**PART 0:**

[**Link to Episodes**](https://spotifyanchor-web.app.link/e/C4Y4LET3rzb)

**PART I: Animal Intelligence and Tool Use OER Podcast**

**Transcript of Podcast Episodes**

Each episode is going to be approximately 5 minutes long. The structure of the episodes will be led by the person who researched that particular topic of the episode. Along with that, the episodes will be set up like a discussion with all group members to create easy conversation. Episode 1 will be an introduction to our series and overarching topic (intelligence and tool usage in animal behaviors). Episode 2 will be led by Samay and discuss the “air” element of animal tool use (how bats hunt in the dark). Episode 3 will be led by Maline and is the fir element of animal tool use (how different bird species use burning sticks, etc. to spread fires and collect prey). The third episode will be covering “earth” and how orangutans use leaves to make themselves appear more intimidating. Which will be led by Genesis. Our final episode will be led by Anna and will spark a fun conversation about the water element and how dolphins use sea sponges to protect themselves while hunting. The closing remarks will emphasize the purpose of an OER. It will include encouraging our audience to join in on the conversation about all different animals (whether that be in the air, water, or on land), and how they use their intelligence and tools to survive and be successful in their environment. We will ask viewers to comment on their thoughts about the animals we discussed in addition to anything new they know about or are wondering about! The comment section will be available below our video uploads. Along with that, a form will be included so people can discuss their thoughts if they don’t want to comment publicly or want to have a conversation with one of us! The form can either be anonymous or not!

**Episode 1: Introduction to Intelligence and tool use in Animals (All)**

(All) Hey everybody!

(Samay) I’m Samay!

(Maline) I’m Maline!

(Genesis) I’m Genesis!

(Anna) and I’m Anna!

(Samay) Welcome to our new Open Education Podcast! This is a series of five episodes in which we will be touching on animals using their intelligence and tools in the four different elements. My element is air, and I am going to be talking to you guys about how bats hunt in the dark.

(Maline) After that stay around because I will be covering the fire element! We will be chit-chatting about certain birds that seek out the fire, swoop into them, and even start fires…all just to catch prey!

(Genesis) That’s fun…I guess, but do you know what is even cooler? Earth elements and Orangutans! Not only that but how they use leaves to make themselves sound bigger! Weird right? Stayed tuned for that!

(Anna) Who hates dolphins? Nobody! That is why you all better stick around til the last episode to learn about the water elements and how dolphins use sea sponges to protect themselves while hunting.

(Maline) We know these may sound whacky, but once you listen to how and why these animals use them, you will find it so cool! So, what is intelligence, Anna?

(Anna) Well, it is the ability to learn or understand or to deal with new or trying situations (Webster's Dictionary). For animals, they face many different challenges, the main ones which include hunting, gathering, sheltering, and defense. Intelligence can be applied through specific behaviors or general actions of a species of animal.

(Genesis) So awesome! With intelligence, animals use tools, too! A study defines tool to use as an “exertion of control over a freely manipulable external object with the goal of (1) altering the physical properties of another object, substance, surface or medium (the target, which may be the tool user or another organism) via a dynamic mechanical interaction, or (2) mediating the flow of information between the tool user and the environment or other organisms in the environment. (St Amant 2008). In animals, some tools are learned, and some are, at least in part, genetically influenced.

(Samay) By studying these things, we can learn about specific species that can help enlighten and enhance the connection between researchers and indigenous populations that can help with these studies.

(Maline) By investigating highly specialized behaviors in animals, we can also lighten areas of research that help sustainability efforts. Biomimicry is a powerful tool in many other fields of research outside of animal behavior.

(Anna) \*At audience\* What are your thoughts about this? What do you know about animal intelligence and tool use?

(Maline) I know a few examples we can share!

(Genesis) With all that being said, let’s kick off this series and turn to Samay to learn about how bats hunt with the Doppler effect!

(Samay) Let’s go!

\*end\*

**Episode 2: Batting Away the Doppler Effect: How do bats hunt in the dark (Samay)**

Hello, and welcome to Clever Critters. Today we’ll be discussing a fascinating phenomenon in the animal kingdom – echo location. Echo location is used by bats and other animals that have the ability to search for prey or navigate their environment through the use of sound waves (Boonman et al., 2020). Specifically, we’ll discuss how this process works, what role the doppler effect has and why studying the behavior of certain species of bats can provide insight into human speech and social communication.

