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A framework for addressing ethical issues in citizen science

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ABSTRACT

The collaboration between laypeople and professional scientists known as “citizen science” is an important trend in research and data gathering. Citizen science offers important benefits to science and society. For example, citizens can help scientists with data collection and provide advice on research design and implementation. Citizens can also gain a better understanding of scientific concepts and methods. Additionally, citizens can help scientists better understand and address issues of concern to their families and communities. However, citizen science also raises ethical issues that should be addressed when projects begin and throughout the course of scientific investigation. To promote ethical research, scientists should develop guidelines for involvement of citizens in research, communicate effectively with participants and local communities at the outset of their involvement in research projects, carefully oversee their work, develop appropriate publication practices, and provide lay-volunteers with education and training on the responsible conduct of research. Researchers also need to be cognizant of clarifying these roles and responsibilities as well as promoting appropriate and safe citizen participation and transparency of the study methods, data analysis, and communication of results.

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1. Introduction

The collaboration between laypeople and professional scientists known as “citizen science” is an important trend in research (Cohn, 2008; Stilgoe, 2009; Silvertown, 2009; Riesch and Potter, 2014). Citizens have helped professional scientists gather data on animal and plant populations (Cohn, 2008; Gardiner et al., 2012; Donnelly et al., 2014), canine behavior (Hecht and Spicer Rice, 2015), celestial objects (The Planetary Society, 2014; Citizen Science Alliance, 2014), environmental pollutants (Conrad and Hilchey, 2011), fisheries (Fairclough

et al., 2014), whale sounds (Citizen Science Alliance, 2014), meteorology (Citizen Science Alliance, 2014), and invasive species (Starr et al., 2014; Gallo and Waitt, 2011). Laypeople have played a pivotal role in study design, subject recruitment, and data interpretation in community-based research in public, environmental, and mental health (O’Fallon and Deary, 2002; Savage et al., 2006; Horowitz et al., 2009). While these collaborations between scientists and laypeople offer numerous benefits for science and society, they may also raise ethical questions and concerns (Resnik and Kennedy, 2010; Riesch and Potter, 2014). This commentary will describe citizen science, discuss its benefits, and explore the ethical issues it creates.

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2. What is citizen science?

If you ask a layperson to describe a scientist, they will probably sketch an image of “professional” researcher—a man or woman in a white coat, working in a laboratory at a university or private company. However, the idea that scientific inquiry is conducted mostly by professional researchers is a relatively modern notion. Prior to the expansion of academic and industrial research in the mid-1800s, most scientists were “amateurs” who were not employed as researchers. For example, Benjamin Franklin (1706–1790) was a diplomat and politician and Gregor Mendel (1822–1884) was an Augustinian friar (Silvertown, 2009). Even Albert Einstein (1879–1955) was working as a patent examiner when he published groundbreaking papers on the photoelectric effect, Brownian motion, and special relativity (Denis, 1996).

The term “citizen science” has taken on several different meanings since it was coined by Irwin (1995) and Bonney in the 1990s (Riesch and Potter, 2014). For the purposes of this article, we define citizen science as a range of collaborative activities between professional scientists and engaged laypeople (citizens) in the conduct of research. In citizen science, laypeople are actively involved in one or more aspects of the research process, including research design, data collection, subject recruitment, data analysis and interpretation, or publication (Riesch and Potter, 2014). Laypeople have an opportunity not only to assist with scientific research, but also to learn more about scientific concepts, methods, theories, traditions, and values. Scientists can learn much from their citizen partners including invaluable local knowledge and enhanced capability to effectively perform research. We use a broad definition of the concept of citizen science in order to include a variety of collaborations between citizens and scientists. Laypeople are distinguished from scientists in that they are not professional researchers, though they may receive some training or expertise in scientific methods and concepts and they may receive some payment for their work. Being paid to collect data does not necessarily make a layperson into a professional scientist, since being a professional involves much more than receiving money for one’s work and includes specialized education and training (Shamoo and Resnik, 2015). Laypeople participating in research as human subjects are not citizen scientists, unless they are also involved in scientific activities, such as data collection, etc.

Citizen science encompasses several different types of collaborations between professional scientists and laypeople (Silvertown, 2009). In community mapping and monitoring (CMM), laypeople assist scientists with data collection in the field. For example, for 115 years the Audubon Society has sponsored the Christmas Bird Count from mid-December to early January each year. Thousands of laypeople take part in this annual event in which participants record data concerning the number of birds they observe from different species. The British Trust for Ornithology’s Garden BirdWatch (GBW) employs thousands of birdwatchers in an annual survey of birds and other garden wildlife. In the last 20 years, citizens have contributed 7.3 million hours of labor and submitted 100 million observations to the GBW (British Trust for Ornithology, 2015). The Open Air Laboratories Network (OPAL) sponsors

several science activities that make use of citizens, including projects that involve collecting data on lichen and fungus growth on Sycamore trees, surveying invertebrate populations in ponds and lakes, and making meteorological measurements (Davies et al., 2011). Citizen bird watches and other CMM projects provide scientists with important data concerning avian biodiversity and changes in populations, which can inform public policy (Battersby and Greenwood, 2004; Ellis and Waterton, 2005; Audubon Society, 2014). Though most CMM projects collect general survey data with no specific hypothesis in mind, some are hypothesis-driven. For example, the Evolution MegaLab (2014) involves citizens in collecting data used to test hypotheses concerning the evolution of banded snails in response to predation and changes in climate (*Cepaea nemoralis* and *Cepaea hortensis*).

Community-based participatory research (CBPR), often used for environmental health investigations, is an approach in which scientists work closely with the local community in developing and implementing research likely to be of concern to members of the community. In CBPR, citizens provide scientists with advice concerning the design of research projects, potentially including the research goals, design of questionnaires and survey instruments, subject recruitment, informed consent, and data interpretation and dissemination (O’Fallon and Dearry, 2002). CBPR projects often include advisory boards composed of citizens from different constituencies in the community. For example, the Gulf STUDY (Gulf Long-Term Follow-Up Study) is a CBPR project conducted by the National Institute of Environmental Health Sciences that aims to follow the long-term health of approximately 33,000 workers involved in cleaning up the 2010 Deepwater Horizon oil spill (Gulf STUDY, 2014). The Gulf STUDY includes a community advisory board composed of representatives from local health departments, businesses, cultural and religious organizations, and groups representing workers involved in the cleanup (Gulf STUDY, 2014).

Interest group research (IGR) is an approach in which citizen groups with a particular social, political, or environmental agenda partner with scientists to conduct research. The interest group sponsors the research and scientists develop and implement studies, usually without the help of laypeople. Citizen involvement typically comes at the level of raising funds and setting the research agenda. For example, the Environmental Working Group (2014) is a non-profit organization that sponsors research on environmental and public health issues, such as consumer product and food safety, farming practices, energy, industrial chemicals, and water quality. Public Citizen (2014) sponsors research on topics such as climate and energy, public health and safety, government reform, and access to medications. Both groups also include public relations and lobbying branches that advocate for legislation and policy related to their interests. Interest groups, with the help of scientists, may also collaboratively collect, analyze, and report data related to particular issues or concerns. For example, the Clean Air Coalition of Western New York (2014) has collected data on a factory that was releasing hazardous pollutants and the Louisiana Bucket Brigade (2014) has monitored petrochemical pollution.

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