



ScienceWatch – As Time Goes By

Can you remember not only what you did last week but where and when you did it? Some of us are better at that than others, but we all have the ability not only to remember what happened, and where, but also *when* it happened. Many animals are able to remember the “what” and the “where”, but until recently, the ability to remember “when”, known as episodic memory, was thought to be uniquely human. Now it seems birds can do that as well.

Episodic memory is memory for events that occur in a specific time and space as opposed to memory for facts or “knowledge”. The “what and “where” ability of birds had already been explored in laboratory experiments. These studies showed that food-storing birds such as titmice, chickadees, jays, nutcrackers and magpies use spatial locations rather than sensory cues of the stored food to recover their caches. Amazingly, some birds can remember the locations of more than a thousand caches!

Taking advantage of the fact that birds will retrieve their favorite food first, two animal behaviorists, Nicola Clayton and Anthony Dickinson, introduced the factor of time in their experiments by allowing scrub jays (*Aphelocoma coerulescens*) to cache their favorite food, wax worms, and asking them to choose between the worms and peanuts some time later. The worms are only preferred when fresh because after a time they die and become unpalatable. Faced with a choice between dead wax worms and peanuts, the birds will choose the peanuts. A group of jays (Degrade group) was pre-trained to learn that the worms degrade over time; they therefore learned to avoid worms when a relatively long time (five days) had elapsed between caching and recovery.

Clayton and Dickinson tested if the birds could remember *when* they stored the food items by scoring their preference when choosing from recent caches and from old ones. During two caching phases, separated by five days, Degrade group jays were allowed to store wax worms on one side of a sand-filled storage tray and peanuts on the other. Recovery of caches always took place four hours after the second caching phase.

If the worms were stored during the second caching phase the jays consistently chose the worms by probing the sand on that side first. By contrast, when the worms were stored first the jays consistently chose the peanuts. The experimenters eliminated any sensory cues by removing the tray contents and replacing it with fresh sand (lacking food) just before the recovery phase. Thus selection by the bird was based solely on what it remembered storing in either side of the tray.

In order to eliminate the possibility that a preference for peanuts after five days was not due to a more rapid forgetting of worm rather than peanut caches, another group (Replentish group) was trained. These jays learned that old worms were still tasty because the cached worms were immediately removed and replaced by fresh ones just before the cache recovery phase. In contrast to the Degrade group, jays in the Replentish

group maintained their preference for worms whether recovery occurred four hours or five days after caching.

Birds in the wild often face pilfering of caches by other animals. A third group (Pilfer group) was trained to learn that as time passed, the likelihood increased that worms, but not peanuts, would be stolen. Like the Degrade group, these birds could recover either worms or peanuts during the four-hour training trial, but during the five-day training trial wax worms were removed from the storage trays before cache recovery was allowed.

During cache recovery on the four-hour test trial, birds in the Pilfer group showed the same preference for wax worms as those in the Degrade group. That preference was reversed during the five-day test trial. Most birds inspected the tray where they had stored peanuts. Evidently, they had learned that with increasing time the tastier wax worms were likely to be “stolen”. The switch in preference to peanuts during the five-day test trial exhibited by this group and the Degrade group can only be explained by the ability of the birds to recall three types of information: “what”-peanuts or worms; “where”-left or right side of tray; and “when”-worms cached four hours or five days earlier.

These findings are significant because they hold promise for studying the mechanisms that underlie the formation of episodic memory. If birds, separated from us by 250 million years of evolution, can demonstrate that they possess a memory trait thought to be exclusively human, how many other, more closely related animals, might possess episodic memory as well? Finding animal models to study could be important medically because episodic memory is especially affected in certain types of amnesia, such as Alzheimer’s dementia.

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