that can cooperate transiently, benefit from collective search for food and detection of threats… among other things.

The troop is more than the herd!

The Trans-Complex system can be more powerfully adapted than the Complex system.

Complicatedness acts as a backbone.

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So monkeys keep track of each other: not just their spatial neighbors, but everybody! Their group dynamics is based on face-to-face contacts: on recognizing and knowing each other.

They demand that they have means of knowing the relations between the members of their groups.

This means that intelligence actually limits how large a monkey troop can become without collapsing in violence and splitting into two groups.

This was never a problem for herds, which split for various reasons, but not because they get socially unstable.

So the troop organization is necessary because of primate intelligence *and it also demands intelligence*.

Robin Dunbar famously made a direct correlation between brain size – or more correctly the ratio between the neocortex size and the size of the whole brain – and the maximum size of the group that the brain's owner can be part of.

This correlation holds quite well, it turns out, and it predicts "Dunbar's number" for modern humans – which we will come back to: Humans should be able to maintain groups of a size of roughly 150 individuals, at least, as we will see, groups that *are* based on face-to-face contact.

This leads to the so-called "social brain" or "Machiavellian intelligence" hypothesis: that selection pressures for maintaining larger groups can drive the evolution of large brains.

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Next time we will move to the Great Apes and early *Homo*.

This will lead us to enter the Sub-Wicked domain, and ever so slightly also the Trans-Complicated domain.