ENVIRONMENT

A Roadmap to Nature's Benefits

Heather M. Leslie

The taste of fresh strawberries. The sounds of the surf and kids playing on a packed shoreline. Warm sun on your back as you kayak across the bay. These visceral summer experiences, just ahead for many of us, are what *Natural Capital* is all about: How does natural capital—or ecosystems and the many species and processes that are part of them—generate benefits for people? And, vitally, how will management, climate change, and other perturbations influence the provision of these benefits in the future? Through careful analysis and illustrative case studies, *Natural Capital* demonstrates how explicit consideration of these benefits, along with how and where they are produced, will enable us to more proactively and effectively sustain the world's ecosystems and the human communities that rely on them.

The science and application of ecosystem services (that is, the benefits provided by functioning ecosystems) have advanced tremendously since Gretchen Daily and colleagues presented a preliminary assessment of their value (*1*). *Natural Capital* captures the substantial progress of the past 15 years from theory to user-driven scholarship in an easily digestible yet impressive array of chapters that will be of interest to the seasoned ecologist or economist, the dedicated congressional staffer, and the conservation practitioner alike.

The book begins with a primer on the science of ecosystem services, which highlights why and how ecosystem services are being applied in diverse contexts, including China, Colombia, and the United States. The initial chapters also provide readers with a sense of three fundamental elements of ecosystem service assessment: quantifying the supply of services generated by ecosystems (How much? Where on the landscape?), estimating their value (What are they worth, in dollars or other common currencies?), and finally, assessing how they may change in response to management and other landscape-level changes (What are the trade-offs among services? Where are the synergies among conservation and development goals?).

Ecosystem service science, which is largely drawn from ecology and economics, enables us to link ecosystem state and processes (such as rates of primary productivity and decomposition) with the generation of services that people value (such as the protection from coastal storms provided by salt marshes and other coastal habitats). This distinction between processes and services highlights the importance of "mapping" services explicitly: If no one is living along a particular stretch of coast, then the marsh there does not provide a coastal protection value (although it may well offer other benefits, such as carbon sequestration, recreation areas, and fisheries nursery habitats). The largest section of the book (occupying more than half its length) presents a complementary set of "multi-tiered models for ecosystem services" including, for example, freshwater provision, forest products, and nature tourism. Although the editors state up front that these chapters are meant to stand alone, given the 106 contributors, the volume is remarkably coherent, both in terms of the overall development of themes as well as terminology.

Importantly, the volume is not intended only for conservation scientists and practitioners. As several contributors note, even though only one of the United Nations Millennium Development Goals (*2*) explicitly mentions the environment, fulfilling all eight of these international goals aimed at cutting global poverty will require healthy ecosystems.

The book's final chapters focus on how ecosystem services have been or could be incorporated into policy and management decisions. One chapter discusses evaluations of alternative future scenarios for land use in Oregon's Willamette Basin and in a watershed on the Hawaiian island of Oahu. Other case studies in this section include links between poverty and the environment in Kenya and the Amazon basin, the valuation of mangrove ecosystems in Thailand, and benefits provided by nearshore marine ecosystems in the Caribbean and Puget Sound, Washington. These chapters are perhaps the most interesting, as they illustrate the many challenges we will need to address if the ecosystem services approach is to be widely adopted. For example, incorporating adaptive behavior by resource users, governments, and other actors into ecosystem service assessments requires information and technical capacity that is at present often impossible to achieve. Yet capturing these dynamics, along with other feedbacks between social and ecological systems, is vital. Other challenges include determining appropriate policy mechanisms (e.g., cap and trade, payment schemes, or taxes), tailoring them to local institutional contexts, and simply getting this idea that humans depend on ecosystems in fundamental, diverse ways on the agendas of more government and civil society institutions.

Although *Natural Capital* does an excellent job of documenting technical advances in the field, action-oriented readers may wish that the interspersed short essays, often focused on model applications and other real-world perspectives, received more space. Hopefully a future book will pick up where this one leaves off. For the time being, those interested in incorporating ecosystem service approaches in their decision-making can find some helpful tools online [e.g., (*3*)].

> **Natural Capital**
> Theory and Practice of Mapping Ecosystem Services
> *Peter Kareiva, Heather Tallis, Taylor H. Ricketts, Gretchen C. Daily, and Stephen Polasky, Eds.*
> Oxford University Press, Oxford, 2011. 391 pp. $134.95, £75. ISBN 9780199588992. Paper, $69.95, £39.95. ISBN 9780199589005.

Source of many services. In addition to the shellfish this Colombian woman is gathering to sell, mangrove forests provide fuel wood, storm protection, nursery habitats for fish, carbon sequestration, and nutrient cycling.

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To date, ecosystem service projects have occurred primarily in terrestrial environments, and most have been led by governments or large environmental organizations. We likely will see a greater diversity of ecosystems and institutions involved in the next wave of ecosystem service assessment and management. For example, ecosystem services are a centerpiece of the new U.S. National Ocean Policy, and some companies (such as Dow Chemical, in partnership with the Nature Conservancy) are embracing ecosystem services as a means to assess potential business strategies. By providing a roadmap for how to move from well-grounded theory to real-world practice, *Natural Capital* offers an excellent resource for these and many other emerging ecosystem service projects. Yet in order for these efforts—and this volume—to fulfill their promise, scholars and practitioners will need to continue to work together to assess how ecosystem services are likely to change in an uncertain future, particularly in the face of humanity's adaptation to our changing environment.

