ABSTRACT

Title of Document:	COLLABORATIVE SCIENCE ACROSS THE GLOBE: THE INFLUENCE OF MOTIVATION AND CULTURE ON VOLUNTEERS IN THE UNITED STATES, INDIA, AND COSTA RICA.
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Reliance on volunteer participation for collaborative scientific projects has become extremely popular in the past decade. Cutting across disciplines, locations, and participation practices, hundreds of thousands of people all over the world are now involved in these studies, and are advancing tasks that scientists cannot accomplish alone.

Although existing projects have demonstrated the value of involving volunteers to collect data, few projects have been successful in maintaining volunteer involvement over long periods of time. Therefore, it is important to understand the unique motivations of

volunteers and their effect on participation practices, so that effective partnerships between volunteers and scientists can be established. This study provides a first look into the relationship between motivation and culture in the context of ecology-focused collaborative scientific projects around the world. Projects in three distinct cultures - the United States, India, and Costa Rica – were examined by triangulating qualitative and quantitative methods followed by a cross-cultural comparison.

The findings reveal a temporal process of participation that is highly dependent on motivation and culture. Initial participation stems in most cases from self-directed motivations. However, as time progresses, the motivational process becomes more complex and includes both self-directed motivations and collaborative motivations. In addition, motivation is strongly modulated by local cultural norms, expectations, and practices. Collaborative and scientific cultures also have an impact throughout the course of the volunteers' participation.

This research provides theoretical and practical contributions: its findings extend current understanding of theories of motivation by showing the connection between culture and motivation, and demonstrate how cultural effects lie at the core of motivation and participation practices in volunteer-based collaborative scientific projects. These findings will also inform scientists, project leaders, educators, administrators, and designers on ways to entice and maintain long-term volunteer participation in collaborative scientific projects that are situated in different cultures.

COLLABORATIVE SCIENCE ACROSS THE GLOBE: THE INFLUENCE OF MOTIVATION AND CULTURE ON VOLUNTEERS IN THE UNITED STATES, INDIA, AND COSTA RICA.

By

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To Yaron, Yoav, Jonathan, and Yael.

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1 Introduction

In July 2011, a nine-spotted ladybug was found on a Long Island organic farm. This discovery was celebrated for two reasons: New York state's official insect had not been seen in the state for 29 years and was thought to be extinct (in fact, the State Assembly had even voted on identifying a new state insect), and the discovery was made by a volunteer rather than a scientist. The volunteer was participating in a collaborative scientific project called "The Lost Ladybug Project" that aimed to document occurrences of the rare insect across the United States. The finding, later confirmed by professional entomologists, drew media attention because it was the first nine-spotted ladybug documented in the eastern United States in more than 14 years and only the sixth of its species known to be collected anywhere in North America in the last ten years (Associated Press, 2011). Media emphasis on the volunteer's role led to a great increase in the number of participants in the project.

1.1 Background of the Study

The Lost Ladybug Project is an excellent example of the way volunteer participation in scientific projects can lead to important scientific findings that otherwise might have been overlooked. Yet this project is not unique. Across the world, the number and impact of collaborative scientific project is greater than ever before. Hundreds, and sometimes thousands, of people across all ages, professions, occupations, and locations, take part in various projects. The projects themselves range from ones that can be done at home or in the backyard, such as sorting photographs of animals in order to document migration habits or documenting the number and species of birds feeding from a birdfeeder, to remote and more complex fieldwork, including field observations, specimen collection, and long-term monitoring. The ever-growing phenomenon of volunteer involvement in scientific projects is now supported by advances in technology, namely internet-based and mobile connectivity that brings scientists, scientific research projects, and volunteers closer than ever before. However, collaborative scientific projects can be traced back to the 19th century with the Audubon Society's Christmas bird count, and some trace it even further, to the 16th century (Droge, 2007), when astronomic observations were done by individuals lacking formal scientific education. (One can argue, however, that at that time, the definition of what constitutes formal scientific education was a bit fuzzy.) In all cases, the basic idea behind collaborative scientific projects is opening the doors of the scientific world to include involvement of individuals who typically lack formal credentials and do not hold professional positions in scientific institutions or projects, who participate in scientific endeavors related to their personal interests, and who take upon themselves research roles that can benefit from mass participation rather than professional expertise (Bonney et al., 2009; Cooper et al., 2009). Over the past decade, collaborative scientific projects have changed gradually and became more and more dependent on technology that reaches larger numbers of volunteers, often located remotely from professional scientists and from each other. This distance is not necessarily a problem, but rather one of the benefits of current collaborative scientific projects: the ability to conduct collaborative scientific projects online or offline allows for broader public participation and for geographically dispersed observations, which in turn lead to a more comprehensive knowledge base than ever before.

While volunteer involvement in collaborative scientific projects has led to the discovery (or re-discovery) of species, chemical compounds (FoldIt.org), galaxies (GalaxyZoo), and close monitoring of ecological and environmental changes (Great Sunflower Project) – broadening the scope of collaborative scientific projects through technological advances and large-scale participation surfaces not only societal benefits, but also serious questions as to the roles volunteers can play in scientific research (Rotman, Procita, Hansen, Parr, & Preece, 2012). For example, scientific collaboration is shaped by a variety of factors, ranging from the social norms of science and the structure of disciplinary knowledge, to the specific characteristics and idiosyncrasies of existing formal and informal research networks and alliances (Bozeman & Corley, 2004; Hara, Solomon, Kim, & Sonnenwald, 2003). Scientific work is founded upon shared vocabulary, practices, and meanings, and is dependent, among other things, on mutual recognition of prestige, knowledge, and competency (Latour & Woolgar, 1979). Prestige, for example, is critical to establishing collaborations (Hara et al., 2003). Volunteers, lacking formal training or credentials, challenge this pattern. Consequently, bringing together scientists and volunteers, whose prestige in the scientific community is inherently different, is difficult. In many cases, although volunteers are allowed to take part in scientific processes, their role may be limited to distributed data collection and limited analysis. They are excluded from later phases of the research in a way that prevents complete collaboration (Kim, Robson, Zimmerman, Pierce, & Haber, 2011). As Jonas Salk succinctly put it: "Scientists often have an aversion to what nonscientists say about science" (in: Latour & Woolgar, 1979). For all these reasons, and despite the well-documented contributions of volunteers in citizen science (Ellis & Waterton, 2004; Van

House, 2002a, 2002b; Wiggins & Crowston, 2011), their participation in collaborative scientific projects is often considered peripheral.

This prompts the question of what draws and motivates volunteers to participate in projects that, by definition, place them in inferior roles, and even more than that, what motivates them to participate in these projects for extended periods of time. Researchers have found a wide variety of reasons, at both the individual and group level, that explain why people participate in online collaborative activities (Preece & Shneiderman, 2009). Examples such as Wikipedia, Encyclopedia of Life, eBird, and even geocaching games suggest that there are numerous methods to motivate individuals to contribute to volunteer projects (Forte & Bruckman, 2005; Nov, Anderson, & Arazy, 2010; O'Hara, 2008), even if we do not fully understand their motivations. Social psychology theories have been harnessed to examine contributions to online repositories and recommender systems. These studies, which tested various social and technical interventions, found that emphasizing the uniqueness of an individual's contribution and setting group goals increased participation, as did expert and peer oversight (Cosley, Frankowski, Kiesler, Terveen, & Riedl, 2005; .Kriplean, Beschastnikh, & McDonald, 2008). Others (Benkler, 2002) emphasized the significance of facilitating small-scale contributions from larger pools of participants. However, none of these studies were conducted in the context of collaborative scientific projects.

Two previous studies that provide the basis for this thesis (Rotman, Preece, et al., 2012; Rotman, Procita, et al., 2012) suggest that scientists and volunteers participate in collaborative projects for inherently different reasons: while scientists seek to promote their professional status and overcome practical difficulties related to fieldwork (e.g., lack of funding) through working with volunteers and publishing these works in scientific outlets, volunteers participate in collaborative scientific projects due to a complex framework of factors that dynamically change throughout their cycle of work. Their motivational framework is strongly affected by personal and societal interests as well as external factors such as attribution and acknowledgment.

