



Learning to Listen: An Ethnographic Approach to Engineering Ethics Education

Dr. Yanna Lambrinidou, Virginia Tech

Dr. Yanna Lambrinidou is a medical ethnographer and adjunct assistant professor in the Department of Science and Technology Studies (STS) at Virginia Tech. For the past 6 years, she has conducted research on the historic 2001-2004 Washington, DC lead-in-drinking-water contamination. This work exposed wrongdoing and unethical behavior on the part of local and federal government agencies. In 2010, Dr. Lambrinidou co-conceived and co-taught the new graduate level engineering ethics class "Engineering Ethics and the Public." Her previous research focused on hospice and pediatric cancer care.

Dr. Marc Edwards, Virginia Tech

Dr. Marc Edwards received his bachelor's degree in Bio-Physics from SUNY Buffalo and an M.S./Ph.D. in Environmental Engineering from the University of Washington. His M.S. thesis and Ph.D. dissertation won national awards from the American Water Works Association (AWWA), the Association of Environmental Engineering and Science Professors and the Water Environment Federation. In 2004, Time Magazine dubbed Dr. Edwards the "Plumbing Professor" and listed him among the four most important "innovators" in water from around the world. The White House awarded him a Presidential Faculty Fellowship in 1996. In 1994, 1995, 2005 and 2011 Edwards received Outstanding Paper Awards in the Journal of American Waterworks Association and he received the H.P. Eddy Medal in 1990 for best research publication by the Water Pollution Control Federation (currently Water Environment Federation). He was later awarded the Walter Huber Research Prize from the American Society of Civil Engineers in 2003, the State of Virginia Outstanding Faculty Award in 2006, a MacArthur Fellowship from 2008 to 2012, the Praxis Award in Professional Ethics from Villanova University in 2010, and the IEEE Barus Award for Defending the Public Interest in 2012. His paper on lead poisoning of children in Washington D.C., due to elevated lead in drinking water, was judged the outstanding science paper in Environmental Science and Technology in 2010. Since 1995, undergraduate and graduate students advised by Dr. Edwards have won 23 nationally recognized awards for their research work on corrosion and water treatment. Dr. Edwards is currently the Charles Lunsford professor of Civil Engineering at Virginia Tech, where he teaches courses in environmental engineering ethics and applied aquatic chemistry.

Learning to Listen: An Ethnographic Approach to Engineering Ethics Education

On a daily basis, the 3.5 million engineers and scientists working in the United States make complicated and critical decisions that ultimately affect the public – their often-unseen client whose health and welfare they are expected to hold paramount. In response to an array of professional, organizational, financial, and political pressures, engineers' and scientists' obligation to protect the wellbeing of individuals they might never meet can be difficult. Indeed, it was at least in part the failure to treat the public's health and welfare as the overriding concern in a series of catastrophic events during the 20th century (e.g., the DC-10 crash in 1974, the Ford Pinto case in 1981, the Union Carbide explosion in Bhopal in 1984) that drew public attention to the ethical duties of engineers and scientists, propelled vigorous writing of professional codes of conduct, and established the academic discipline of engineering ethics.¹⁻² As a growing number of documented real-world cases suggests, engineers and scientists who become alienated from their public clients, are also much more vulnerable to self-interest, self-delusion, and institutional pressures that can contribute to unethical conduct and suboptimal professional decisions.³⁻⁸

The growing multi-cultural and international dimensions of engineering and science;⁹⁻¹⁰ an increasing reliance on interdisciplinary, inter-organizational, and team-based collaborations;¹¹⁻¹² rising competition in the technological marketplace;¹³ and the trend toward reduced financial resources for science¹⁴ create additional pressures that can widen the gap between technical experts and the diverse publics they serve. Indeed, a recent review of scientists' perceptions of "the public" revealed that scientists who have limited professional experience engaging with non-scientists tend to "believe the public is uninformed about science and therefore prone to errors in judgment and policy preferences."¹⁵

An increasing awareness that successful engineering and science require more than technical proficiency has led engineers, scientists, and public stakeholders in communities across the country to make calls for a new generation of technical experts.¹⁶⁻²⁷ Today the engineers and scientists of the 21st century are advised to develop expertise in collaboration with the diverse social world in which they practice, and competence in integrating their specific technical knowledge with other types of knowledge that are often overlooked.^{2,28-30} "Marginalized" knowledge includes "local" knowledge (i.e., individual and collective histories, observations, experiences, assessments, values, and goals of non-experts), which is increasingly recognized as having the capacity to provide crucial insights into engineers' and scientists' areas of technical expertise and moral responsibility, and improve the effectiveness of their work.³¹⁻³⁷ It also includes "scientific counterknowledge" (i.e., contested knowledge of technical experts who occupy subordinate positions in officially-sanctioned networks of scientific knowledge), a phenomenon that has received less scholarly attention.³⁸

