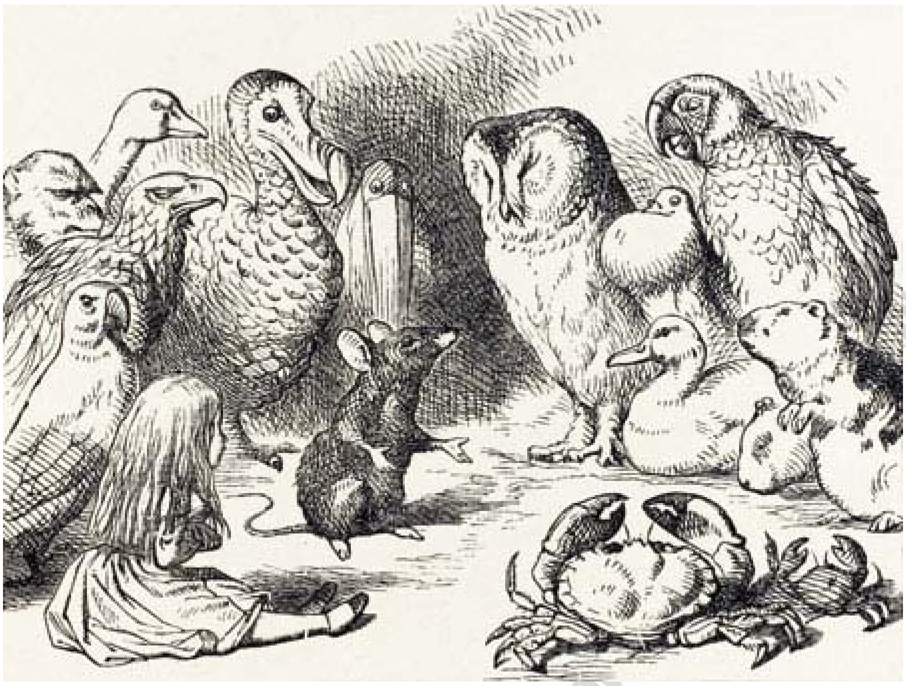
Decisions, decisions

What people can learn from how social animals make collective decisions



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Dictators and authoritarians will disagree, but democracies work better. It has long been held that decisions made collectively by large groups of people are more likely to turn out to be accurate than decisions made by individuals. The idea goes back to the “jury theorem” of Nicolas de Condorcet, an 18th-century French philosopher who was one of the first to apply mathematics to the social sciences. Now it is becoming clear that group decisions are also extremely valuable for the success of social animals, such as ants, bees, birds and dolphins. And those animals may have a thing or two to teach people about collective decision-making.

Animals that live in groups make two sorts of choices: consensus decisions in which the group makes a single collective choice, as when house-hunting rock ants decide where to settle; and combined decisions, such as the allocation of jobs among worker bees.

Condorcet’s theory describes consensus decisions, outlining how democratic decisions tend to outperform dictatorial ones. If each member of a jury has only partial information, the majority decision is more likely to be correct than a decision arrived at by an individual juror. Moreover, the probability of a correct decision increases with the size of the jury. But things become more complicated when information is shared before a vote is taken. People then have to evaluate the information before making a collective decision. This is what bees do, and they do it rather well, according to Christian List of the London School of Economics, who has studied group decision-making in humans and animals along with Larissa Conradt of the University of Sussex, in England.

The runaway queen

In a study reported in a special issue of the Philosophical Transactions of the Royal Society B, researchers led by Dr List looked at colonies of honeybees (Apis mellifera), which in late spring or early summer divide once they reach a certain size. The queen goes off with about two-thirds of the worker bees to live in a new home leaving a daughter queen in the nest with the remaining worker bees. Among the bees that depart are scouts that search for the new nest site and report back using a waggle dance to advertise suitable locations. The longer the dance, the better the site. After a while, other scouts start to visit the sites advertised by their compatriots and, on their return, also perform more waggle dances. The process eventually leads to a consensus on the best site and the swarm migrates. The decision is remarkably reliable, with the bees choosing the best site even when there are only small differences between two alternatives.

But exactly how do bees reach such a robust consensus? To find out, Dr List and his colleagues made a computer model of the decision-making process. By tinkering around with it they found that computerised bees that were very good at finding nesting sites but did not share their information dramatically slowed down the migration, leaving the swarm homeless and vulnerable. Conversely, computerised bees that blindly followed the waggle dances of others without first checking whether the site was, in fact, as advertised, led to a swift but mistaken decision. The researchers concluded that the ability of bees to identify quickly the best site depends on the interplay of bees' interdependence in communicating the whereabouts of the best site and their independence in confirming this information.

This is something members of the European Parliament should think about. In the same journal, Simon Hix, also of the London School of Economics, and his colleagues examined their voting and concluded that, as might be expected, it was along party-political lines even though the incentives to do so were far less than at national parliaments. Dr Hix and his colleagues reckon that European parliamentarians share the collection of information but, unlike the honeybees, they do not necessarily progress to investigating the issues for themselves before taking a vote.

There is danger in blindly following the party line, a danger that the honeybees seem to avoid. Condorcet's theory fails to consider whether there is an inbuilt bias among a group that comes together to consider a problem. This “groupthink” occurs when people copy one another. According to Dr List: “The swarm manages to block and prevent the kind of groupthink that can bedevil good decision making.” Dr List adds that people demonstrate this kind of bad decision-making when investors pile into a stock and others follow, creating a bubble for which there is no good reason.

Another form of groupthink occurs when people are either isolated from crucial sources of information or dominated by other members of the group, some of whom may have malevolent intent. This too has now been demonstrated in animals. José Halloy of the Free University of Brussels used robotic cockroaches to subvert the behaviour of living cockroaches and control their decision-making process. In his experiment, reported in an earlier issue of Science, the artificial bugs were introduced to the real ones and soon became sufficiently socially integrated that they were perceived as equals. By manipulating the robots, which were in the minority, he was able to persuade the cockroaches to choose an inappropriate shelter—even one which they had rejected before being infiltrated by machines. Could this form the basis of a new way of catching them?

The way animals make collective decisions can be complex. Nigel Franks of the University of Bristol, in England, and his colleagues studied how a species of ants called Temnothorax albipennis establish a new nest. In the Royal Society journal they report how the insects mitigate the disadvantages of making a swift choice. If the ants' existing nest becomes threatened, the insects send out scouts to seek a new one. How quickly they accomplish this transfer depends not only on how soon the ants agree on the best available site but also on how quickly they can migrate there. When a suitable place is identified, the scouts begin to lead other scouts, which had remained behind to guard the old nest, to the new site. The problem is that if the decision is reached rapidly, as it might have to be in an emergency, then relatively few scouts know the route. It would then take much longer to train all the scouts needed to achieve the transfer, which involves carrying the queen, the workers and the brood to the new nest.

Dr Franks and his colleagues identified a type of behaviour called “reverse tandem runs” that makes the process more efficient. During the carrying phase of migration, the scouts lead other scouts back along the quickest route to the old nest so that more scouts become familiar with the route. Thus the dynamics of collective decision-making are closely entwined with the implementation of these decisions. How this might pertain to choices that people might make is, as yet, unclear. But it does indicate the importance of recruiting active leaders to a cause because, as the ants and bees have discovered, the most important thing about collective decision-making is to get others to follow.

The Economist, New York, 13 fev. 2009, Science & Technology, online. Disponível em <www.economist.com>. Acesso em: 18 fev. 2009.