1.2 The problem

The previous studies were the first steps undertaken to try to understand the various motivations that facilitate or hinder participation in collaborative projects; both were done in the context of the culture of the United States. The current study builds on these studies and looks deeper into the motivational factors shaping participation in collaborative scientific projects, with a specific emphasis on three factors: what is the leading motivation of volunteers to participate in collaborative projects; how does this motivation change over time, and what are the effects of cultural differences on volunteers' motivation. These factors will be explored through a mixed-method, cross-cultural study that will highlight similarities and differences among volunteers from three cultures: the United States, India, and Costa Rica.

Three distinct subcultures are interwoven into the collaborative science projects of each locale:

- *National culture* – "the collective programming of the mind distinguishing the members of one group or category of people from others" (Hofstede, 2001, p. 3).
- *Scientific culture* – both a corpus of conceptual and experimental methods that allow the investigation of objects of the natural or social worlds, and the body of

knowledge they create; “the expression of all the modes through which individuals and society appropriate science and technology” (Godin & Gingrass, 2000).

- *Collaborative culture* – participatory culture based on the practice and habit of working jointly with others towards a group goal, that may or may not benefit the individual directly (Olson, Malone & Smith, 2001)

While each subculture is based on unique values and principles, this study examines how the principles symbolizing one subculture cut across the other cultures. For example, scientific culture can dictate how collaborative work is done; alternatively, principles of national culture that support collectivism or individualism can determine the importance of collaborative scientific work in that country, as well as the way it develops. The seminal work of Hofstede (1980) provides an initial framework for understanding how culture affects motivation and participation in collaborative scientific projects. Hofstede’s work examines values across which cultures vary, initially grouped into several major dimensions, as follows:

- *Individualism vs. collectivism* – how people define themselves and their relationships with others. In an individualist culture, the interest of the individual prevails over the interests of the group, and ties among individuals are loose, while in a collectivistic culture, individuals are organized into cohesive groups, and the interest of these groups prevails over that of the individual.
- *Masculinity vs. femininity* – masculine cultures emphasize maximal distinction between what women and men are expected to do and value assertiveness,

competition, and material success, while feminine cultures value quality of life, interpersonal relationships, and concern for the less fortunate.

- *Power distance* – the extent to which less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally (i.e., how people accept the inherent institutional inequality and obey it).
- *Uncertainty avoidance* – the culture's tolerance of ambiguity and acceptance of risk.
- *Long term vs. short term* (or "Confucian") cultural difference – the culture's sense of commitment, organizational identity, and loyalty (Hofstede & Bond, 1988).

Hofstede's theory has often been criticized for being incomplete and overly specific so that it does not encompass all the cultural aspects characterizing individual nations. It has also been seen as being applied too often without regard for the contextual aspects of the studied culture or group. With this critique in mind, the survey instrument developed by Hofstede will not be used in this study; however, the results from Hofstede's original studies (1980), and the five dimensions he presented, will be considered as a valuable starting point from which to explore the three different national cultures represented in this study. It is interesting to note that the United States, India, and Costa Rica were all included in Hofstede's original studies, and were found to be located at different ranges on all dimensions:

- *Individualism vs. collectivism* – the United States was ranked as the most individualistic (1 of 53 countries), India was ranked in the middle range (21/53), and Costa Rica was among the most collectivist of countries (6/53).
- *Masculinity vs. femininity:* here the differences were not that substantial, yet the three countries were located at different points on the scale, with the United States identified as most masculine (15/53), followed closely by India (20/53). Costa Rica was rated as having the most feminine culture of the three countries (48/53).
- *Power distance* – India led as the culture with the most pronounced power distance between different strata (10/53), with the United States and Costa Rica quite close to each other, and far lower in power distance (United States – 38/53, Costa Rica – 42/53).
- *Uncertainty avoidance* – Costa Rica was ranked higher in security seeking (10/53), with the United States and India close to each other and far behind Costa Rica (United States – 43/53; India 45/53).
- *Long term vs. short term* – although this dimension was ranked for only 23 countries, India ranked higher in long-term affinity (7/23), and the United States ranked lower (17/23). Costa Rica was not ranked.

From the placement of each country on the various scales, we can learn that the three countries represent fundamentally different cultures. These differences affect the way collaborative scientific projects unfold in each of the countries, and specifically the way motivational factors are affected by national culture.

In addition to the cultural lens, this study focuses on motivational theory. Among the plethora of theories and models of motivation to consider (e.g., external vs. internal motivation; cognitive and social psychology, etc.) one theory of social motivation stands out: Batson, Ahmad & Tsang (2002) theory of social identity. Batson et al. identified four types of motivation: egoism, altruism, collectivism, and principlism, all dependent on the social context of behavior. *Egoism* occurs when the ultimate goal is to increase one's own welfare, regardless of the group. *Altruism* has the goal of increasing the welfare of another individual within the group, or that of a subgroup. *Collectivism* has the goal of increasing the overall welfare of the group. *Principlism* has the goal of upholding one or more principles. Underlying Batson et al.'s framework is the assumption that motives are goal-directed. This theory, discussed in greater detail in Chapter 2, will be the foundational theory for examining how motivational factors affect participation in collaborative scientific projects.

The juxtaposition of the cultural framework suggested by Hofstede and the motivational theory of Batson et al. will set the theoretical basis for this study.

1.3 Research questions

The research questions foreshadowing this study are drawn from the existing literature discussed in detail in Chapter 2, and from the two previous studies. The overall research question guiding this study addresses issues of motivation and culture:

How can we motivate volunteers to continuously collaborate with scientists on large-scale biodiversity projects in different cultures?

This question is then broken down into a series of sub-questions that attempt to unpack the concepts of continuous motivation and the cultural aspects affecting it. The research questions are examined based on the theoretical framework that is derived from cross-cultural studies and the current literature discussing motivation. Study findings that address these questions are reported in Chapters 4-6.

RQ1. What brings volunteers to contribute to ecology-related collaborative scientific projects?

This sub-question examines the reasons and motivations behind volunteers' engagement in collaborative scientific projects, and specifically those that are focused on ecology. To answer it, I've used a multi-method framework, in which surveys (in the United States and India) and qualitative interviews (in all three countries) were used to inform a thematic analysis of concepts related to motivation.

RQ2. Do volunteers' motivations change over time?

This question is based on the same data, and looks at the longitudinal aspects of participation – how the relationship between scientists and volunteers is built over time, and how different motivations come into play at different points in time.

RQ3. Are the motivating factors similar in different cultures?

This research question brings together the case studies of the three cultures and compares the previous findings regarding the way motivation transpires within and across cultures.

1.4 Research plan

The study consists of three separate case studies that explore the same concepts. The three case studies were done independently and consecutively, starting with the United States, and moving on to India and Costa Rica. The study was based on a mixed-method approach in which survey results and qualitative data comprise the corpus and complement each other, but with a deeper emphasize on the qualitative component. The data were analyzed using appropriate methods: qualitative data were analyzed using a grounded theory approach (Corbin & Strauss 2007), and survey data were analyzed using inferential statistics. The research plan attempts to obtain a comprehensive understanding of both the practical and theoretical motivational bases for continuous participation in collaborative scientific projects, as well as the cultural aspects that affect them. The cross-cultural lens is then collectively superimposed on the motivational model that is examined separately in each country, in the discussion chapter. The goal of this research plan is to construct a theoretical framework of the way culture affects motivation to participate in collaborative scientific projects that will create a foundation for future work. Figure 1-1 presents the research plan and the order in which the study was implemented.

