

raphy and hydrology, do if asked about a river's direction, branching and neighboring villages?" (p. 93, my loose translation). Anticipating Dehaene *et al.*, Ferreira conducted an experiment and asked this question of a Tapuio Indian, who by tying together several cords was able to create an approximate map of the local river and its tributaries, as well as point out the location of Indian villages. Further, Ferreira wrote that a Macuxí Indian he encountered not only drew an intelligible map of local river patterns and scaled hut outlines using a stick to trace lines in sand, but when presented with a pen and ink rendered the same idea on paper. Clearly, the naturalist understood native Brazilians not only to be reasoning individuals, but capable of understanding geometric and geographic concepts. Thus, on the basis of his own experiments, Ferreira would have agreed with Dehaene *et al.*'s conclusion that "geometrical knowledge arises in humans independently of instruction, experience with maps or measurement devices, or mastery of a sophisticated geometrical language."

ROBERTA M. DELSON

Division of Anthropology, American Museum of Natural History, New York, NY 10024, USA, and Department of History, Drew University, Madison, NJ 07940, USA.

Reference

1. A. R. Ferreira, *Viagem Filosófica pelas capitânias do Grão Pará, Rio Negro, Mato Grosso e Cuiabá*, vol. 2, *Memórias zoologia e botânica* [manuscript 1783–1792] (reprinted by the Conselho Federal de Cultura, Rio de Janeiro, Brazil, 1974).

Response

WULFF CONTRASTS PROCESSES OF DEDUCTIVE reasoning based on the axioms and postulates of Euclidean geometry with processes of visual pattern recognition, and he suggests that the latter processes underlie performance on our tests of geometrical categorization and map use. Our tasks were designed to assess geometrical concepts at a higher level of representation. Recognition of visual patterns is orientation-specific (1), yet both our tasks required that the Mundurukú abstract geometrical relations from figures that varied in orientation. The Mundurukú's globally high performance, particularly in the map task which requires a transformation from two to three dimensions, cannot plausibly be attributed to low-level processes of visual pattern recognition and implies extraction of genuine geometrical invariants.

Our tasks also do not depend on processes of deductive reasoning. Although geometry now appears as a beautiful logical construction, logic and deduction are neither necessary nor sufficient to account for core human geometrical concepts and intuitions. The central intuitions of Euclidean geometry cannot be deduced from simpler axioms, as the history of mathematics and physics attests (2): Absent the problematic and unprovable parallel postulate, Euclid's axioms and postulates support an infinite family of geometries at odds

with human intuition. Geometrical intuitions nevertheless come naturally to the human mind and continue to guide commonsense reasoning about space, even in scientists who have come to believe, by deduction and experiment, that the classical three-dimensional view of space fails to capture the structure of the universe (3).

We thank Delson for drawing our attention to Alexandre Rodrigues Ferreira's report. His informal observations on map-making appear to antedate ours by two centuries. Insofar as his observations were found to be general, they would confirm that the capacity to understand maps predates the most serious intrusions of Western culture. Caution is required in evaluating such ancient reports, but both Ferreira's report and our research suggest that all human cultures share an approximate arithmetic and intuitive geometry, which are highly stable over variations in education, language, and intercultural contact. On this point, we distance ourselves from claims of a radical "incommensurability" of cognitive functions in other cultures such as the Pirahã (4, 5), which are sometimes lumped together with our own views.

Research on core knowledge of geometry is at an early stage. How do geometrical concepts emerge in children? Are these concepts unique to humans or shared by other animals? What accounts for the distinctive profile of geometrical abilities shown both by indigenous tribes and by urban Americans? Converging studies across species, ages, and cultures, using methods of psychology and neuroscience, can begin to address these questions.

STANISLAS DEHAENE,^{1,2*} VÉRONIQUE IZARD,^{1,4}
PIERRE PICA,³ ELIZABETH SPELKE⁴

¹INSERM-CEA Cognitive Neuroimaging Unit, Service Hospitalier Frédéric Joliot, Commissariat à l'Énergie Atomique, 91401 Orsay Cedex, France. ²Collège de France, 11, place Marcelin Berthelot, 75231 Paris Cedex 05, France. ³Unité Mixte de Recherche 7023 "Formal Structure of Language," CNRS and Paris VIII University, Paris, France. ⁴Psychology Department, Harvard University, Cambridge, MA 02139, USA.

*To whom correspondence should be addressed. E-mail: dehaene@shfj.cea.fr

References

1. I. Rock, *Orientation and Form* (Academic Press, New York, 1973).
2. G. Hatfield, *The Natural and the Normative* (MIT Press, Cambridge, MA, 1990).
3. L. Randall, *Warped Passages* (Ecco, New York, 2005).
4. D. Everett, *Curr. Anthropol.* **46**, 621 (2005).
5. P. Gordon, *Science* **306**, 496 (2004).

Ecological Revitalization of Chinese Villages

I READ R. STONE'S ARTICLE "VILLAGERS DRAFTED into China's model of 'sustainability'" (News of the Week, 7 Apr., p. 36) with great interest. In my 16 years investigating long-term ecological

changes in rural China, I have witnessed numerous governmental programs aiming to link improved rural livelihoods with ecological revitalization of village landscapes (1–3). Energy self-sufficiency and improved land management have been central to all of these programs, which have combined national and provincial policy and organizational efforts with demonstration villages, townships, counties, and even provinces. Although often only modestly successful, China's efforts to improve rural environments are an absolute triumph when compared with those of most rural developing countries and compare well with those of many developed countries during their own industrial transition.

The convergence of national and international environmental agendas on a single rural village will inevitably cause conflict. And Huangbaiyu will probably end up as have other village experiments: Temporary improvements will ultimately be dwarfed by the needs of local people to adapt to the developments going on around them. Although local demonstration projects might therefore be avoided, these can help to highlight and fix problems before more extensive programs are implemented. Regardless, the failings of a single village experiment should be presented as a minor part of the main story. China and the Chinese continue to make major efforts, by many means, to make the best of what is arguably the greatest environmental challenge any human population has ever faced (4).

ERLE C. ELLIS

Department of Geography and Environmental Systems, University of Maryland, Baltimore County, 211 Sondheim Hall, 1000 Hilltop Circle, Baltimore, MD 21250, USA.

References

1. X. Cheng, C. R. Han, D. C. Taylor, *World Dev.* **20**, 1127 (1992).
2. T. Shi, *Ecol. Econ.* **42**, 359 (2002).
3. "Opinion: Document shows determination to build a new countryside," *People's Daily Online*, 23 Feb. 2006 (http://english.people.com.cn/200602/23/eng20060223_245370.html).
4. V. Smil, *China's Environmental Crisis, an Inquiry into the Limits of National Development* (M.E. Sharpe, New York, 1993).

Stereotype Threat: A Clarification

THE REVIEW BY D. LEWIS (24 JUNE 2005, P. 1871) of the book *Gender Differences in Mathematics (1)* inadvertently perpetuates misinformation that has appeared elsewhere (2–4) about a key finding in our study of stereotype threat on an Advanced Placement calculus test (5, 6).

The study investigated whether asking women to record their gender immediately before taking the test elicited stereotype threat and thereby adversely affected their test performance. A quote in the review from a chapter in the book (4) cites an erroneous statistic from our initial technical