References and Notes
1. G. Daily, Ed., *Nature's Services: Societal Dependence on Natural Ecosystems* (Island, Washington, DC, 1997).
2. www.un.org/millenniumgoals/.
3. www.naturalcapitalproject.org/policy_tools.html.

NEUROSCIENCE

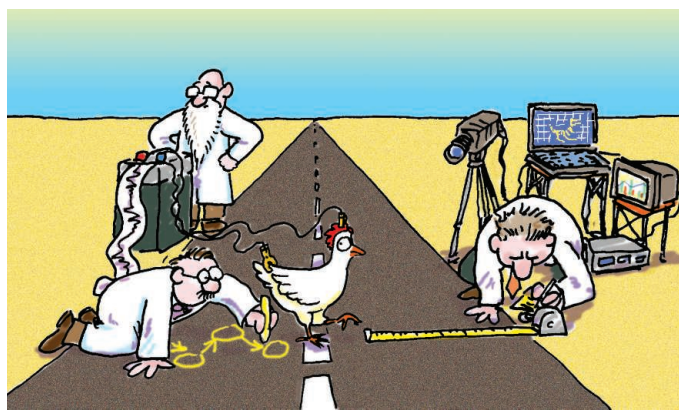# Why We Laugh

Walter Sinnott-Armstrong

Inside Jokes is funny in two ways. It is funny ha-ha, because it includes hilarious jokes. (Question: "How do you tell the sex of a chromosome?" Answer: "Pull down its genes.") It is not funny huh, because it is clear and accessible rather than confusing or disturbing. Yet it is funny peculiar. Like a funny-looking tree, it holds your interest and raises new questions.

Science advances by asking new questions, and in the book, Matthew Hurley, Daniel Dennett, and Reginald Adams raise a lot of them: Why is humor enjoyable? Why do we laugh out loud? Why do we tell jokes? Why do we go to such great lengths to hear jokes? Why are some jokes funny and others not? Among funny jokes, what makes some funnier than others? Why does humor depend on knowledge and culture? Why do some old jokes (and movies) still make us die laughing, whereas other jokes (and puns) die when repeated? Why are timing and order so important when telling jokes? Why is humor always about humans and never about rocks or roses unless they are anthropomorphized? What makes caricatures, nonsense, and incongruity funny? Why are our own failings and foibles funny? How does first-person humor differ from third-person humor? Why are practical jokes funny? Why is it funny to disparage certain groups of people but not others? How do sexual innuendo and bathroom references enhance humor? Why do men get more laughs and women give more laughs? Why do we laugh—and laugh so long—when tickled? Why don't other animals have a sense of humor? Why is the sense of humor so widespread in humans? Some of these questions have been asked before, but no previous attempt succeeds in answering so many so well.

The key to the authors' success is that they locate humor within recent cognitive science and evolutionary theory. To aid survival, our brains constantly and covertly use heuristics to generate expectations about what we will experience next, but we would be too inventive for our own good if we did not regularly search for and remove discrepancies between our expectations and our experiences. The immediate incentive to look for such discrepancies and thereby to reduce error comes from the pleasure of discovering a mistake in a currently harmless active belief that was introduced covertly. That pleasure is mirth, and humor is what produces it. Thus, humor is "a cognitive cleanup mechanism" that stains with mistaken belief before washing out the error (as in "I wondered why the Frisbee was getting bigger, and then it hit me."). Laughter is then a public signal of our ability to clean up our minds. Because such cognitive prowess is useful, it attracts mates—both friends and sexual partners—and spreads throughout the world.

Hurley, Dennett, and Adams apply their theory to well over a hundred examples (including stupid jokes, dark humor, musical jokes, and witty remarks that are not humorous), to many apparent counterexamples (such as surprises, forgetting, riddles, and lies), and to related phenomena (such as magicians and garden-path sentences). They also use their theory to answer or refine the questions above, as when they explain why jokes can be ruined by taking too little time (for an active expectation to form) or too much time (so that the active belief is given up before the punch line) even though theatrical comedies can last for hours. Analysis is said to ruin jokes, but I still found myself laughing while the authors carefully dissected joke after joke. Perhaps my reaction could be taken to support their theory.

Their account also suggests several larger lessons. Humor is related to the scientific method of testing hypotheses, although it operates more quickly and covertly. Humor also illustrates how epistemic emotions motivate and control cognition. Reason is the slave of the funny bone. And humor exemplifies the human tendency to project our emotions onto the world, since humor is a feature of our thought processes rather than of jokes or any other external stimuli in themselves. Because humor is central to and distinctive of human life, understanding it can help us understand much more about ourselves.

Many parts of the authors' theory are, of course, not new. Hurley, Dennett, and Adams laugh on the shoulders of giants. In addition, much work remains to be done, especially regarding the neural mechanisms of humor. And critics will surely propose counterexamples and refinements. Whether or not the details of this theory survive, it is a very promising leap forward. Everyone who reads *Inside Jokes* will be enlightened as well as amused.

Inside Jokes
Using Humor to Reverse-Engineer the Mind
by Matthew M. Hurley,
Daniel C. Dennett,
and Reginald B. Adams Jr.
MIT Press, Cambridge, MA, 2011. 373 pp. $29.95, £22.95. ISBN 9780262015820.

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