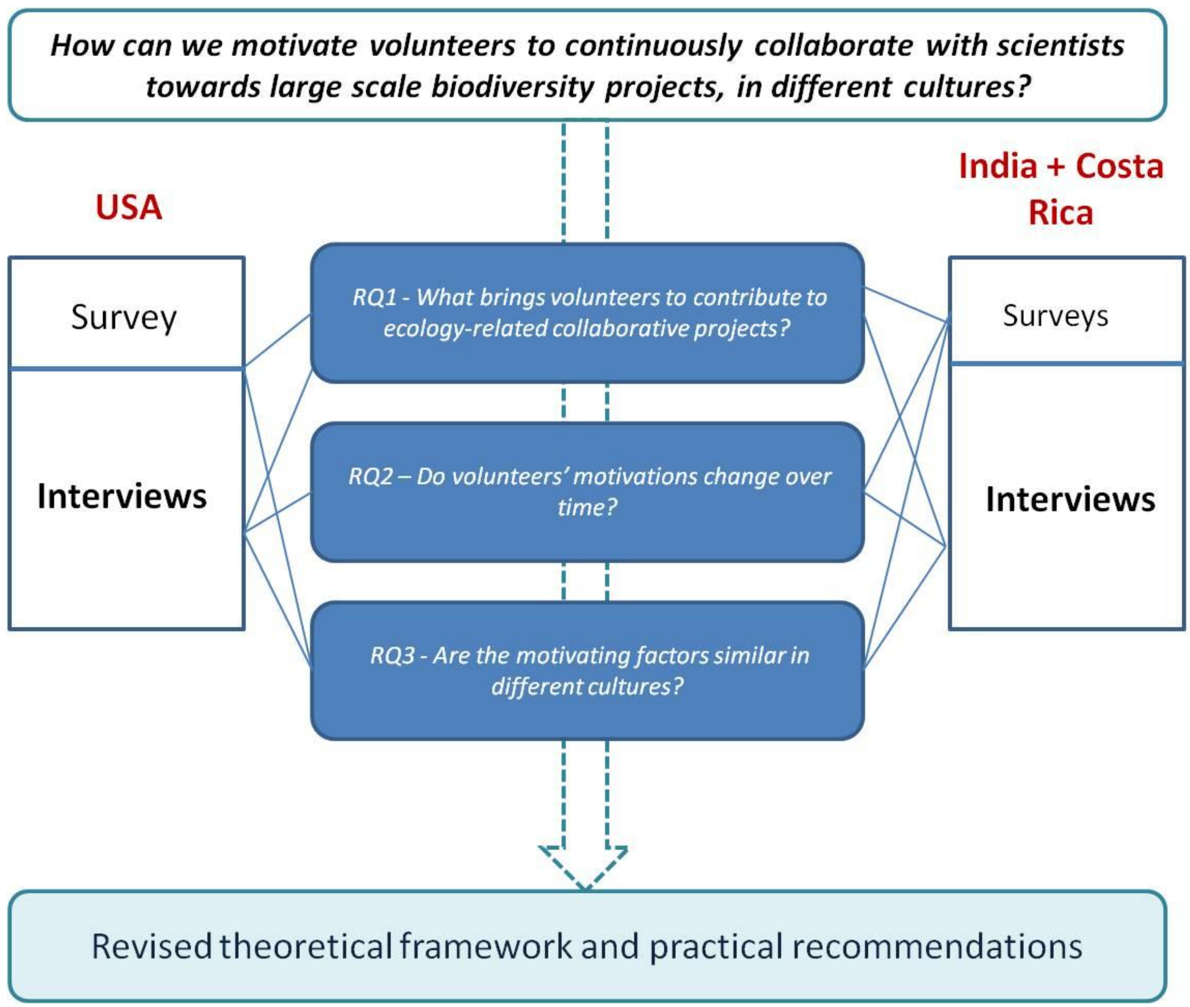

Figure 1-1 Overview of the research plan, associating the research questions with the methods that were used to address them

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Table 1-1 presents the various research questions, the methods that were used to address each specific question, and their outcome. Where relevant, previous publications that address the specific research questions are indicated with (√).

Chapter	Country	Methods	Research questions	Data collected and relevant publications
4	United States	Survey, interviews	1-3	147 survey respondents; 13 interviews √ CSCW and JASIS&T papers
5	India	Surveys, interviews	1-3	156 survey respondents; 22 interviews
6	Costa Rica	Interviews	1-3	9 interviews
7 (Discussion chapter)	Cross-case analysis		Overall research question	Synthesis of findings from previous research questions

Table 1-1 The research plan and its correspondence to the research questions and data

1.5 The significance of the study

Collaborative scientific projects are becoming increasingly popular due to budgetary issues, the need for "big science," and the feasibility of conducting distributed projects through mediated tools. The data and findings resulting from collaborative scientific projects are beginning to gain recognition and validation within the scientific community, and the value of these projects is slowly becoming understood (Rotman et al., 2012). Fathoming the motivational factors affecting collaborative scientific projects necessitates the juxtaposition of several knowledge domains – scientific collaborations, culture, and motivation. This study aims to bring these together in a way that will contribute to the existing body of academic knowledge and to practitioners who design systems that support collaborative science.

The study will also aid in filling the gap existing in current literature regarding motivational factors affecting collaborative scientific projects, and particularly the motivations affecting continuous participation. Researchers will benefit from implementing relevant methodologies to tackle the challenges that stem from studying collaborative scientific projects, and from highlighting the issue of motivation for continuous participation, which is relatively unexplored.

The study will inform designers and curators of collaborative scientific projects about intents, motivations, and cultural influences that affect volunteers' contribution and participation practices. It can, and will, be translated to design of relevant tools and applications within the Biotracker project [NSF SoCS grant # 0968546].

It should be noted that the study addresses a specific domain and population – volunteers working on ecology-related collaborative scientific projects. The reason for that is twofold: (1) Scientific collaborations involving scientists have been studied extensively (cf. Olson's work); (2) Although there are many variations of collaborative scientific projects, ranging from astronomy to history, ecology-related collaborative scientific projects are common, highly successful, and have both local and global effects. Because domain-specific, ecology-related collaborative scientific projects share many of the same attributes that other collaborative scientific projects have, the outcomes of this study are relevant to other domains as well.

1.6 Key terms and nomenclature

Collaborative scientific projects – for purposes of this study, projects actively involving volunteers and scientists will be termed "collaborative scientific projects" to differentiate them from general citizen science projects that may not involve active participation of volunteers but rather their resources (e.g., using the computational power of their computers, or placing reporting tools such as cameras on their properties). The range and purpose of collaborative scientific projects is broad, and so are the technological tools facilitating them.

Citizen science – a broad term used to describe all types of projects involving public participation in collaborative research, whether by personal involvement or by allocating resources toward them. The basic tenet of citizen science is the involvement of both professional scientists and amateurs.

Crowdsourcing – using loosely organized groups or masses of individual volunteers working together to perform piecemeal, sometimes tedious, tasks needed for data collection or analysis.

Motivation – the cognitive aspect of goal-oriented intention, which facilitates activity. Motivation has been a central aspect in cognitive psychology, where numerous studies have been conducted in order to explain or alter human behavior. Researchers have found a wide variety of motivational factors that influence behavior, both at the individual and group levels. Many theoretical frameworks have been suggested to explain the motivational reasoning for human action, but there is no agreement as to one theory that can be representative of all human motivation.

Culture – a heavily contested term, eluding an absolute definition. Generally, it can be seen as the compilation of social relationships and symbolic patterns, explicit and implicit, which transmit the agreements and achievements of specific human groups. Culture can also be defined based on the specific area to which it applies, namely, national culture, scientific culture, and collaborative culture.

Volunteers – individuals who lack formal scientific education or credentials, but participate in collaborative scientific projects in different roles, ranging from data collectors and data curators to analysts and designers of collaborative projects. Volunteers are given different names in various countries: in India, they are called “enthusiasts” or “naturalists”, while in Costa Rica they are called “urban scientists.”

1.7 Summary and chapters ahead

This chapter introduced the rationale for the research, the research questions that guide the study, the research plan that was used to examine the research questions, and the goals and contributions of the study. A set of key concepts was also introduced and defined.

The rest of the thesis is organized as follows:

Chapter 2 – Literature Review situates the current study within the existing literature and describes relevant prior work. Several topics will be discussed: collaborative scientific projects and their relationship to citizen science; various aspects of culture; and the foundational aspects of motivation, specifically as they relate to culture.