Recent efforts to "connect" engineers and scientists to society have given rise to an increasing number of interdisciplinary educational initiatives that bring humanities, social

sciences, and even art into technical curricula. Often embodied in project-based service learning (PBSL) components, projects, and programs and facilitated by academic and non-academic institutions alike, these initiatives aim to cultivate what some have termed “humanistic” scientists and engineers.³⁹⁻⁴⁰ They are designed to foster in students cultural competence, civic responsibility, and the ability to reflect critically on the professional “cultures” and often-invisible “values” informing science and engineering practice. They also attempt to sensitize participants to non-technical worldviews and alert them to the need for ethical conduct and sustainable innovation.^{28-29,39-40}

With the support of the Ethics Education in Science and Engineering (EERE) program of the National Science Foundation (NSF), we have developed a graduate engineering ethics course that might take these initiatives a step further by making the case that the connection of engineers and scientists to society is *a central pillar of ethical professional practice*. The course brings together engineering, science, ethics, and ethnographic research methods to demonstrate that listening to marginalized stakeholder voices is necessary for morally-sound decision-making. The goal is to cultivate a generation of technical experts who understand the social context of their profession, question the societal relevance of their work, and appreciate the potential human impact of their actions by training students to engage with the public in order to understand “*what is locally at stake*”⁴¹ (emphasis in original). In this context, “active listening” becomes a necessary ingredient of competent moral reasoning and engineering practice.

To foster an approach to ethical dilemmas that helps students see themselves *in* society rather than *apart* from it, the course introduces a 3-dimensional exploration of ethics that allows engagement with real-world unfolding cases not only cognitively, but also emotionally and interactively. This places students in direct contact with a community’s diverse stakeholders, and requires them to use ethnographic interviewing to understand a case from their interviewee’s perspective. Moreover, it allows students to define and refine their own ethical values, and promotes a first-hand understanding of principles embodied in professional codes of conduct, moral theories, and multidisciplinary studies of human behavior. By “listening” not only to official publications, but also to unofficial documents and stakeholder experiences, students are confronted with the technical and moral relevance of the public’s experiences, knowledge, values, and needs; gain appreciation for the day-to-day impacts of engineering and science on individuals and communities; and begin to recognize the personal, professional, and institutional values that underlie the production of expert knowledge and the development of regulatory solutions to large-scale problems.

A main objective of the course is to promote the goals of engineering ethics education – increased ethical sensitivity, clear understanding of professional codes of ethics, improved ethical judgment, and a strengthened ability to act morally⁴²⁻⁴³ – by demonstrating that engineers who are open to marginalized points of view will invariably gain insights that can expand their personal and professional perspectives. Ultimately, the course attempts to help students identify the engineer’s and scientist’s broader scope of professional responsibility from a strictly technical to a moral domain, which often encompasses multiple disciplinary perspectives, diverse values, and often contested

views about what is “real” and “right.”

Our hypothesis is that listening will put a human face on ethical dilemmas and reduce tolerance for conduct that can harm the public, by showing students how engineering and science affect the lives of ordinary people, professionals and non-professionals alike. By extension, we hypothesize that listening can help students better appreciate the interconnections between engineering and society, the technical and ethical relevance of stakeholder perspectives, and the crucial role engineers can play in improving quality of life through an ethic of public engagement and care.

As part of this effort, we are developing four educational modules for use by other institutions. Topics are: 1) Witnessing wrongdoing and the obligation to prevent harm, 2) Aspirational ethics and learning to listen, 3) Responsible conduct of research, and 4) Responsible conduct of practice.

We believe that our imperative for the incorporation of “ethnographic listening” in engineering ethics instruction can have promising applications in PBSL initiatives and, conversely, that PBSL initiatives can have promising applications in engineering ethics instruction. Both of these “marriages” would be fruitful areas for future research.