Echolocation is a physiological process used by certain animals, such as bats and whales, to detect objects in their environment. By emitting sound waves and listening for the echoes, these animals can measure the distance and direction of an object, as well as its speed and size (The Editors of Encyclopaedia Britannica 2019). Birds typically echolocate at frequencies of 1,000 hertz, while whales can reach up to 200,000 hertz (The Editors of Encyclopaedia Britannica 2019). This biological adaptation allows animals to orient themselves, avoid obstacles, find food, and even interact socially.

Now that you know what echolocation is, let's delve into what makes it difficult for bats, specifically: the doppler effect. What is the Doppler effect? Well, it’s named after Austrian physicist Christian Doppler who first described the phenomenon in 1842. In essence, when a source of sound moves relative to its observer, the observed frequency of the sound wave changes. For example, when an ambulance is driving towards you, the sound of its siren is perceived to be higher in pitch than it is. As the ambulance moves away from you, the pitch is heard to be lower than it is. So if a bat flies at high speeds while echo-locating without compensating somehow for the doppler effect, its perception of distance and velocity can be greatly distorted.

Certain species of bats use Doppler Shift Compensation (DSC) to adjust their call frequency as they change speed while approaching a target, so that the returning echo remains at the same frequency (Wikiwand - Doppler shift compensation, n.d.). A study on Doppler shift compensation in the Hipposiderid bat revealed some interesting insights (Schoeppler et al. 2018). Researchers recorded their flight behavior whilst flying to a grid and determined that within each flight the average echo frequency remained constant with a standard deviation of 110 Hz (representing .1% error) independent of flight speed.

There is still one question: how do bats know how fast they are moving? One way they can do this is to listen to the returning echoes and change their call accordingly (think of this like trying to hit a note on an instrument or while singing). But what if bats can’t hear back the echoes, can they still perform DSC? A study found that yes, indeed they can, this study found that bats have some intrinsic knowledge of how fast they are going Boonman et al. 2020. They tested bats experiencing accelerations in an environment without echoes and found that the DSC response remained intact. Additionally, using GPS tags, the researchers discovered that for bats, relying on internal information might come in handy when echo feedback isn't available (Boonman et al. 2020).

Research like this represents just how important a multidisciplinary approach to science is. The research article I just mentioned has authors who study widely different things: ranging from animal Physiology to mechanical engineering and physics. Arjan Boonman, the lead researcher studies animal physiology and has published extensively on echolocation in bats, and another author: Yossi Yovel is an engineering faculty member at Tel-Aviv University and has published on a variety of different topics. Together the authors provide a great look into how powerful a multidisciplinary team can be when studying science!

Bats possess many qualities associated with vocal learning, such as close social interaction and mammalian brains and physiology. From understanding more about the neural encoding occurring during vocal behaviors (like DSC), to researching the prevalence of vocal learning across bat species, scientists are uncovering pieces of the puzzle that could potentially reveal important facts about our own evolutionary paths (Vernes & Wilkinson, 2019).

This wraps up today’s podcast on Doppler shift compensation and echo location used by bats. We hope you learned something new and stay tuned for our next episode. If you’d like to learn more check the description!

**Episode 3: The Burning Hunt: Adventures of the Fire Hawk (Maline)**

Hey everybody! Before I start, pause this video and take two seconds to comment why YOU think wildfires spread.

…

Ok so now that you did that, I am sure most of you wrote “dry environment”, “lack of precipitation”, or “climate change”. But did any of you think or write “birds”? Yes? No? I won’t be surprised if you didn’t, because I honestly didn’t think birds could spread wildfires until I began to research this topic.

But there are a few species of birds, including **whistling kites, black kites, and brown falcons** that are considered **“firehawks”.**

These are raptors that, according to lore, use fire to hunt and introduced fire to humans. (Nicholas, 2018).

The most fascinating knowledge about their behavior is that a majority of our understanding comes from the indigenous Australian people.

These birds are commonly known amongst Indigenous Australian Aboriginal People. (Nicholas, 2018). The Alawa, MalakMalak, Jawoyn, and other Indigenous peoples of northern Australia, whose ancestors occupied their lands for tens of thousands of years, have long known about the nighthawks' behaviors! It is so important to note this, as much of the information is new to Western scientists.

