Environment plays key role in changing movement behaviour of animals

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Mathematicians from the University of Leicester have developed a theory which explains how small animals, such as bats, insects and birds, adjust their movement behaviour based on cues within their environment.

In a paper published in *Scientific Reports*, the researchers propose a unified theory of animal movement that relates the movement pattern to an animal's biological traits such as its mass and body shape and to the properties of the environment.

The theory shows how different movement patterns may arise naturally from the interplay between an animal's force, the environmental drag, and an animal's behavioural response to the environmental cues. The cues include information about an animal's movement environment, in particular the information about the location of food sources, predators and mating partners.

The theory is based on two assumptions: firstly, that in its movement a foraging animal has to continuously exert a force to overcome the drag or friction from the environment, and secondly, that in response to clues or signals received from the environment - for example through noise or smell –the animal has to change its speed accordingly and hence exert some additional force, for instance as is needed to avoid predators.

Professor Sergei Petrovskii from the University of Leicester's Department of Mathematics, who led the research, said: "For the last two

decades, the patterns of animal movement have been an issue of high controversy and sometimes even a heated debate.

"The traditional view is that a foraging animal disperses in space in a slow, diffusive way, similar to how small inanimate 'Brownian' particles moves in physical systems. It has been challenged by growing evidence that under some conditions animals may perform a faster 'Levy walk', which is also thought to provide a more efficient search strategy.

"However, how animals actually choose between the two patterns remained a mystery. Our new theoretical study sheds a new light on this problem."

The theory works best for small animals such as insects, small fish and small birds.

The study, which is funded by The Royal Society, makes an important step to understanding animal movement behaviour and could help to provide answers to issues such as management of biological invasion, control of epidemics spread, and protection of endangered species.

Professor Petrovskii added: "We have been working on this problem for almost ten years, and we are very grateful to The Royal Society for their support which allowed us to make this significant step in our research."

More information: A random acceleration model of individual animal movement allowing for diffusive, superdiffusive, and superballistic regimes, *Scientific Reports* (2017). DOI: 10.1038/s41598-017-14511-9

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