Chapter 3 – Methodology presents the methodology of the study in detail. First, the overarching research questions are broken down into foreshadowing questions. Then, details regarding the mixed methods used in the study are provided. Finally, the reliability and the limitations of the study are discussed.

Chapter 4 – United States case study addresses all research questions in the context of the American culture and presents the findings from the survey and the interviews that were conducted in the United States.

Chapter 5 – India case study addresses all research questions in the context of the Indian culture and presents the findings from the survey and the interviews that were conducted in India.

Chapter 6 – Costa Rica case study addresses all research questions in the context of the Costa Rican culture and presents the findings from the interviews that were conducted in Costa Rica.

Chapter 7 – Discussion and theoretical framework compares the three cases, aligns the findings with existing theoretical frameworks, and suggests a refined theory of the cultural impact of motivation on participation in collaborative scientific projects.

Chapter 8 – Conclusions, limitations, and future work wraps up the thesis, discusses its limitations, and suggests future direction to follow.

2 Background literature

This chapter discusses the background research literature that informs the main research question guiding this study – *How can we motivate volunteers to continuously collaborate with scientists towards large scale biodiversity projects, in different cultures?*

The chapter starts with a brief introduction to the nature of collaborative scientific projects and the way they relate to citizen science and to other scientific collaborations. The next section examines various aspects of culture: namely national culture, scientific culture, and collaborative culture. Next, the foundational aspects of motivation are discussed. The chapter closes with a brief summary that presents the ways in which my research is informed by the existing literature.

2.1 Collaborative scientific projects

Collaborative scientific projects based on volunteer participation are an ever-growing phenomenon. Their origins can be traced to times when the most advanced technology was pen and paper, certainly much earlier than the prevalence of the internet. Although some see Galileo's observations as a form of citizen science, the common view of collaborative scientific projects is that they involve groups of volunteers – not simply individuals – who are engaged in scientific observations. By this definition, the first collaborative scientific projects took place in the 1800s, when lighthouse managers across the northeastern United States were asked by the American Ornithology Society to count the number of birds that crashed on their sites (Droge, 2007, p. 125). This effort, considered laughable at first, turned into what became one of the hallmark collaborative scientific projects – The Christmas Bird Count, led annually since 1900 by the Audubon

Society. This, and similar efforts, were based on people's interest in nature, and piggybacked on other activities in which they engaged (e.g., hunting, traveling, and family gatherings). They were not dependent on technology, nor were they global in nature. Rather, they were local, or at most national, in scope. Technological advancements, and mainly the growth of mediated interaction, have enabled volunteers and scientists to engage in projects with broader scope and potential impact than ever before. "Citizen science" is now used as a broad term describing projects involving public participation in collaborative research (Cooper, Dickinson, Phillips, & Bonney, 2007). Sometimes called "public participation in scientific research" (PPSR) (Bonney et al., 2009; Hand, 2010) or "collaborative scientific projects" (Rotman, Procita, et al., 2012), these projects can be done online or offline, by school children or adults, in the field or in front of the computer. As Bowker posits, citizen science projects "hold out the possibility of scaling up the processes of scientific research so that they are truly global in scale and scope" (2005 p. 125). The range and purpose of collaborative scientific projects is broad, and so are the technological tools facilitating them.

Understanding what motivates and facilitates collaborative scientific projects requires a broader look into various practices of collaboration – both within and outside of the scientific world. Drawing from works on traditional scientific collaboration, peer production, and the broader aspect of volunteerism, this section will situate the current research within existing work.

2.1.1 Traditional forms of collaboration among scientists

Scientific progress is in large part dependent on the sharing of high-quality information between scientists and among scientific communities. Scientific data and the resources in which they are curated – including repositories, databases and archives – were traditionally created and maintained by a handful of professional scientists who are committed to the scientific method. The scientific method is guided by tradition, implicit and explicit rules, and grounded in processes that govern research design, data collection and analysis, and the dissemination of results. It has an established process for validating observations while minimizing observer bias and enabling repetition. Scientists are committed to the standards set by their individual scientific communities, governing everything from the educational thresholds required for a person to become a vetted scientist, to the reward system, to the existence of visible and invisible colleges (Crane, 1969; Trane, 1972). Although various scientific disciplines have domain-specific norms, some norms prevail across domains: the apprenticeship process one has to go through to become a professional scientist, the need to validate findings and maintain scientific standards, and the significance of peer review and publication (Latour & Woolgar, 1979). Thus, scientific work and scientific collaboration are shaped by a variety of factors, ranging from the social norms of science and the structure of disciplinary knowledge, to the specific characteristics and idiosyncrasies of existing formal and informal research networks and alliances. Prestige, for example, is critical to establishing collaborations (Hara et al., 2003). Consequently, it can be difficult to link scientists and volunteers, given their differing prestige in the scientific community.

Scientific work always had some collaborative aspects. However, increasing specialization within science, the growing complexity of scientific instruments, the need to combine different types of knowledge and expertise to solve complex problems (Katz & Martin, 1997), along with the advent of mediated interaction – and not the least, budgetary constraints – have enabled distributed scientific communities to collaborate at a scale and pace never before realized (Borgman, 2007). Current literature discusses collaborative scientific projects at length, although most studies focus on collaboration *among* scientists and not on collaborations that involve the public (Bos et al., 2007; Bozeman & Corley, 2004; Finholt, 2002; Finholt & Olson, 1997; Qin, Lancaster, & Allen, 1997). That is not surprising, given that collaboration among scientists is based on a long tradition, whereas collaborative scientific projects involving volunteers have become popular only in the past decade. Sonnenwald (2007), after reviewing the various terms used to describe scientific collaboration (e.g. "inter-," "multi-," "trans-" and "cross-disciplinary collaboration"; "international scientific collaboration"; "intradisciplinary" or "disciplinary collaboration") synthesized them into a definition of collaboration among scientists as "interaction taking place within a social context among two or more scientists that facilitates the sharing of meaning and completion of tasks with respect to a mutually shared, superordinate goal" (p. 645). In essence, scientific collaboration usually involves individual scientists or small groups of scientists forming larger groups that together tackle large-scale scientific problems through data and resource sharing. Some are based on the nature of scientific collaboration changes according to the disciplinary, geographical, or organizational foci (Sonnenwald, 2007). Other collaborations may be described according to the stage of the scientific process in which they take place, from the formulation of the research question to the data collection phase and on to the analysis process and the dissemination of findings. Sonnenwald's synthesis divides the stages of collaboration into four categories: foundation, formulation, sustainment, and conclusion. Each stage is dependent on the existence of several factors, as can be seen from Table 2-1 The stages and requirements of scientific collaboration (based on Sonnenwald, 2007).

Stage	Outcomes	Pre-requisites
Foundation	Research coordination and resource allocation	Need for complementing scientific competencies Political – promoting national, international or disciplinary goals Socioeconomic – spreading risks Resource accessibility Personal and social networks
Formulation	Overall research plan, question(s) and processes	Joint research vision and agreement on goals; Leadership and organizational structure Facilitating communication and coordination Agreement on intellectual property rights
Sustainment	Scientific inquiry, data collection and analysis	Mechanisms to resolve conflicts and address challenges Mutual learning Ongoing communication
Conclusion	Findings, dissemination and project completion	Definition of success Accepted modes and routes of dissemination of results.

Table 2-1 The stages and requirements of scientific collaboration (based on Sonnenwald, 2007)

Most interesting is the fact that any of these stages can raise numerous challenges stemming not only from the requirements and processes endemic to each scientific discipline, and from personal preferences and relationships, but also from the way technology and communication mechanisms affect collaboration. Olson and Olson (2000) highlighted the role technology has played in facilitating scientific collaboration as they saw it interwoven with the other challenges such projects face (namely, social, organizational, and cultural challenges).