An interesting study was done to examine the behaviors of these animals. A team led by Bonta and Gosford centered their investigation on traditional Indigenous ecological knowledge. They point out that parts of their ceremonial customs, religious beliefs, and creation stories contain references to the local knowledge of the firehawks' behavior. The firehawks widespread attention offers a chance to examine the disparity between Western scientists' acceptance of Traditional Knowledge and other forms of knowledge. (Nicholas, 2018)

Archaeologists, ecologists, biologists, ethnobotanists, climatologists, and others increasingly highly respect traditional knowledge as a source of knowledge. This knowledge includes anything from insights into the significance of biological diversity and the therapeutic powers of plants to patterns of caribou migration and the results of deliberately burning the area in order to manage certain resources. For instance, to explain changes in sea ice conditions observed over many generations, several climatology research have included Qaujimajatuqangit (Inuit traditional knowledge). (Nicholas, 2018)

As you can see there’s a great amount of knowledge coming from the indigenous Australian people about these birds. Along with their knowledge western scientist have been able to get a good grasp on what exactly these birds do and why they do it!

These birds are able to sense and see a fire from miles away. Once they notice one, they pick up their speed in swoop down in the fire to grab branches or sticks; really anything that can hold a fire. And what they do is they fly to another location nearby and drop the stick in order to begin another fire. After they do so they closely watch the area to see their prey try to escape the fire. When the prey tries to do so these birds swoop in and steal them. Lunch is served!

It seems absolutely crazy that these birds can detect and gather things from fires to start other ones but if you think about it, it’s a fascinating behavior that they’ve developed over time.

The deeper understanding of why and how they have learned this behavior is still in the works, but what is known as that this is what they have learned to do to collect food.

What do you guys think about this?

Do you think this could be a problem for other species in the area? Do you think you could even be a problem for civilization?

Well, these are factors that many scientists ponder the issue of. The rapid spreading of these fires can obviously cause harm to other species in the area especially because of the dry environment. When the Hawks spread the fires attends to destroy a lot of the homes and shelters that other animals have built, end it can destroy the food sources for other animals as well. But for years indigenous people have tried to coexist with the animal’s behaviors. However, there are recent studies and explorations about how this could be an increasing issue with the growth of climate change.

What are your thoughts on this? Do you think that this is a dangerous enough behavior that these birds could actually end up hurting the environment they live in and eventually their selves? I am very interested as to what you guys have in mind.

Thanks, everyone!

**Episode 4: *Autotune for Apes*: Orangutans use leaves to make themselves sound bigger (Genesis)**

**Genesis:**

Hello everyone, welcome back to our podcast. Today we will be talking about this sound (Play the Kiss Squeak Recording). This and more on today's episode, *Autotune for Apes.*

Now let's play the audio again. (Play audio again)

This is a recording of orangutans in Borneo and Sumatra.

Both are beautiful islands located in Southeast Asia. In addition to being home to over 60 million people, these islands are also the habitat for most of the world's orangutang population.

The voiceless calls you heard in the recording are known as the “kiss squeak”. Orangutans make this sound when faced with changes in their environment.

 Scientists have determined that the frequency of this pitch is greatly determined by the age and sex of the orangutan.

A higher frequency means a very young male or female. The lower frequency comes from older males. An orangutan's size, situation, and personal identity can also be encoded in the squeak.

The complex nature of this method of communication has interested many scientists. Some have even likened these kiss squeaks to how humans use different words to convey the same meaning. Researchers from the University of Warwick in England have even likened these squeaks to how humans created vowels and consonants, leading many language psychologists to learn more about how languages originated.

Here comes the very interesting part, some orangutans use leaves and their hands to alter how their kiss squeak sounds. They do this by holding a bundle of leaves close to their mouths. This difference is powerful enough to make a young male sound like a full-grown adult male.

Scientists have tried to find out what causes orangutans to use leaves for some of their calls. The research behind this has been hard because it is difficult to observe how orangutans behave without introducing something new in the environment. However, they have observed this tool-use behavior when they sense a disturbance or feel threatened by a potential predator. This alarm calls work when deterring predators. Researchers have observed that leopards and tigers tend to leave their hiding spots when many of these alarm calls are made.

This is just another example of how animals can use intelligence when trying to deal with a new situation. This type of behavior shows how some animals can use the land around them to create a tool.

Thanks for watching “Autotune for Apes”! Stay tuned for the next episode with Anna titled, Put on Your Hunting Gear.

All resources featured in today's podcast can be found in the link in the description.

**Episode 5: Put on Your Hunting Gear: How Dolphins Use Sea Sponges to Protect Themselves While Hunting (Anna)**

What a great episode from Genesis about orangutans! We all know that the great apes are some of the smartest animals. But which animals come after? That’s right – dolphins!

So, I guess it’s not too surprising to learn that these clever creatures use tools too. Did you know that dolphins use protective gear when foraging for food?

Bottlenose dolphins in Shark Bay, Australia have been observed to pick up sea sponges and use them as foraging tools. This is a technique known as sponging! So, what exactly is it, and why is it beneficial?

