Abstractions

FIRST AUTHOR

Most children at primary school spend years mastering single-digit addition and multiplication. These precise numerical operations require instruction and can be difficult. But Camilla Gilmore, an experimental psychologist at the Learning Sciences Research Institute at the University of Nottingham, UK, and her colleagues show on page 589 that even preschool children can perform symbolic addition and subtraction problems — if only in approximate terms.

What has been the biggest surprise recently regarding children's aptitude for maths?

It was shown some years ago that infants understand basic numerical concepts. We now know that before they are ever taught maths or the ability to manipulate numerical symbols, children can approximate addition and subtraction. As soon as they learn verbal counting, they can do symbolic addition and subtraction, which is surprising given the struggles often evident in learning exact addition and subtraction.

Why does arithmetic take so long to master if children can solve approximations?

The key is the difference between approximate and exact. Children found our symbolic problems easy to solve. We used visual displays and problems with large differences, and asked them to add, subtract and compare numbers. But the type of maths done at school is exact and has to be learned.

Did you find any surprising gender or socioeconomic differences?

We found no gender differences at all. And children from a broad range of backgrounds could do our symbolic problems.

Were teachers surprised by their students' mathematical abilities?

They were not only surprised that children could solve the problems, but by how much they enjoyed doing them. I think it's because maths is defined by exact maths. We don't think about approximate addition and subtraction. Teachers aren't aware that students have these abilities. We were surprised they could do it without any maths instruction at all.

How might these findings help teachers teach maths?

This is a first, and very simple, study. It's exciting that such remarkable abilities can be shown without a complex study. But it's just a first step. To understand how this could benefit maths education, the next stage is to learn more about how children build on these intuitive competencies in learning formal maths in school. ■

MAKING THE PAPER

Max Wolf

A model suggests that reproduction underlies animals' personalities.

The study of personality is typically the domain of psychologists. Recently, however, animal researchers have been keen to delve into the personality traits of non-human animals. "During the past couple of years, animal personality has become a very active area of research," says Max Wolf, a PhD student at the University of Groningen in the Netherlands. "But many questions about the evolutionary value of variation in animal personality have still not been answered." Such questions, as it turns out, became the focus of his graduate thesis.

Researchers had observed variations in certain behaviours among animals — for example, some are more aggressive than others. Furthermore, such differences tend to be consistent — an individual who is more aggressive today is likely to be more aggressive in the future. And an individual that tends to be more aggressive is also inclined to be bolder in exploring its territory. Such observations suggested that something akin to human personalities exists in other animals. But why would evolution give rise to different personality types?

Wolf's mentor, theoretical biologist Franz Weissing, and his colleagues noticed that many personality traits described in the literature could be categorized as 'risk-taking' behaviours. They reasoned that the predilection for or against taking risks — aggressive and bold individuals take more risks than non-aggressive and shy individuals — might be explained by how much an individual stands to lose in terms of future reproduction. For example, an individual that has a good chance of mating in the near future would have a lot to lose, and would therefore evolve to be consistently risk-averse in different situations.

Starting with this basic intuition, Wolf began working towards a mathematical model to study the idea. He first scoured the literature and discussed ideas with his colleagues, then used the resulting information to develop the model. "It took months to arrive at a satisfying model structure," he says. The trick was to simplify the problem enough so that it became tractable — for example, by assuming that an individual lives for only a couple of years and reproduces only once a year — but not so much that it lost its most crucial ingredients. The model had to provide repeated choices for each behavioural situation, such as whether or not to run away from a predator, throughout individuals' lives.

In the model (on page 581), the degree to which an individual has invested in future reproduction determines how that individual behaves in risky situations. This model can now be tested experimentally by looking for a correlation between the reproductive profile of an animal and its propensity to take risks. "Ultimately, what we want to achieve with our theoretical work is to influence empirical work," says Wolf.

With almost two years left of his PhD, Wolf is currently applying his ideas to more specific ecological situations. For example, in a Dutch population of oystercatchers, some birds start breeding early in life on low-quality territory, whereas others delay reproduction by queuing for high-quality territories. Wolf's model predicts that the birds that queue for the high-quality territories have more to lose than those that have already reproduced. Thus, the queuing birds should be relatively shy and non-aggressive. "Applying our ideas to more specific ecological scenarios will make it easier for researchers to test these ideas," says Wolf. ■

FROM THE BLOGOSPHERE

Electronic communication among reviewers and publishers or granting agencies threatens peer reviewers' anonymity, according an entry on *Nature*'s Peer-to-Peer blog this week (http://tinyurl.com/3ae8p6). Cristofre Martin of St George's University in Grenada, West Indies, and Kenneth Storey of Carleton University in Ottawa, Canada, note that most state-of-the-art software applications embed information about the creator of the document with the normally invisible metadata of the file. But these metadata can easily be viewed, providing the user with the account information associated with the specific computer used to generate the document. Authors, journal editors, publishers and granting agencies need to be cautious about how 'anonymous' information is transmitted between the creator and the recipient.

Nature Publishing Group journals use a web-based peer-review system to ensure anonymity, as do many other publishers. Further details of NPG policies can be found at the authors and reviewers' website at http://tinyurl.com/33fg2r. ■

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