CellPress

Q & A

Xing Xu

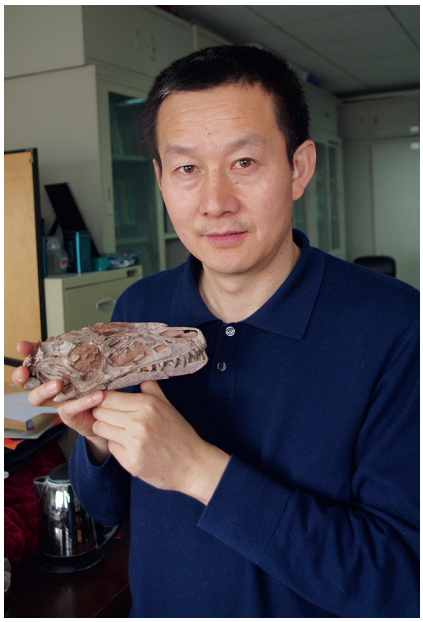
Xing Xu mainly works on dinosaurian morphology, taxonomy, and systematics. One of his current research projects aims to reconstruct a robust theropod phylogeny and use it to analyze the important modifications along the line to birds in detail, combining both paleontological and neontological data. He has conducted fieldwork in the major dinosaur-producing areas of China as well as in several other countries, and this has led to the discovery of numerous vertebrate fossils. Based partly on this work, he and his various collaborators have named more than 70 new dinosaur species. He is also interested in science popularization, and one of his articles is even included in an elementary school textbook read annually by millions of students. He is a Professor at the Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, and an Adjunct Professor at both Shenyang Normal University and Nanjing University, where he is helping to further develop the vertebrate paleontology research program. He is an Honorary Fellow of the Geological Society of London.

What turned you on to biology in the first place? Believe it or not, I got into biology by accident. I wanted to be a physicist when I was a teenager because I felt that it would be wonderful to explore the fundamentals of the universe, after reading a lot about Albert Einstein, his peers, and their work. But I was assigned to paleontology when I was admitted to Peking University for my bachelor's degree because I had agreed to be assigned to any major if my score were not high enough for my preferred choice. This really disappointed me at the time but eventually turned out to be great for my life and career. In fact, I've come to love collecting fossils in the field and studying them in labs, and it's hard to imagine how I would live without studying paleontology.

And what drew you to your specific field of research? Again, it was an accident. Originally, I was told that I was going to study mammal fossils when I was admitted to the graduate program at the Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, but later I was assigned to dinosaur paleontology. There have been a surprising number of accidents in my life, and fortunately the major ones have mostly turned out well. Apart from the accidental choice of dinosaur paleontology for my research area, I accidentally found some amazing dinosaur fossils in the Gobi Desert when I pretended to dig in a somewhat randomly chosen spot for a Japanese TV crew that had come out to make a documentary about my fieldwork.

If you had to choose a different field of biology, what would it be? It would be evolutionary developmental biology. I've enjoyed collecting and studying fossils over the past two decades, but during roughly the same time period I've also had a lot of communication and even collaborations with developmental biologists in order to better understand the evolution of such important biological structures as avian beaks, fingers, and feathers. It's amazing that we can actually build up a picture of the genetic architecture associated with historical, biological diversity and reconstruct the developmental mechanisms underpinning evolutionary changes in animals that died out millions of years ago. I think that this is very cool. I have also been thinking of doing something even more fun: bringing some dinosaurs, such as the four-winged *Microraptor*, back to life using the toolkit of developmental biology. In fact, my colleague Bhart-Anjan Bhullar — a paleontologist at Yale University — has already started some research in this direction. He and his colleagues manipulated some aspects of protein expression in embryonic chickens, and this caused the birds to grow something that looked more like an ancestral dinosaurian snout than a typical avian beak.

Do you have a scientific hero? Of course, I have to pick Charles Darwin, who had so many qualities that are wonderful in any scientist: the extraordinary persistence that helped him to collect the huge amount of data needed to demonstrate the phenomenon of evolution, the exceptional talent that led him to the discovery of the law of natural selection,



Xing Xu holding the skull fossil of tyrannosaur *Dilong paradoxus.*

and the great courage that enabled him to challenge the authority of religion. I admire him so much, and I think that his contribution to humanity still has not been fully appreciated.

What is some of the best advice you've been given? Try and try your best. Finish the job because there's no excuse not to finish it. I like thinking, and at the age of fifty I still even sometimes have day dreams, but I think it is more important to be acting.

What is your favorite conference? One of my favorite conferences is Science Foo Camp, an annual scientific conference organized by O'Reilly Media, Digital Science, Nature Publishing Group and Google Inc. at the Googleplex campus in Mountain View, California. The conference has a few unusual features: it's fully interdisciplinary and invitation only and there's no fixed agenda. For various reasons, I've attended this conference only once, but I really enjoyed the fresh atmosphere and the free spirit of the meeting.

