Illinois Press, Urbana, IL, 1949).
6. See, for example, S. R. X. Dall, R. A. Johnstone, *Philos. Trans. R. Soc. London Ser. B.* **357**, 1519 (2002).
7. J. C. A. van der Lubbe, *Information Theory* (Cambridge Univ. Press, Cambridge, UK, 1997).
8. See, for example, E. D. Weinberger, *BioSystems* **66**, 105 (2002).

IN THEIR REVIEW "PUBLIC INFORMATION: from nosy neighbors to cultural evolution" (23 July 2004, p. 487), É. Danchin *et al.* illustrate convincingly that animals can use information about the behavior of other individuals in their decision-making and that such use can trigger cultural evolution. Yet, their suggested unified concept of "public information" (PI) remains somewhat vague, possibly for two reasons.

First, in their attempt to highlight the implications of PI, they expand the meaning of this term from merely describing a potential resource (a type of information) to a term that also describes a "phenomenon," and a "tool" for research (p. 490). As a result, it is not clear whether the concept of PI represents a theory, a process, or merely a potential resource. We believe that the latter, less complicated designation would in fact be more constructive. The existence of PI as a potential resource is hardly disputed, and the open issues for research are (i) the extent to which this resource is actually being used by animals and (ii) the extent to which it is being transmitted culturally across generations.

The second problem in defining PI is the authors' exclusion of information derived from animals' locations and signaling behaviors (see their fig. 1). This narrow definition may be impractical. For example, information about location may frequently be correlated with information about performance or quality (e.g., feeding site or male's position on a lek), so it seems difficult to distinguish between PI and information about location in practice. Signaling behavior, such as bird singing, in addition to containing cues for male quality, likely also provides information about male density: Is such information not PI? The exclusion of signaling comes to a real paradox when we have to deal with teaching, which is the most advanced form of information transmission in cultural evolution and which clearly involves communication: What are we to make of such intentional information transmission? Rather than viewing what we teach as nonpublic information, it would seem that there is room for considering a variety of public information sources available to animals and for using a more practical definition of PI that includes any information derived from the behavior of other individuals.

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IN THEIR STIMULATING REVIEW "PUBLIC information: from nosy neighbors to cultural evolution" (23 July 2004, p. 487), É. Danchin *et al.* combine a sweeping survey of behavior and culture with a focused advocacy for public information's role in cultural evolution. In my reading, these elements are in tension. The examples given often go beyond the definition that public information is about the quality (rather than location) of a resource and is revealed by the performance of other individuals. Scrub jays only need to learn the location of other jays' caches to rob them, and fish do not need to observe any behavior to avoid an area containing alarm substance. These examples reveal that many interesting and important aspects of behavior may not strictly involve public information.

Although the authors couch their conclusions in terms of public information, this term is mentioned only sporadically in the second half of the Review. I found many instances where the broader terms "social information" or "inadvertent social information" could be substituted for "public information" without loss of meaning. It may be useful to discuss the relative importance of communication and inadvertent social information to cultural evolution, but it seems unnecessary and potentially counterproductive to advocate for one form of information while ignoring others.

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WE ENDORSE É. DANCHIN *ET AL.*'S EMPHASIS on public information, both as a taxonomically widespread source of adaptive behavior and as a driver of social evolution ("Public information: from nosy neighbors to cultural evolution," Review, 23 July 2004, p. 487). However, we feel it is important to stress the costs of public information and to consider why some species of vertebrates do not exploit this reservoir of knowledge. In our study of public-information use in two closely related species of sticklebacks (*1*), we found that nine-spined sticklebacks (*Pungitius pungitius*), after watching conspecific or heterospecific demonstrators feeding at two patches and then tested alone, tend to approach the former location of the richer patch. As their observational experience was restricted to the relative success of their demonstrators, and potential alternative explanations could be ruled out, we surmised that nine-spined sticklebacks were capable of public-information use. However, three-spined sticklebacks (*Gasterosteus aculeatus*), when subject to the same test, swam with equal frequency to the former locations of rich and poor patches. Why should one species and not the other rely on public information?

The answer to this conundrum comes from a mathematical analysis of the adaptive advantages of human culture. Boyd and Richerson (*2*) postulate a costly information hypothesis, which proposes an evolutionary trade-off between reliable but costly self-acquired information and potentially less reliable but cheap socially transmitted information. The relative cost of acquiring personal information varies between the two stickleback species, which determines the value of public information. Three-spines have large spines and armored body plates—robust structural defenses that allow them to sample alternative food patches directly, in relative safety. Such sampling by nine-spines, which have weaker physical defenses, would leave them vulnerable to predation and hence, in fitness terms, would be extremely costly. Consequently, nine-spines spend much of their time in refuge, from where selection seemingly has favored the ability to monitor the foraging success of others. Considerable evidence is accumulating among fish, birds, and mammals that animals will ignore public information under specific circumstances (*3*). For example, nine-spines will ignore public information if they have reliable, up-to-date personal information, yet switch to exploiting public information if their personal information is unreliable or outdated (*4*). In turn, the costs associated with public information can stimulate the collection of personal information that refreshes the cultural knowledge pool (*5*), providing the variation required for cultural evolution.

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Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted through the Web (www.submit2science.org) or by regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.