From the perspective of the scientific process outlined by Sonnewald and the potential challenges outlined by Olson and Olson, an interesting case may be made of *collaboratories*, or distributed communities of scientists. This term, combining the words "laboratory" and "collaboration," was first introduced in the early 1980s to indicate a laboratory without walls in which data is shared via advances in information technology independent of temporal and spatial constraints (Bos et al., 2007; Finholt, 2002; Finholt & Olson, 1997). Collaboratories led to an increase in the diversity of participants and participation levels (Birnholtz & Bietz, 2003; Bos et al., 2007; Finholt, 2002; Wulf, 1993). Yet, issues of data reuse, upholding scientific standards and maintaining high data quality persist (Zimmerman, 2007). Unlike the studies of scientific work at large, many studies of collaboratories focus on the technological aspects of supporting distributed collaborations (cf. Agarwal, Sachs, & Johnston, 1998; Farooq, Ganoe, Carroll, & Giles, 2007; Kouzes, Myers, & Wulf, 1996), and less on the organizational aspect of bringing together various individual and groups toward a collective goal, although Olson and Finholt (2002) studied this aspect in depth. It should also be noted that the term "collaboratories" was somewhat abandoned in the past few years in favor of the broader "e-Science" and "cyberinfrastructure" (Hey & Trefethen, 2005), as the scale of the projects and the role technology has played in facilitating them has grown substantially, although cyberinfrastructure/e-Science usually denotes projects that are highly dependent on mass computational abilities to form large-scale databases, and less on close collaboration by individuals and small groups (Wiggins & Crowston, 2011). The social aspects of cyberinfrastracture were studied by Lee, Dourish, & Mark (2006); they found that despite the scale and the virtual nature of cyberinfrastructure, personal connections and collocation were essential to its success. They also found that the “fuzziness” of the organizational structure of the cyberinfrastructure projects led participants to move away from any central organizational efforts toward more personal networks of collaborators. That may be due, in part, to the scale of cyberinfrastructures, which is even bigger than that of collaboratories, but also to the need to create a mechanism that will facilitate coordination and establish social norms that will be acceptable and applicable to all participants in the project, a task made more complex by scale. The difficulty of facilitating this kind of mechanism often leads participants to remain within the social structures and norms with which they are familiar, continuing to work within their groups or basing their collaboration on personal relationships and prior association.

Thus, missing greatly from many discussions of collaboratories or scientific cyberinfrastructure is the role of volunteers as facilitators of large-scale collaborative processes, or parts of these processes.

2.1.2 Collaborative scientific projects involving volunteers

Collaborative scientific projects involving volunteers can be defined in a number of ways. The basic premise of collaborative scientific projects is the engagement of non-professionals in the systematic collection and analysis of scientific data. Other definitions emphasize not the practices of collaborative projects, but rather the policy-related aspects of the “engagement of nonscientists in true decision-making about policy issues that have technical or scientific components” (Lewenstein, 2004), or in the educational process initiated through the scientific endeavor by asking questions, collecting data, or interpreting results (Miller-Rushing, Primack, & Bonney, 2012). The involvement of volunteers in collaborative scientific projects can range from families and young students engaged in specific, short-term, local projects (such as “bioblitzes,” which are compressed forms of biological surveys aimed at capturing a snapshot of current ecological conditions), to long-term involvement in continuous projects that encompass global phenomena.

The roots of collaborative scientific projects can be traced back to much earlier times. In China, for example, both citizens and officials have been tracking outbreaks of locust for at least 3,500 years (Miller-Rushing et al., 2012). In the United States, phenological records kept by farmers and agricultural organizations have documented the timing of important agronomical events, including sowing, harvests, and pest outbreaks, for nearly a century (Hopkins, 1918, in: Miller-Rushing et al. 2012). Today, there is a growing reliance on volunteers’ contributions to science for various budgetary and practical reasons: scientists can no longer afford long excursions into the field, yet the availability of data is greater than ever before. This deluge of data, coming from sensors, probes, observations, and computerized assessments, makes it impossible for even large teams of professional scientists to methodically collect and analyze the data without the help of volunteers. The importance of volunteers’ contributions to scientific projects can be illustrated by the sheer number of such projects: In the United States, websites such as www.citizenscience.org and www.scistarter.org present hundreds of opportunities for involvement in collaborative scientific research, in various domains ranging from astronomy to chemistry. Most projects, however, seem to center around ecology and sustainability (Dickinson & Bonney, 2012). In Europe, Schmeller et al. (2008) found that more than 45,000 individuals contributed almost 100,000 days of monitoring to almost 400 individual projects.

Volunteers make contributions to many disciplines in which the collection of large-scale field data is crucial, including biology (Sullivan et al., 2009), environmental studies (Kim et al., 2011), astronomy (Raddick, 2010), and also in other fields, such as chemistry and mathematics (Cranshaw & Kittur, 2011). A broader definition of collaborative scientific projects may also include the contribution of local computer resources for large-scale algorithmic and computational efforts, when a volunteer's computer is idle, such as Seti@Home, or setting sensors on one's property. Yet this does not conform to the definition of collaborative science as including an active involvement of volunteers in the scientific work and will therefore not be included in the range of collaborative scientific projects discussed here.

There are numerous ways of defining and categorizing collaborative scientific projects involving volunteers. They can be grouped according to the specific domain, practices, and levels of volunteers' involvement in the project, or based on the organizational structure underlining it. Bonney et al. (2009) divided citizen science projects into three major categories: (1) contributory projects, in which volunteers contribute data to projects designed by scientists; (2) collaborative projects, designed by scientists, which enable volunteers to not only contribute data but also aid in the project design; and (3) co-created projects, in which both scientists and volunteers are involved in all parts of the project. In most cases, collaboration between scientists and volunteers does not amount to co-creation or collaboration, but is maintained in the contributory phase, in which data collection, and in some cases, partial data analysis (e.g., classification, documentation) is done by the volunteers under scientists' supervision. The data is then delivered to scientists, who use it in their research. According to Bonney et al., current collaborative scientific projects place more emphasis on “scientifically sound practices and measurable goals for public education” than similar historical efforts. Wiggins and Crowston (2011) suggested that collaborative scientific participation spans not only educational efforts but also a broad range of volunteer monitoring, community science, living labs, and participatory action; they also focused on the infrastructure that enables collaborative scientific projects – be it physical (e.g., sensor network) or virtual (e.g., online community). In many cases, the stage of the scientific process, the purpose of the project (conservation, investigation, action, etc.), and the task structure lead the definition; the project can span the phrasing of the research question and the hypothesis, data gathering, study design, collection or analysis of the data, and its interpretation and dissemination, or any part of those stages.

Categorization of collaborative scientific projects may also be made based on the level of volunteer participation: Cooper et al. (2007) differentiated between informal and casual involvement based on educational purposes and meticulous stewardship. Both can be done by volunteers, yet both need to be sanctioned and directed by professional scientists. Another perspective of collaborative scientific projects was offered by Wilderman (2007), who considered the role of community involvement in the project, as well as the scope, goals, and nature of the project, to be pivotal aspects. Wilderman offered two models for volunteer involvement: science *for* the people, a model of community consulting in which the community, comprised of volunteers, defines the problem and the professional scientists perform the study (a model which is mostly popular in Europe); and science *by* the people, in which community involvement encompasses not only defining the problem, but also designing the data collection, analysis, and interpretation.

A different type of project, which Wilderman did not see as corresponding to the other two, is the “community worker project,” in which the professional scientists define the problem and design the study, and the community is involved only at the data collection stages, with little input into the actual study.

Efforts to reconcile the different models suggest that most collaborative scientific projects feature some attributes by which they may be differentiated. Based on the definitions suggested by Wiggins and Crowston, Bonney, Bowker, and Wilderman, it seems that collaborative scientific projects can be differentiated mainly based on the level of volunteers’ involvement in the project, from contributing data, without any further involvement at any other stage of the project (as happens during bioblitzes) to comprehensive, deep involvement in all stages of the project, from initiation to dissemination of its products. The issues pertaining to domain, educational purposes, scale, and technological infrastructures are superimposed on the basic structure of the project as being “for the community” or “by the community.”

Breaking down the tasks that volunteers perform within a project is helpful in understanding the various ways in which scientists are able to collaborate with the public. Yet it is the high-level configuration of the collaborative project that establishes the difference between scientific projects that are truly collaborative and those that are contributory in nature. Figure 2-1 summarizes the relationship between collaborative and contributory projects, as well as the broader (sometimes peripheral) role that structure, infrastructure, purpose, scale, and the project’s stage, take in shaping the nature of the project.

