Quick guide

Patience

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What is patience? Humans and other animals often make decisions that trade off present and future benefits. Should a monkey eat an unripe fruit or wait for it to ripen? Should I purchase the iPhone at its debut or wait for the price to drop in a few months? In these dilemmas, large gains often require long waits, so decision makers must choose between a smaller, sooner reward and a larger, later reward.

It sometimes makes sense to choose the smaller, sooner alternative, for example in a very rich environment, but in many natural situations, waiting for the larger, later option produces the best long-term outcome. The ability to wait for larger, later rewards in these situations is called patience — also called self-control or delayed gratification — whereas preference for smaller, sooner rewards is called impulsivity. Nonhuman animals experience the patience versus impulsivity dilemma in many contexts, including foraging for food, searching for mates and territories, investing in offspring, and cooperating with others.

Humans also face questions of patience in deciding whether to save money for the future, controlling appetite and addiction, choosing between health outcomes, and making consumer choices. Walter Mischel and colleagues uncovered a strong relationship between children's patience at young ages and characteristics such as IQ, academic performance, standardized test scores and drug use later in life, even decades later. Given that patience is an important aspect of decision making, the key question is when should one be patient and when impulsive?

Why be patient? Most investigations of nonhuman patience study choice in the context of foraging for food, because waiting for delayed rewards often pays for foragers. In particular, not all food is available for immediate consumption, so animals must often extract their food from the environment. For instance, marmoset monkeys chew on tree bark and wait for sap to exude, which can take seconds or even minutes. Other species invest time and energy into cracking open nuts and shells, digging in earth and under bark for food items, and even fashioning tools to extract insects from their nests. Thus, in some sense, animals are prepared to wait the time required to process different types of food. Yet, can animals invest in benefits over longer time periods than seconds or minutes? One of the most remarkably patient behaviors is caching or hoarding food for future use. When we see a squirrel with an acorn in the autumn, she confronts a choice between the immediate gratification of eating the nut and the delayed benefit of having a stock of food to eat when other options are scarce. Clark's nutcrackers may store up to 33,000 seeds every autumn — that is 33,000 decisions to delay gratification. Certainly, in the foraging domain, waiting can pay.

Why be impulsive? An intuitive reason for preferring sooner over later rewards is that the future is uncertain. For instance, when a squirrel caches an acorn for winter (Figure 1), many hazards in the environment could prevent recovery of the nut: the squirrel may forget its location, a competitor may find it, or a fungus could infect it. Though quite intuitive, the importance of an uncertain future on temporal preferences in animals is not well established; researchers have only recently begun testing this hypothesis directly, and much work remains to explore the role of uncertainty in patience.

A second, more well-established advantage to impulsive behavior is that it avoids the lost opportunity associated with delaying benefits. Waiting itself is costly because it prevents animals from engaging in other fitness-enhancing activities. This notion underlies the rate-maximization models of foraging theory because an organism may achieve a higher overall intake rate by choosing smaller, earlier rewards. The time required to crack a particularly large nut may be better spent cracking several smaller nuts. This intuition also applies to other domains such as mate search, parental care, territory defense and social behavior. Which activity yields the greatest fitness bang for the buck?

In addition to temporal opportunity costs, waiting accrues investment opportunity costs. Rewards obtained now can be put to use now and invested in fitness. For instance, even though caching can benefit a squirrel in the harsh winter months, if that squirrel is starving at the moment, there is an immediate benefit to consuming the nut now. Opportunity costs and an uncertain future make waiting costly and may offset the benefits of delaying gratification.

How do we measure patience? Researchers studying patience in humans and nonhuman animals typically use different methodologies. To test human patience, subjects are usually asked questions such as: "Which would you prefer to receive, $100 today or $110 in one week?" By asking subjects a series of these questions, they can estimate how the value of an immediate reward subjectively decreases (is discounted) with increasing delay to receiving that reward. For instance, $100 today is subjectively more valuable than $100 in a week, but will an additional $10 offset the costs of waiting a week? Notably, most work on human discounting involves hypothetical rewards and delays: subjects often do not receive any chosen reward amount, or if they do, they only receive one randomly chosen reward.

