simplest sense consciousness is an awareness of the outside world"—empties 'consciousness' of any meaning [1]. On the contrary, recognizing that every organism is conscious opens up enormous opportunities for experimental investigation and evidence-based understanding of this crucial biological capability. Awareness can be considered as an ability to respond to certain patterns of stimulation or signalling. By comparison of these data with internal information and assessment, awareness then leads to intelligent behaviour, an ability shared by all classes of organism. Alternatively, awareness can be regarded as resulting from a set of maintained internal images that can be used for comparison with the integrated signal pattern. The image, a network, can be either molecular or nervous, although the distinction is often blurred. Awareness is clearly an adaptive quality that enables organisms to sense and optimize their behaviour within the perceived environment and will be subject to selection.

Olsson and Forkman provide a typical description of consciousness as feelings, reflecting on experience and existence. This description, rooted solely in human experience, is abstract and personal to the individual experiencing it. It provides little in the way of real biological measurement; does one individual have more consciousness than another? It certainly provides for endless, subjective philosophizing. Mankind has qualities that render him unique: a complex language with excellent verbal communication, a large, unusually structured brain, manual dexterity and consequently complex culture. Do we really expect other organisms to be humanly conscious? Since we cannot communicate directly, it is no more than speculation whether other species are conscious by this definition. Even Alex, the communicative parrot with his 100 words, which we described in relative detail, gave no real hint of such experience. But by our definition, he was clearly conscious. The de-construction of this kind of anthropomorphic agenda was ably and classically performed by Nagel [2] when he asked what it was like to be a bat, a mammal, using echolocation—like dolphins—and flying. His conclusions, "No reason to suppose a bat's (or even wasp's) experience is subjectively like anything we can experience or imagine. The less it depends on a specifically human viewpoint, the more objective is our description."

The wasp *Polistes*, an invertebrate, uses learned facial recognition both to recognize itself and other nest mates as individuals, and to attack unrecognized enemies [3]. Wasps in these colonies recognize their position in the nest order and discriminate between the ranks [4]. They must therefore also have self-awareness as an individual distinct from others. All classes of organism are able to recognize members of their own species, to recognize that they themselves are part of that species group, to mate with them and to recognize enemies. Each individual recognizes itself as different from other species members and must also be self-aware. Again, comparisons with predetermined molecular or image networks probably form the basis of self-awareness.

Olsson and Forkman's primary concern seems to centre on animal welfare, which animals are conscious and which are not by their definition—an entirely subjective exercise—and presumably the resulting legislation. Similarly, they include the qualities of pleasure and pain, which even in humans are entirely variable qualities and thus indeterminate in animals. Again, only subjective assessments are available. The trap to avoid here is that of Lovejoy's discredited *The Great Chain of Being* [5] that

assumes mankind to be perfection, ranks other organisms according to their degree of perfection and ordered usually according to their similarity or proximity to human beings. It is crudely anthropocentric. Animal welfare research and legislation have contributed a lot to improve the welfare of laboratory animals. Yet, if we want to seriously improve the fate of most animals, it is more efficient to tell farmers that well-treated animals give better yields and to educate children to respect the planet on which they live and the organisms with which they share it.

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Anthony J. Trewavas is at the Institute of Molecular Plant Science, University of Edinburgh, UK. E-mail: trewavas@ed.ac.uk
Frantisek Baluska is at the Institute of Cellular and Molecular Botany, University of Bonn, Germany. E-mail: baluska@uni-bonn.de

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English of science or scientific English?

In his recent editorial, *All Chinese to me*, Howy Jacobs raised the issue of language in science [1]. I feel that some debate is necessary to determine what one might call the 'English of Science Communications'.

The Nobel Laureate and eminent physicist Niels Bohr once remarked that science is deeply immersed in language, which influences the way it is interpreted and practiced. Present-day biology, with an explosive rate of quantitative data generation, certainly needs a consistent language code for communications. It will both help to create an objective criterion for editorial decisions and make the computerized scanning of the scientific literature and automated content analysis more effective. Most importantly, however, the non-native English speakers, who are otherwise capable of producing excellent data, would get an opportunity to report them, independently of an interpreter.

With English as a basis, each discipline of science has progressively developed its own style of communication, effectively defined to describe objective thinking and

quantifiable results. Thus, the message is easily translated into any other language. It is distinct from both creative writing in English and creative English. In order to broaden the scope and help non-native English speakers communicate the results of their research in English, we should minimize the emphasis on 'readability', which is subjective and not so well-defined, and ensure simply that the manuscripts are written following proper syntax and present logically constructed arguments and analysis. Sometimes, thinking about science in a language other than English might help to discover a whole new paradigm. One should not foreclose on recognizing that opportunity.

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Krishanu Ray is at the Department of Biological Sciences, Tata Institute of Fundamental Research, Mumbai, India. E-mail: krishanu@mailhost.tifr.res.in

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