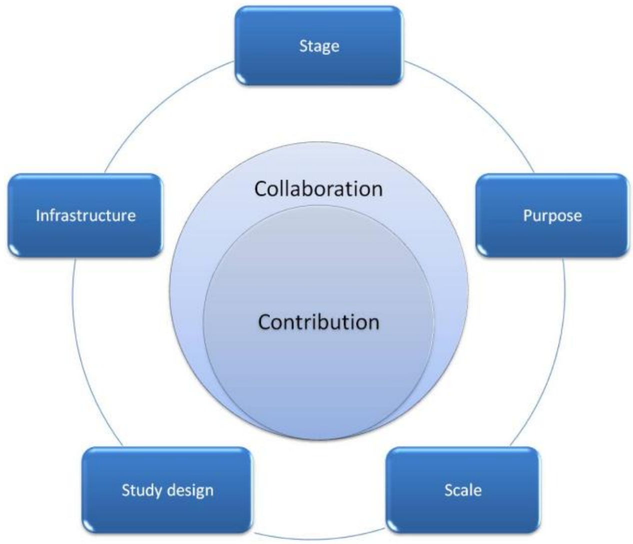


Figure 2-1 Contributory and collaborative scientific projects

Three related terms that are not directly tied to collaborative scientific projects, but can be relevant in understanding the mechanisms behind collaborative work are *volunteerism, peer production, and crowdsourcing*. These terms are not interchangeable; rather, they highlight various aspects of the structural and behavioral patterns associated with collaboration.

2.1.3 Volunteerism

Volunteers are people who give an asset to others –time, resources, or attention – without the expectation of monetary or other rewards (Dekker & Halman, 2003). The Independent Sector, a non-partisan coalition of foundations and corporate giving programs annually surveys the level of volunteering in the United States. According to their latest published data (2010), 61.8 million Americans volunteered for a total of 8 billion hours; the archetypical American volunteer is a middle-aged, educated, employed woman living in a small town, who is involved in her community and religiously affiliated (Eckstein, 2001). Curtis, Grabb, and Baer (1992) found in a comparative study that Americans have a higher level of voluntary association membership than other western and Central American cultures. When calculated in monetary terms, the value of volunteer service was estimated to be worth more than $160 billion dollars (The Independent Sector, 2010). Despite the magnitude of volunteerism in the United States, most of the research that has been conducted in this area stems from two distinct and separate academic disciplines: marketing and theology. The reason is that within the United States, many formal volunteer opportunities are located within established associations, organizations, and local chapters of religious denominations (Putnam, 2001). The value of volunteerism is, in many cases, its grassroots-like nature in responding to local conditions (Florin, 1990). The most common definitions of volunteerism, from Clary and Snyder (1999) and Penner (2004), characterizes volunteerism it as a thoughtful, organized process: volunteers must seek out the opportunity to help, they arrive at this decision after a period of deliberation, they provide assistance over time, and the decision about beginning and continuing to help is influenced by whether the particular activity fits within their individual needs and goals.

These attributes hint at a need for a basic organizational structure that will support individuals who wish to volunteer. Both Putnam (2001) and Penner (2004) suggested that where thick pockets of community exist, there is already an infrastructure within which volunteerism can happen. Lacking these pockets, individuals will find it much harder to move beyond occasional contributions towards continuous involvement. Indeed, the studies that have looked at volunteerism situated the individual action within a broader organizational context, and did not look at actions taken by individuals outside these contexts (Curtis et al., 1992; Finkelstein, 2009; Finkelstein, Penner, & Brannick, 2005).

The structural context in which volunteering is seen is very different from other examples of collective engagement that are technology based, such as peer production and crowdsourcing, which will be discussed next.

2.1.4 Peer Production

Peer production stands on the opposite side of the participation continuum. Benkler (2002) defined peer production as "a process by which many individuals, whose actions are coordinated neither by managers nor by price signals in the market, contribute to a joint effort that effectively produces a unit of information or culture" (p. 1256). Popular examples of peer production include open source software (OSS), open content repositories such as Wikipedia, and open access tools like Ushaidi (peer-produced GIS information), and parts of Project Gutenberg.

While peer production networks are typically examined against traditional business models and firms' structural organizations (Feller, Finnegan, Fitzgerald, & Hayes, 2008), it is also useful to compare peer production with volunteerism. Where an existing organization is vital for coordinated volunteering efforts, peer production networks lack, by definition, a rigid organizational structure; they are constantly reshaped by their participants, the project's needs, and its aims (Duguid, 2006). Although the seeming self-organization and lack of formal structure has received much criticism in the past few years (Crowston & Howison, 2005; Duguid, 2006; MacCormack, Rusnak, & Baldwin), and some studies have shown that formal structure does exist in many cases of peer production networks (Kittur & Kraut, 2010), this level of organization is widely different from that of traditional concerted efforts, as exemplified by volunteerism. Secondly, peer production networks heavily rely on technology, and as such are distributed and not specific to a religion, culture, geographic location, or association. Where volunteerism is based on pre-existing ties, peer production defies these ties and replaces them with interest-based affiliations (or "distributed knowledge communities" per Sproull and Kiesler (1991)) . In this context, Haythornthwaite (2009a) reflects on the difference in peer production networks based on the level and strength of ties among their participants. Haythornthwaite differentiates between lightweight and heavyweight peer production: lightweight peer production is an incremental contribution made by individuals, which is not necessarily dependent on previous knowledge (or the need to gain this knowledge). Participants' commitment is limited and defined by "rule based additions to the product as a whole." NASA Clickworks is one such example. On the other hand, heavyweight contributions entail prolonged activity, and participants are expected to "play an ongoing role in determining the course of the enterprise as a whole" (Haythornthwaite, 2009a p.2). As such, they are also expected to be knowledgeable about the foundations of the project and foster norms of participation and interaction within it. The heavyweight project is usually smaller than the lightweight one, and is closer in nature to a knowledge community and to the traditional entrepreneurial or academic model than to that of pure peer production.

2.1.5 Crowdsourcing

A third related concept is that of crowdsourcing. Though sometimes used interchangeably, there are those who argue that crowdsourcing is fundamentally different from peer production in that it follows the traditional path of an organization or an enterprise, pulling upon masses of crowds to facilitate a task that would have been otherwise assigned to a specific group or groups (Howe, 2006). Originally used to describe the human input used to complement computational processes (Bederson & Quinn, 2011), it was later broadened to include outsourcing all manner of tasks to undefined groups and networks of people. Online crowdsourcing is mostly used for distributed problem solving through resource allocation. Bederson and Quinn (2011) emphasize the difference between predetermined tasks that are directed at solving a specific problem, and collective efforts that are initiated and mandated through the creativity of the project's participants, which resemble peer production. In that sense, crowdsourcing is closer to heavyweight peer production, and even to formal volunteerism, than to lightweight peer production and mass collaborations. Similarly, what Malone, Laubachar, and Dellarocas (2009) defined as "collective intelligence," or "groups of individuals doing things collectively that seem intelligent" (p. 2) is at the same time too narrow and too broad to encompass collaborative scientific projects. Some of the tasks mandated by volunteers (especially in contributory projects) may seem monotonic, manual, and not necessarily "intelligent," while scientific projects as a whole are, by definition, "intelligent." Therefore, these concepts can be useful when trying to understand the general sense of public participation in large-scale projects but are not specific enough to guide our understanding of collaborative scientific projects.

2.1.6 Collaborative scientific projects on the collaborative continuum

It is interesting to consider the spectrum of collaborative projects supported by volunteerism, peer production, and crowdsourcing, as well as their sub-forms (lightweight and heavyweight), in the context of collaborative scientific projects. Figure 2-2 demonstrates the way collaborative scientific projects can span a variety of collaboration definitions, based on the specific attributes of the individual project. From purely contributory models in which volunteers play a significant role as data collectors, but do not have a substantial role in the design or governance of the project, to collaborative projects that involve volunteers in a deeper sense but still adhere to the scientific paradigm that places professional scientists at the helm, these projects do not directly correspond to the loosely self-organized form typifying mass collaborations. By default, most collaborative scientific projects are centrally organized and hierarchical, led by scientists with the help of volunteers. In order to respond to the needs of the scientific world and produce useable outcomes they need to adhere to basic, clear scientific standards that require predefined input and output structures, as well as mechanisms to support the relevant processes.