Studies of animal patience use very different techniques. Rather than asking about hypothetical monetary rewards, researchers offer choices between smaller, sooner and larger, later rewards. Typically, subjects choose between arbitrary signals of the rewards in an operant chamber, and receive the chosen food after waiting the specified delay. For example, pigeons may choose between a green key, which results in two food pellets immediately or a red key, which results in six food pellets after

Figure 1. Patience in animals.

Nonhuman animals, like New Caledonian crows, act patiently by investing time in using tools to extract food from their environment. Other animals, such as squirrels, cache food items away for days, weeks, or months before consuming them when other food is scarce. Thus, patience is not tied to a particular time delay but to a preference for delayed rewards when sooner outcomes are present. New Caledonian crow (left): copyright: Gavin Hunt (with permission). Squirrel (right): copyright: www.FreeDigitalPhotos.net (freely available for commercial use).

10 seconds. To learn the contingencies of the situation, animal subjects experience repeated trials of the same choices. Like the researchers on human discounting, many studying animal patience assess how the value of an immediate reward decreases with time delay.

Are all animals equally patient?

Most of the early work on animal patience tested pigeons and rats. Pigeons seem to be more impulsive than rats, although neither species will wait more than a few seconds for much larger food amounts. When choosing between two food items received immediately or six food items after some delay, pigeons will only wait about four seconds for the large reward; otherwise, they prefer the smaller, sooner option. Rats wait about 22 seconds in a similar situation. More recently, however, investigators have tested several primate species using this paradigm. Surprisingly, many of the monkeys (including tamarins, marmosets and capuchin monkeys) look much like the pigeons and rats, waiting between 8 and 15 seconds for two versus six food items. Yet, some macaques and, more dramatically, the apes can wait much longer for food in these situations: chimpanzees and bonobos can wait up to 2 minutes!

Though many of the species tested seem to have comparable levels of patience, they do vary, and foraging ecology may play an important role in determining species differences in patience. For instance, insectivorous tamarins act quite impulsively in these tasks, perhaps because of the quick foraging action required to feed on insects. In contrast, the gummivorous marmosets seem more patient, likely reflecting the patience required to wait for sap to exude from trees. So the cognitive mechanisms used for making impulsive or patient choice seem to be tailored to the decision-making environment in which they evolved.

Are humans uniquely patient?

The most extreme examples of nonhuman animal patience pale in comparison to the levels of patience seen in humans. Rather than waiting for only seconds or minutes, humans will wait days, weeks, months or even years for gains. Is this a true cognitive divide? The answer is yes and no. In one sense, comparing the human and nonhuman experimental work is like comparing apples and oranges because the methodologies differ so greatly. Repeated choices with all real rewards and time delays may yield different results from one-shot choices with hypothetical rewards and delays. When tested in a manner similar to other animals, human subjects look similar to (or sometimes even more impulsive than!) chimpanzees.

Thus, in certain situations humans show similar levels of patience as other primates. Yet, clearly situations exist in which humans are much more patient than other animals. It is difficult to imagine even chimpanzees investing in the future in a way comparable to depositing money into a retirement account 30–40 years before receiving a return. Nonetheless, we know that, for instance, many species show impressive abilities for future planning. Western scrub jays can plan for their breakfast in the morning. Monkeys and apes, especially chimpanzees, strategically invest in relationships with group members to climb the political ladder of their dominance hierarchies. Though these species lack the complex language and symbolic systems (such as money and legal contracts) that allow humans to work over vast temporal horizons, they do demonstrate a flexible means of dealing with the future. Perhaps the recent surge in interest in animal patience will tell us whether long-term patience is a uniquely human virtue.

Where can I find out more?

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