Bibliography

- ¹ Davis, M. 1998. *Thinking Like an Engineer: Studies in the Ethics of a Profession*. New York, NY: Oxford University Press.
- ² Johnson, D. G. and J. M. Wetmore. 2008. STS and Ethics: Implications for Engineering Ethics. In E. J. Hackett, O. Amsterdamska, M. Lynch, and J. Wajcman, eds., *The Handbook of Science and Technology Studies*, pp. 567-581. Cambridge, MA: MIT Press.
- ³ Davis, D. 2002. *When Smoke Ran Like Water: Tales of Environmental Deception and the Battle Against Pollution*. New York, NY: Basic Books.
- ⁴ Schneider, A. and D. McCumber. 2004. *An Air That Kills: How the Asbestos Poisoning of Libby, Montana, Uncovered a National Scandal*. New York, NY: The Berkley Publishing Group.
- ⁵ Michaels, D. 2008. *Doubt is Their Product: How Industry’s Assault on Science Threatens Your Health*. New York, NY: Oxford University Press.
- ⁶ Lerner, S. 2010. *Sacrifice Zones: The Front Lines of Toxic Chemical Exposure in the United States*. Cambridge, MA: The MIT Press.
- ⁷ Steingraber, S. 2010. *Living Downstream: An Ecologist’s Personal Investigation of Cancer and the Environment*. Cambridge, MA: Da Capo Press.
- ⁸ Makary, M. 2012. *Unaccountable: What Hospitals Won’t Tell You and How Transparency Can Revolutionize Health Care*. New York, NY: Bloomsbury Press.
- ⁹ Downey, G. L. and J. C. Lucena. 2005. National Identities in Multinational Worlds: Engineers and ‘Engineering Cultures.’ *International Journal of Continuing Engineering Education and Life-Long Learning* 15(3-6):252-260.
- ¹⁰ Allert, B. I., D. L. Atkinson, E. A. Groll, and E. D. Hirleman. 2007. Making the Case for Global Engineering: Building Foreign Language Collaborations for Designing, Implementing, and Assessing Programs. *Online Journal for Global Engineering* 2(2):1-14.
- ¹¹ Lehrer, J. 2011. Sunset of the Solo Scientist. *Wall Street Journal* (February 5).

- ¹² Kligyte, V., R. T. Marcy, S. T. Sevier, E. S. Godfrey, and M. D. Mumford. 2008. A Qualitative Approach to Responsible Conduct of Research (RCR) Training Development: Identification of Metacognitive Strategies. *Science and Engineering Ethics* 14(1):3-31.
- ¹³ Grasso, D. and D. Martinelli. 2007. Holistic Engineering. *The Chronicle of Higher Education* 53(28):B8.
- ¹⁴ Semeniuk, I., J. Tollefson, and M. Wadman. 2011. US Science Agencies Targeted for Budget Cuts. *Scientific American* (February 10): <http://www.scientificamerican.com/article.cfm?id=us-science-agencies-targeted-f>.
- ¹⁵ Besley, J. C. and M. Nisbet. 2011. How Scientists View the Public, the Media and the Political Process. *Public Understanding of Science*, p. 1, available at <http://pus.sagepub.com/content/early/2011/08/26/0963662511418743>.
- ¹⁶ Ollis, D. F., K. A. Neeley, and H. C. Luegenbiehl. 2004. *Liberal Education in Twenty-First Century Engineering: Responses to ABET/EC 2000 Criteria*. New York, NY: Peter Lang.
- ¹⁷ NSF. 2010b. The National Science Foundation Proposal and Award Policies and Procedures Guide [OMB Control Number: 3145-0058]. http://www.nsf.gov/pubs/policydocs/pappguide/nsf11001/gpg_index.jsp.
- ¹⁸ Tucker, J., A. Pawley, D. Riley, and G. Catalano. 2008. New Engineering Stories: How Feminist Thinking Can Impact Engineering Ethics and Practice, p. T1A-1. 38th ASEE/IEEE Frontiers in Education Conference (October 22-25), Saratoga Springs, NY. http://web.ics.purdue.edu/~apawley/Alice_Pawley/Research_files/FIE_1788_032408_submitted.pdf.
- ¹⁹ Pantazidou, M. and I. Nair. 1999. Ethic of Care: Guiding Principles for Engineering Teaching & Practice. *Journal of Engineering Education* 88(2):206.
- ²⁰ Broome, T. H., Jr. and J. Peirce. 1997. The Heroic Engineer. *Journal of Engineering Education* 86(1):51-55.
- ²¹ Martin, M. W. and R. Schinzinger. 2005. *Ethics in Engineering* (4th edition). New York, NY: McGraw-Hill.
- ²² Broome, T. H., Jr. 1987. Engineering Responsibility for Hazardous Technologies. *Journal of Professional Issues in Engineering* 113(2).
- ²³ Broome, T. H., Jr. 1986. The Slippery Ethics of Engineering. *Washington Post* (December 28):4S1.
- ²⁴ Broome, T. H., Jr. 1996. The Heroic Mentorship. *Science Communication: An Interdisciplinary Journal of the Social Sciences*, 17(4):398-429.
- ²⁵ Hollander, R. and C. R. Arenberg, eds. 2009. *Ethics Education and Scientific and Engineering Research: What's Been Learned? What Should Be Done?* [Summary of a Workshop at the National Academies Keck Center, August 25-26, 2008]. Washington, DC: National Academies Press.
- ²⁶ Herkert, J. R. 1994. Ethical Risk Assessment: Valuing Public Perceptions. *IEEE Technology and Society Magazine* (Spring).
- ²⁷ Vallero, D. A. and P. A. Vesilind. 2006. Preventing Disputes with Empathy. *Journal of Professional Issues in Engineering Education and Practice* 132(3).
- ²⁸ Bielefeldt, A. R., K. G. Paterson, and C. W. Swan. 2010. Measuring the Value Added from Service Learning in Project-Based Engineering Education. *International Journal of Engineering Education* 26(3):535-546.
- ²⁹ Bielefeldt, A. R., M. M. Dewoolkar, K. M. Caves, B. W. Berdanier, and K. G. Paterson. 2011. Diverse Models for Incorporating Service Projects into Engineering Capstone Design Courses. *International Journal of Engineering Education* 27(6):1206-1220.
- ³⁰ Ottinger, G. and B. Cohen. 2011. *Technoscience and Environmental Justice: Expert Cultures in a Grassroots Movement*. Cambridge, MA: The MIT Press.
- ³¹ Dietz, T. and P. C. Stern, eds. (Panel on Public Participation in Environmental Assessment and Decision Making, National Research Council). 2008. *Public Participation in Environmental Assessment and Decision Making*. Washington, DC: The National Academies Press.
- ³² Corburn, J. 2005. *Street Science: Community Knowledge and Environmental Health Justice*. Cambridge, MA and London, UK: The MIT Press.
- ³³ Brush, S. 1980. Potato Taxonomies in Andean Agriculture. In D. Brokensha, D. Warren, and O. Werner, eds., *Indigenous Knowledge Systems and Development*, pp. 37-47. Lanham, MD: University Press of America.
- ³⁴ de Guchteneire, P., I. Krukkert, and G. von Liebenstein. 1999. Best Practices on Indigenous Knowledge. UNESCO's Management of Social Transformations Programme (MOST) and the Centre for International

