Ways of Thinking: from Crows to Children and Back Again

By Dr. Nicola Clayton

Background

Dr. Nicola Clayton is a professor in the Department of Psychology at the University of Cambridge where she leads the Comparative Cognition Lab.

From Corvids (Crows) to Children and Back Again

Dr. Clayton chose this title because she wanted to share discoveries of how cognition works in corvids and how this impacted her research in children. She integrated her knowledge of cognition in corvids into the research she did with children. The main point of the talk was to show her argument that many actions corvids take are far from trivial. Food catching corvids show a suite of cognition abilities that resemble those in children and there were three types of cognition that Dr. Clayton decided to discuss in her presentation.

First – Social Cognition

One of the things we can use to investigate the social cognition of corvids is their ability to cache food. Corvids remember where they put their food and also take great care to defend their stores from other birds that may pilfer from it, the latter being an important aspect of social cognition.

Scrub-Jays do all of the following to protect their caches:

- Degrade info by caching in shade
- Remove info by caching behind barriers
- Degrade info using distance
- Conceal auditory info when others can hear but don’t see
- Keeping track of who was watching them while they do these actions

These Jays are typically long term cachers, but Dr. Clayton noticed that some birds would move their caches. Dr. Clayton had a guess as to why this was occurring.

Do Jays re-hide the worms the observer saw?

Dr. Clayton ran an experiment to see if a bird that was with a potential thief noticed that the thief was watching them hide their food, would the bird move the cache after the potential pilferer left? It turns out, the answer seemed to be yes, for birds that have had previous pilfering experiences. They also typically moved their caches to a new location that they had never used for that purpose. What Dr. Clayton found most remarkable, is that not all birds do it; naïve birds, that have no experiences being thieves themselves, did not do this. She summed this up with the statement “it takes a thief to know a thief,” explaining that the bird may remember its own experiences and that this may be what causes them to re-hide their cache.

Testing Social Cognition in 2-year Old Children

For this experiment, the researcher, the child, and the child’s mother were all sitting together at a table. The child played a game in which they were collecting stickers and then placing them on a little board. As part of the procedure, stickers were placed in non-transparent cups. If the mother saw where the
stickers were placed, the child asked their mother to give them the cup with the sticker. If the mother’s eyes were covered with her hands when the sticker was hidden, the child would spontaneously point to the cup that they wanted instead of asking their mother for the proper cup.

There was a slight issue with this set up though; you could not fully tell if this was because the child had any idea that eyes had to do with seeing, or because they had a lot of previous experience with peek-a-boo games.

**The First Experiment**

Two additional conditions were added. Mom would wear some goggles. There were two pairs - blue and yellow. Each was worn half the time and one pair of goggles could see and the other couldn’t. They looked essentially the same on the outside, besides the color.

In each case, the children were allowed to wear the goggles. They were asked if mommy could see at the start and end – 100% answered the same to both questions.

*Results*

The experiment replicated the open close conditions for the original cognition experiment. It turns out that when the mother was wearing the goggles, the children didn’t seem to base their actions on whether they thought their mother could see or not.

**The Second Experiment**

The children were not allowed to wear the goggles at the start. The children were shown their mother moving around wearing the goggles, aka, completely normally when she could see but fumbling about when she could not see.

*Results*

The pointing was significantly reduced when they observed that their mother could see, however they weren’t sure whether their mother could see just by knowing that their mother had one of the pairs of goggles on.

**Second – Physical Cognition**

The second thing Dr. Clayton wanted to consider was the physical cognition of corvids.

Corvids:

- Spontaneously manufacture novel tools
- Can select the appropriate tool
- Can use one tool to get another tool
- Can use water as a tool

One other interesting thing about these birds is that Rooks and Jays don’t really use tools in the wild, but if given waxworms (their favorite food as determined by Dr. Clayton) in the lab, they would spontaneously use tools to get to the worms.
Tool Training – The First Experiment

With all species tested – Jays, Rooks, New Caledonian Crows – the tool training apparatus was a transparent box with a tube coming out of its top, and the lower half of one side of the box left open. There was a metallic plate right above the opening in the cube, holding a worm right above the opening. There was also a stone at the top of the tube and the birds would accidentally knock the stone down the tube, which would knock the board down, releasing the worm at the bottom for them to eat. The hope was that the birds would recognize that the rock helped them get the worm.

Sinking vs Floating – The Second Experiment

The birds had a tube filled half way with water that had worms floating at the top just out of reach of their beaks. They were also given rubber that sank and foam that floated in water. The experiment was to see if the birds would recognize which material to put into the tube to get to the worms. The results for the experiment showed that both of the birds from Dr. Clayton’s lab realized to put in the sinking items instead of the floating items into the tube and sometimes even removed the floating items after realizing they were useless.

