be pivotal to solving the mystery of high-temperature superconductivity. ■

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EVOLUTIONARY BIOLOGY

Animal personalities

Alison M. Bell

That different people differ in their readiness to take risks is an obvious feature of human personality. Theoretical advances now help in making sense of observations of analogous behaviour in animals.

Personality might seem to require a complexity and subtlety that is unique to humans. But evidence for individual variation in traits that we would recognize as personality, for example aggressiveness in fighting or boldness in the face of a predator, has cropped up in animals ranging from fish to monkeys to squid. Even an individual spider behaves differently from other spiders, through time and in different situations[1]. Wolf *et al.* (page 581 of this issue[2]) now show how such variation in behaviour can make evolutionary sense.

Personality has been difficult to explain from an evolutionary perspective because, at first glance, it could seem maladaptive[3]. An individual that is consistently uninhibited and bold is going to end up eaten by a predator. The optimal animal should be bold only when it makes sense to be bold, and adjust its behaviour when the situation changes. Although animals are legendary for their remarkable 'behavioural plasticity' (think migration or camouflage, for example), there is growing evidence that animals do not always change their behaviour as much as they should. In other words, behavioural plasticity is limited[3].

One possible explanation for this is that individuals should behave consistently if it's simply too hard to undergo a personality transformation. If turning off a general tendency to be aggressive requires time and energy to entirely rewire neural machinery, or to build a physiology that can support a different metabolism, then individuals might be better off sticking to an intermediate strategy[4]. Similarly, if information about the immediate environment is uncertain, then it makes sense just to behave the same way and avoid the risk of making a mistake[5].

This line of reasoning can help to explain why a given individual behaves consistently, but not, for example, why some individuals are always more aggressive than others. Such variation is puzzling, because natural selection will favour individuals with characteristics that perform the best, and less 'fit' individuals will be removed from the population. If a trait is heritable and linked to survival or reproductive success, then evolutionary theory tells us that variation will eventually disappear from the population. But, empirically, we know that personality traits are heritable[6], are linked to fitness[7] and are quite variable.

So how is all this behavioural variation maintained? One way is if the fitness of one strategy depends on the frequency of other strategies in the population[8,9]. Imagine, for example, a group composed entirely of individuals that accumulate resources by guarding them — territorial male birds, for example. An individual using a different strategy — say, dashing in to sneak the resource while a guard is otherwise occupied — would do well in that situation (so long as it is rare), because it would effectively occupy an 'open niche', devoid of competitors.

Alternatively, behavioural variation can be maintained if the best strategy depends on an individual's 'state', which effectively anchors a personality type[8]. This state can be anything from sex or health to body size, and the idea is that an individual should behave consistently so long as its state does not change. This explanation leaves the question of what maintains variation in state.

Wolf *et al.*[2] offer an answer by proposing that an individual's strategy for survival and reproduction — its life-history strategy — is a relatively unchanging state (unlike hunger level, for example), and that individuals adopt different life-history strategies because of fitness trade-offs. Any behaviour that is related to a life-history strategy will be stable through time and differ between individuals with different strategies.

The authors' model starts by assuming that an individual can either reproduce now, but

50 YEARS AGO

"Incorporation of radioactive amino-acids in the proteins of bull spermatozoa" — It is widely held that ribonucleic acid is directly involved in protein synthesis, and there have been several recent demonstrations of the necessity for the presence of ribonucleic acid during synthesis of proteins. In view of this, it seemed to be of interest to examine protein turnover in mature, ejaculated spermatozoa, which apparently contain at most only traces of ribonucleic acid... The absence of the acid from bull semen has been confirmed in the present investigation... It is possible that in this case deoxyribonucleic acid may be involved in the synthesis of proteins... The other possibility would be to regard protein synthesis in spermatozoa as an enzymatic process independent of nucleic acids.

From *Nature* 1 June 1957.

100 YEARS AGO

Mr. Walter Wellman, who proposes to make another attempt to reach the North Pole by means of his airship *America*, has left for Norway, on the way to Spitsbergen, where the balloon will be inflated. In the first week of July there will be trials of the airship until it is demonstrated that it is ready for the voyage... Mr. Wellman has given Reuter's representative the following particulars of his plans:— The airship has been made 18 feet longer and its lifting power increased by 3000 lb., giving a total lifting force of 19,500 lb. The balloon is 184 feet long and 52 feet in its greatest diameter, its cubic volume being 265,000 cubic feet. With the single exception of Count Zeppelin's airship, this is the largest ever built... The total radius of action is believed to be 2500 miles, or double the distance from the base to the Pole and back again. The balloon will not ascend more than 300 feet to 500 feet, and a guide-rope will trail over the surface of the earth.

From *Nature* 30 May 1907.

50 & 100 YEARS AGO