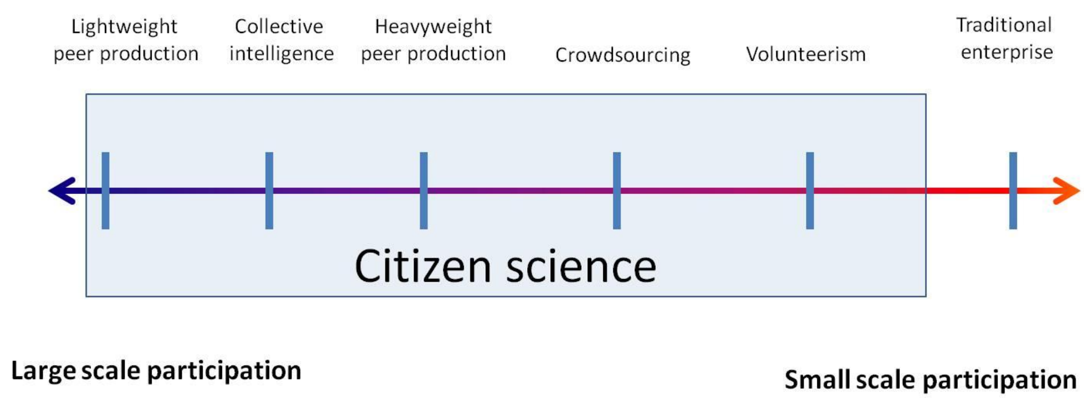


Figure 2-2 The continuum of mass collaborations

On one end of the spectrum are projects that entail large-scale participation in order to succeed. Such projects can span the range of lightweight peer production and collective intelligence projects. These projects are, by and large, less organized than specific, small-scale, collaborative projects. They ask volunteers to engage in the project for short periods of time, or contribute incremental pieces of data (some examples of that are the Christmas Bird Count and local bioblitzes), that do not require in-depth knowledge of the scientific basis of the project. They also do not require long-term commitment to the scientific or voluntary community that works around the project. At the other end of the spectrum are localized, focused projects that are highly structured and closely monitored by scientists, where volunteer contribution can build up to actual collaboration and long-term commitment is required. Becoming a data curator of the Encyclopedia of Life is one example of that. Such projects correspond to the model of volunteerism – engaging with pro-social beneficial work through an existing organization, and doing so through highly hierarchical conditions. In between the two stand a variety of collaborative projects that are less structured and more self-organized than volunteerism projects, but are shaped by the principles of the scientific method and cannot be completely self-organized.

This continuum does not necessarily correspond to the typology of collaborative scientific projects as presented in Figure 2-1. Collaborative scientific projects can be lightweight, heavyweight, or highly structured through a volunteeristic scientific organization. In very few cases, the collaborative project starts as a co-created project that resembles the ideal peer production model, and in most cases, masses of volunteers are engaged in the collection of incremental pieces of data towards a grander goal that may be outside the scope of their understanding (e.g., FoldIt - http://fold.it/portal/). Still, acknowledging the continuum of collaborative projects, and applying some of the principles behind it to relevant cases of scientific collaboration, can be helpful in understanding the motivational aspects and the mechanisms behind these projects.

2.2 Culture

Collaborative scientific projects are dependent not only on the type of collaboration, but also on the culture in which they are situated. In order to fully understand how culture affects these projects, it is first necessary to determine what culture is. Culture is a heavily contested term, eluding an absolute definition. Different fields (e.g., anthropology, sociology, psychology, education) offer different definitions of the term, treating culture as a concept offering various perspectives and connotations of behaviors and meanings. As Malinowski (1939) posited, culture is “the most central problem of all social sciences” (p. 588).

Offering a conclusive definition of culture is not only beyond the scope of this work, it may be virtually impossible. Yet, one of the classic definitions of culture comes from anthropology, where it can be seen simply as the ordinary – “an everyday activity that everyone does” (Williams, 1983 p. 6), or, more intricately, the “patterns, explicit and implicit, of and for behavior acquired and transmitted by symbols, constituting the distinctive achievement of human groups” (Klukhohn, 1962 p. 72). Later scholars distinguished between subjective culture – values and meanings – and the objective artifacts representing them (Geertz, 1973). Shared meanings, values, behaviors, and practices are seen as the tangible products of culture, and as the observable manifestation of the human relationships that allow researchers to study and understand the ways of thinking that distinguish various cultures. This section will discuss different notions and concepts of culture, and specifically how these notions of culture relate to collaborative scientific projects.

Looking into the implicit ways in which culturally produced knowledge is learned and acted upon offers a mode for understanding everything from the mundane minutia of everyday life to extreme social changes. In as much as culture is a contested and complex term, breaking it down into different aspects of social relationships and circumstances under which it is examined can be helpful in understanding the various structures that shape collaborative scientific projects. Specifically, the cultural environments that affect these projects are three: national culture, scientific culture, and collaborative culture.

2.2.1 National culture

The seminal work on national cultural differences comes from Geert Hofstede (1980, 2001). Hofstede collected data from more than 116,000 IBM employees across 40 (later, 50) countries within three regions for six years, and then statistically compared the differences in values that presented in different countries against socio-economic and climatologic data. Hofstede controlled for gender, age, and position within the company and found that when administering the same survey to different populations across the various locations of the IBM Corporation, national identity translated into systematically different responses. From that followed the conceptualization of the four (later, six) national dimensions discussed below.

2.2.2 The definition of a national culture

When embarking on his study of national cultures, Hofstede (1980) defined culture as "the collective programming of the mind that distinguishes the members of one group or category of people from another" (p. 9). This "shorthand" definition (as he described it) was used to examine national cultures, but explicitly failed to detail how "national" culture differs from other categorical associations such as mutual interests, ethnicity, or geographic co-location. The terms "society" and "national culture" were used interchangeably in his work, suggesting that he sees them as sharing the same properties. A society may be part of a national culture (based on organizational affiliation, gender, religion, or even educational level) or can encompass the entire nation, leaving the concept of national culture rather ambiguous. Hofstede supported his reluctance to offer an unambiguous definition of national culture by emphasizing the inherent value judgment embedded in any dealing with societies and groups other than one's own. Lacking a clear definition of national culture, we can learn about the central elements that compose a national culture from the practical steps that Hofstede took to study them.

- Looking for a distinct, sometimes unique, value system shared by a substantial part of the population (expressed through language, rituals, religion, behavioral patterns, family patterns, and other societal power structures).
- Examining the institutions that reinforce this value system and societal norms (e.g., the political system and the official government structure, as well as non-government institutions, and the education system).
- Studying the shared history of the population through tales, myths and formal historical research.
- Taking into account outside influences, both natural circumstances (e.g., forces of nature, geography) and human-created (e.g., trade, diplomatic relationships, domination), which help create or reinforce the value system.

However, these concepts are extremely close to the more general meaning of culture that can also be applied to smaller groups, subcultures, and associations, and they don't offer a very good distinction between culture in general (or a particular subculture) and specific national cultures. A helpful direction may come from Clark (1990) describing "national character." Clark offers an in-depth discussion of the origins of national character, originating in Cicero and culminating in sociological studies from the 1930s to the 1950s, sometimes interlaced with issues of colonialism, race, and heredity. According to Clark, a nation differs from a culture in that it is a well-delimited unit of analysis which is "a political entity and can be defined and identified precisely in space and time" (p. 69). In other words, Clark refers to the institutional component more than to the systems of values and meanings that are the basis of a culture. Combining Clark's concept of a national-institutional characteristic and Hofstede's cultural attributes provides a working definition of national culture as a concept based on the structures, values, and relationships among members of one group which is situated in a specific geographic area during a certain period.