Dolphins typically use echolocation to find their prey similar to how bats do, as Samay mentioned earlier. Boney fish have swim bladders, which are organs of air that easily deflect sound waves, which is how dolphins track them down (Gross, 2022). But sometimes dolphins crave something a little bit more delicious.

This is where bottom-dwelling fish come in. These fish are more nutritious due to their constant immersion in the mineral-rich sand of the sea floor, making them a tasty food option for hungry dolphins.

Sea sponges are immobile invertebrates with a soft, porous texture, making them ideal for protecting the beaks, or rostrum, of dolphins.

Dolphins wiggle their beaks into their tubular shape, sort of like putting on a thick protective glove, so they can dig around in rough sand without hurting their sensitive beaks since this area has a higher concentration of nerve endings. (Morell, 2011)

So, that’s sponging in a nutshell. But does every dolphin use this hunting method?

Sponging studies have been thoroughly observed in the waters of Shark Bay, Australia. Most of them have shown, however, that it’s primarily just female dolphins that demonstrate this behavior.

This has led scientists to conclude that sponging is primarily adopted by female dolphins via vertical social transmission through the matriline. This means the behavior passes socially from mother to daughter. I’ll expand more on this later on! (Krützen, 2005)

These findings are pretty cool because they’re one of the first observations of material culture among marine mammals! When we think about material culture, we’re talking about things that are passed down - material objects that represent some societal factor, like we see in humans passing down heirlooms. So, it’s super interesting to think about that happening amongst animals too. (Krützen, 2005)

So, how exactly are scientists even able to assess this type of social learning?

The answer is network-based diffusion analysis or NBDA! This is a system used to assess and quantify social learning. Scientists observing Shark Bay dolphins used 4 types of networks to apply NBDA to one, vertical transmission through the matriline, two, horizontal learning, so relatedness other than mother-daughter, three, individuals across the same environment to replicate the effect of a dyadic home range (where everyone’s related), and lastly, dyadic biparental effects. (Wild, 2019)

So, NBDA works by having a mathematical basis to categorize observational data by taking important factors into account, such as ecological, social, genetic relatedness, and even more. After the study and observations were conducted, the model ended up showing that sponging was primarily transmitted via the vertical (again, talking about mother-offspring) network, and hardly at all through horizontal association or any other ecological influences. (Wild, 2019)

So, we’ve talked about the social factors of sponging. But is there a genetic explanation for all of this?

To control the fact that genetically related dolphins may be predisposed to their sponging habits, scientists took tissue samples from 415 dolphins from 2007 to 2018. By genetically assessing the sexes of the samples and their respective genotypes, researchers calculated the dyadic genetic relatedness of the population, coming up with a population-wide average of 0.043. They also found that genotype similarities found among spongers once again pointed to the fact that the behavior was primarily being passed down through matrilines. (Wild, 2019)

Ultimately, these results showed evidence of a very recent development of co-ancestry amongst the Shark Bay dolphin population, which may suggest that the behavior stemmed from just one individual dolphin, which scientists have coined the term for as “Sponging Eve”! (Garber, 2014). And since then, the behavior has continued to be passed through the matriline! (Krützen, 2005)

Ultimately, it seems like the genetic and social factors go hand in hand when it comes to sponging behaviors amongst dolphins. Since these are more recent findings, who knows what other clever techniques for survival we might see dolphins using in the future!

This episode’s scientist spotlight is dedicated to Dr. Sonja Wild, a driven behavioral ecologist who is currently completing her postdoctoral studies at UC Davis. Dr. Wild has spent much of her time studying remarkable social strategies and cultural phenomena in the animal kingdom. This has led her to complete her PhD thesis (as well as her Master’s) in dolphin foraging techniques and tool use, where a lot of the information in this podcast is from! (Wild, 2023)

That’s it for “Put on Your Hunting Gear”!

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**PART II: Team Member Contributions**

Team Leader: Maline Demers

**Contributions:**

Maline: Team Leader of the Week, Completed Part 2, Wrote/found resources for the introduction episode. Wrote the overview. Wrote and cited script for Episode 3, edited and revised Episodes 4 and 5.

Samay: Completed the outline for episode 2. Edited the final submission document and wrote Part 2. Also edited and revised episodes 3 and 4.

Genesis: Wrote and cited script for Episode 4, edited and revised Episodes 2, 3, and 6.

Anna: Wrote and cited script for Episodes 5 and 6, edited and revised Episodes 1 and 2.

**Points:**

Samay: 5, Maline: 5, Genesis: 5, Anna: 5