Do you believe that there is a need for more crosstalk between biological disciplines? Absolutely. A great example comes from my own research. I used to mainly study the morphology, taxonomy, and systematics of dinosaur

fossils. After I started working on the origin of birds, I realized that the traditional paleontological approach was not sufficient for understanding bird origins. To get a reasonably complete picture of the evolution of avian features, we need not only data from fossils but also insights from other disciplines. So I started working with the developmental biologists Cheng-Ming Chuong of the University of Southern California and Susan Mackem of the National Cancer Institute, the comparative genomicist Guojie Zhang of the University of Copenhagen and the China National GeneBank, and the biomechanist Robert Dudley of the University of California at Berkeley, among others, in order to understand how feathers and wings evolved and how avian flight originated. This approach turned out to be fruitful, and I've co-authored several papers with these collaborators in different disciplines. I've also been communicating a lot with Huanming Yang of the Beijing Genomics Institute — one of China's leading genetics scientists — and we've even co-organized academic symposiums to promote crosstalk between paleontology and neontology. The history of evolutionary biology is all about integrating an ever-growing number of disciplines into evolutionary studies, and I believe that this trend will continue into the future.

What do you think about post-publication peer review of papers?

Post-publication peer review is a great idea and definitely benefits the scientific community. I believe that almost every scientist has at some point wanted to correct some mistakes or flaws in a paper that he or she just published, but there's never been a good mechanism for that. Furthermore, the current model of peer review normally involves only two or three referees for each submission, and this limited number of minds and eyes can easily produce biased or careless comments. Post-publication peer review helps to provide a better, less-biased assessment of the research.

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Attachment bonds between domestic cats and humans

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Worldwide, domestic cats (*Felis silvestris catus*) outnumber domestic dogs (*Canis familiaris*). Despite cats' success in human environments, dog social cognition has received considerably more scientific attention over the last several decades [1–3]. A key aspect of what has been said to make dogs unique is their proclivity for forming attachment bonds, including secure attachments to humans [1,3], which could provide scaffolding for the development of human-like socio-cognitive abilities and contribute to success in human environments [3]. Cats, like dogs, can be found living in social groups or solitarily, depending on early developmental factors, resource distribution, and lifetime experiences such as human interaction [1,2,4]. Despite fewer studies, research suggests we may be underestimating cats' socio-cognitive abilities [2]. Here we report evidence, using behavioral criteria established in the human infant literature [5,6], that cats display distinct attachment styles toward human caregivers. Evidence that cats share social traits once attributed to dogs and humans alone would suggest that broader non-canine-specific mechanisms may be needed to explain cross-species attachment and socio-cognitive abilities.

In our study, cats and owners participated in a Secure Base Test (SBT), an abbreviated strange situation test used to evaluate attachment security in primates [7] and dogs [8]. During this test, the subject spends 2 minutes in a novel room with their caregiver, followed by a 2-minute alone phase, and then a 2-minute reunion phase (see Supplemental Information for details). Cats were classified into attachment styles by expert attachment coders using the same criteria used in the human infant [5,6] and dog literature [8,9]. Upon the caregiver's return from a brief absence, individuals with secure attachment display a reduced stress response and contact-exploration balance with the caretaker (the Secure Base Effect), whereas individuals with an insecure attachment remain stressed and engage in behaviors such as excessive proximity-seeking (ambivalent attachment), avoidance behavior (avoidant attachment), or approach/avoidance conflict (disorganized attachment) [6].

The SBT was conducted with kittens aged 3–8 months. Seventy kittens were classified into an attachment style (see Supplemental Information) and 9 kittens were unclassifiable. Of the classifiable kittens, 64.3% were categorized as securely attached and 35.7% were categorized as insecurely attached (Figure 1). Of the insecure kittens, 84% were ambivalent, 12% avoidant, and 4% disorganized. To determine if attachment style could be predicted by differential socialization and reinforcement opportunities alone, a portion of the kittens were enrolled in a 6-week training and socialization intervention with their caretaker following baseline. When comparing 39 class and 31 control kittens, there were no significant differences in the number of kittens classified as secure or insecure either at baseline (Fishers, $p = 0.14$) or approximately 2 months later at follow-up (Fisher's, $p = 1.0$). These results indicate that although social reinforcement is likely a factor that contributes to the development of an attachment style, once an attachment style has been established between the members of a dyad, it appears to remain relatively stable over time, even after a training and socialization intervention [5]. Indeed, we found the proportion of secure and insecure kittens at follow-up mirrored that of baseline, with 68.6% displaying secure attachment and 31.4% displaying insecure attachment. At the individual level, 81% of kittens retained the same secure base designation (secure/insecure) at retest (Binomial, $p < 0.0001$). This may suggest that heritable factors, such as temperament, also influence attachment style and could contribute to its stability.

Because cats, like most domesticated animals, retain several juvenile traits into maturity and remain dependent on humans for care, we predicted that attachment behavior toward a primary caretaker would be present in adulthood. To evaluate this, 38 cats over one year of age participated in the SBT. Distinct attachment styles were evident in