Research and Advisory Networks (CIRAN). The Hague: Netherlands Organization for International Cooperation in Higher Education.

³⁵ Farmer, P. 1999. *Infections and Inequalities*. Cambridge, MA: Harvard University Press.

³⁶ Van der Ploeg, J. D. 1993. Potatoes and Knowledge. In M. Hobart, ed., *An Anthropological Critique of Development: The Growth of Ignorance*, pp. 209-227. London: Routledge.

³⁷ World Bank. 1999. World Development Report 1998/1999: Knowledge for Development, http://wdronline.worldbank.org/worldbank/a/c.html/world_development_report_1998_99/abstract/WB.0-1952-1118-9.abstract.

³⁸ Hess, D. J. 2010. To Tell the Truth: On Scientific Counterpublics. *Public Understanding of Science* 20:627-641.

³⁹ Fisher, E. and R. L. Mahajan. 2010. Embedding the Humanities in Engineering: Art, Dialogue, and a Laboratory. In M. E. Gorman, ed., *Trading Zones and Interactional Expertise: Creating New Kinds of Collaboration*, pp. 209-230. Cambridge, MA: MIT Press.

⁴⁰ Fisher, E. and R. L. Mahajan. 2003. Humanistic Enhancement of Engineering: Liberalizing the Technical Curriculum [Presentation]. International Conference on Engineering Education, July 21-25, Valencia, Spain.

⁴¹ Kleinman, A. 1999. Moral Experience and Ethical Reflection: Can Ethnography Reconcile Them? A Quandary for "The New Bioethics." *Daedalus* 128(4):70.

⁴² Herkert, J. R. 2000. Engineering Ethics Education in the USA: Content, Pedagogy and Curriculum. *European Journal of Engineering Education* 25(4):303-313.

⁴³ Davis, M. 2007. Perils of Using Hurricane Katrina to Teach Engineering Ethics. *IEEE Technology and Society Magazine* 26:16-22.