Testing Physical Cognition in Children (4-10 years of age)

Dr. Clayton wanted to run a similar experiment with children. She used the same setup as the water tube with the birds, but obviously with a different reward. There was a big tube filled half way with water, which had a special University of Cambridge sticker floating at the top of it. There were two piles of balls next to the tube, one set of heavy balls that would sink, and one set of light balls that would float.

Sinking vs Floating – The First Experiment

Dr. Clayton showed some videos of children of various ages attempting the experiment. Younger children tended to be unsure of what to do, while older ones quickly solved the task at hand. At 4 years old, the action is random. Children of ages 5-7 showed some signs of growth, but it was not until children were at least 8 years old could they do the test spontaneously. The age of 10 seemed to be when children completely understood the task.

Three Tubes on a Table - Second Experiment

This was an experiment in which children fared much better than the birds. In this experiment, as the title suggests, there were three tubes on a table. They were placed adjacent to one another with the middle tube being too thin for stones. The two on the side had plenty of space to drop anything in. All of them were filled half way with water with the respective prizes for birds or children floating in the tube that was too thin for stones. The birds never solved the puzzle, after realizing the middle tube with the worms was too small to fit a rock into, they flew away. Typically the children didn’t know what was happening, but after messing with the balls and tubes some noticed that the water level might be rising and they decided to pursue this. Typically the older children eventually managed to obtain the sticker, especially those ages 8 – 10, but prescribed the water level shifting to magic. The tubes were actually connected under the table, which was hidden from their view.
Third – Forethought

Can Scrub-Jays plan where to cache food for breakfast?

The experimental setup was as follows: there was a big aviary split into three zones; two bedrooms on either end and a dining room in the middle. The bedroom on the right was the breakfast room, in which the birds were fed an early breakfast and the bedroom on the left was the hungry room, in which the birds were not fed breakfast at all and could only eat once lunch was served in the dining room. The birds were left in the aviary for six days and were free to sleep in either “bedroom.” After the six days, Dr. Clayton changed the setup of the cages. She placed caching trays into both bedrooms in the evenings to see if the Jays would cache more food on the side that had no breakfast and it turned out that they did in fact do so. The birds cached about five times as much food in the hungry room.

Can Children Plan Where to Play?

Dr. Clayton did a similar experiment with children that she briefly explained due to time running short. She had three rooms – a no play room and a play room, as well as a current room. The children were asked two different questions in two different runs of the experiment: where would they store the toys for now and where would they store the toys for their next birthday. Younger children somewhat understood this, but children 8 and over seemed to do the task really well.

Conclusions

In the case of social cognition and planning, children tend to show a developmental progression and can perform well in tasks related to them early on. What was surprising was the physical task, which the children were passing at a later age, around 8+. Perhaps the fact that they pass the water test really late may be due to a cultural influence.

So why are crows showing such complex cognition?

One theory is Humphrey’s Hypothesis, which proposes that it is the social interactions between primates; their ability to recognize individuals, track their relationships, and deceive one another that occupies their time and substantial brainpower. Dr. Clayton argues that you can maybe explain the same hypothesis to Corvids – as Humphrey’s explains to primates.

Social Relationship Intelligence – The Challenge of Monogamy

Dr. Clayton talked about the social displays corvids make, especially with their partners. When perched next to their partners, both corvids tend to mimic each other’s movements, so as to appear to be moving in sync.

Desire State Attribution May Govern Food-Sharing in Jays

During the courting season, males will feed their females. Dr. Clayton created a food-sharing experiment to test social relationship intelligence. The male corvid would sit at a food sharing window where he would be offered two foods, one of which he just watched the female eat, then he is given the opportunity to share with the female.

Each male was fed mealworms or waxworms earlier until they were full. When full, if offered more food, the birds chose the opposite food when offered a choice between the two.
During the actual experiment, the male could either see what the female was eating or could not see the female at all. If he saw what she ate, then he gave her the opposite worms. If he did not see what she was eating, there is no difference, the choice seemed arbitrary. This shows that there must be some social relationship intelligence in corvids, as the males really based their decisions on what the female would want, if they could see the selections the females made.

Convergent Cognition Divergent Neuroarchitecture

Primates and corvids shared an ancestor a very long time ago, but they followed very different developmental paths. They have similar cognition but very divergent neuroarchitecture.

Feathered Apes

Dr. Clayton ended with a slide that said, “If men had wings and bore black feathers, few of them would be clever enough to be crows,” a quote from a reverend who noticed corvid intelligence many years ago, suggesting that maybe it has been known for quite a while that corvids are very intelligent birds.