In Hofstede's analysis, national identity translated into systematically different responses. From that followed the conceptualization of four (later, six) national dimensions discussed below.

Power distance - based on the concept of human inequality, power distance defines the level of hierarchy in a given society. According to Hofstede, this concept is focused on the less powerful members, or the degree to which they accept and expect the fact that power is distributed unequally (2001, p. 83). National cultures differ based on the level of power distance. In cultures with *low* power distance, people strive to equalize the distribution of power and ameliorate inequalities, working toward a new equilibrium that will allow them to gain more power. In cultures with *high* power distance, hierarchies determine, to a large extent, the level of authority, governance, and the inability to shift the equilibrium towards equality. Hofstede defined several sub-dimensions that reflected the role of power distance in differentiating between cultures. He found that equality, interdependence, and latent harmony between the powerful and powerless typify low power-distance cultures, while dependence, inequality, and superior-subordinance are the hallmarks of high power-distance cultures. In addition, low-power-distance cultures value rewards and expert power, leading to a decentralized decision structure, pragmatic hierarchical relationships, and open information- sharing practices.

Uncertainty avoidance - uncertainty about the future is a basic fact of human life with which humans try to cope through the advancement of artifacts, law, religion, and rituals (p. 145). According to Hofstede, different cultures have adapted to uncertainty in ways that differ not only between traditional and modern societies, but also among modern societies. Adaptation to uncertainty is reflected in the heritage of cultural institutions such as the family, the education system, and the country governance, and is also reflected in the values held by the members of a particular culture.

A culture is considered intolerant of ambiguity if it is characterized by tendencies toward prejudice, rigidity, and dogmatism, intolerance of different opinions, traditionalism, superstition, racism, and ethnocentrism. In high-uncertainty-avoidance cultures, anxiety is released through the showing of emotions, yet the nature of emotion is less accurately readable by others, and the uncertainty inherent in life is felt like a continuous threat that must be fought. In low-uncertainty-avoidance cultures, the overall anxiety level in the population is lower, leading to less work stress, tolerance of diversity, openness to change and innovation, and acceptance of unknown risks, and informality.

Individualism vs. collectivism - one of the most interesting and relevant dimensions presented by Hofstede is that of individualism versus collectivism. In an individualist culture, the interest of the individual prevails over the interests of the group, and ties among individuals are loose, while in a collectivistic culture, individuals are organized into cohesive groups, and the interest of these groups prevails over that of the individual.

While the first publication of Hofstede's Culture's Consequences (1980) treated individualism and collectivism as opposites, in later editions (2001) Hofstede differentiated between personal tendencies and the societal level. While an individual can show both individualistic and collectivistic personal traits at the same time, culture as a whole will exhibit only one dimension (p. 216). Just as with the other dimensions, this translated into particular aspects in Hofstede's study: individualistic cultures supported nuclear families and weaker extended-family ties, families were smaller, privacy and self-consciousness prevailed over emotional expressions, and lasting relationships were rare. In collectivistic cultures, extended-family ties were stronger, marriage was often arranged, and having children was the norm. Language demonstrated the collectivistic nature of the culture by the frequent use of the word "we" and rare use of the word "I." In terms of organizational behavior, collectivistic cultures supported behavior that was in the interest of the group and not the individual; relationships were based on morals, leading to cooperation within the group and hostility toward out-groups; and collective decision making and teamwork were valued over individualistic behavior which led to sharing information and openly committing oneself to the group. Individualistic cultures granted incentives to individuals and not to groups because individual decisions were valued over collectivistic ones.

Hofstede also emphasized the role of information in both cultures: in individualistic cultures people tend to keep information to themselves as important resources that allows them to advance themselves within the group and share it with others through a complex and a strongly structured system of communication, while in collectivistic cultures communication is an inherent part of societal relationships, and sharing information leads to stronger in-group membership and collective conventions. This resembles, in part, Hall (1976) dichotomy of high and low context cultures. High context cultures are those in which little has to be said or written because most of the information is located either in the physical environment or internalized within individuals, while low context cultures make most of the information explicitly available. High context cultures can be seen as collectivist cultures in which information is self-evident and does not need to be made explicit, while low context cultures require things to be explicitly expressed in order to communicate meanings and needs.

Masculinity vs. femininity - with this dimension, Hofstede brings biological difference into the ways various cultures construct social roles and emotions. Masculine cultures are those that emphasize maximal distinction between what women and men are expected to do, and value "ego goals" such as assertiveness, competition, and material success (p. 279). Feminine cultures attach more importance to "nurturing" relationships, helping others, and the physical environment (p. 284). When controlling for gender, it was found that actual gender does not directly translate into a masculine or feminine point of view. Masculine cultures were the ones in which gender roles were "clearly distinct: men are supposed to be assertive, tough, and focused on material success; women are supposed to be more modest, tender, and concerned with the quality of life. Femininity stands for a society in which social gender roles overlap – both men and women are supposed to be modest, tender, and concerned with the quality of life" (p. 297). In feminine cultures, expectations of both genders are similar in terms of socializing, learning, and rewards. At the same time, these cultures are less aggressive, less stressful, and more cooperative. Masculine cultures are defined by a larger gender gap, more decision making by men, and socialization determined by gender and not by individual ability.

Long term vs. short term - the fifth, later developed dimension, is the long term versus short term orientation (or "Confucian dimension"), which was developed a decade after the first four dimensions were introduced and builds on Eastern values that were not necessarily present in the original survey. This dimension refers to the culture's sense of commitment, persistence, and respect for tradition (Bond & Hofstede, 1988). Translated into practical terms, this dimension looks at the way a culture gears itself toward long-term goals or emphasizes the present. Personal stability, protecting one's "face," respecting tradition, and reciprocation of favors and gifts characterize the short term orientation (p. 354). While these concepts may seem too similar to be placed on two opposing ends of the dimensional spectrum, Hofstede claims that they represent Confucian thinking that may be foreign to Western conceptualization, and are particularly relevant to studying Eastern cultures.

Among the interesting differences between long and short term cultures is the emphasis on cognitive consistency that characterizes short term cultures (which also translates to a belief in absolute guidelines about good and evil and government by law), and synthetic thinking (and the fact that opposites complement each other and do not negate each other) supported by long term cultures. This leads to looser organizational structures in long term cultures that are based in traditions that adapt to changing circumstances, rather than looking at the bottom line.

Indulgence vs. restraint - in 2010, Hofstede and colleagues introduced a sixth dimension – indulgence versus restraint. This dimension is based on gratification (Hofstede, Hofstede, & Minkov, 2010): "Indulgence stands for a society that allows relatively free gratification of basic and natural human drives related to enjoying life and having fun. Restraint stands for a society that suppresses gratification of needs and regulates it by means of strict social norms." (p.15); this dimension is less developed than other dimensions. Among the concepts that characterize indulgent cultures is the pursuit of happiness, the importance of freedom of speech, remembrance of positive emotions, obesity (where enough food is available), more personal leisure, and more lenient sexual behavior. Indulgence tends to prevail in South and North America, in Western Europe, and in parts of Africa. Restraint prevails in Eastern Europe, in Asia, and in the Muslim world.

Critique of Hofstede's theory

Hofstede's cultural dimensions are extremely influential in social studies. In a meta-review of 36 papers published in information system books and journals, Myers and Tan (2002) found that more than two thirds of them used Hofstede's work or referred to it. A search of academic publications shows that Hofestede's book was cited in more than 7,000 academic publications (ISI Web of Science, retrieved September 2012). While the influence of Hofstede's studies in the field of on social studies, and particularly organizational research, cannot be overestimated, his work has often been criticized. These critiques focus on several aspects: that Hofstede's work is incomplete and overly specific so that it doesn't encompass all the cultural aspects characterizing individual nations, that the survey instrument is ill-fitting for a dynamic concept such as culture, and that it is often applied without regard to the contextual aspects of the studied culture or group. As Batteau (2010) summarized, Hofstede often treated cultures as "storehouses filled with collective attitudes cut from similar templates." (p. 851).

One of the most vocal critics of Hofstede's work is Brendan McSweeny (2002), who unpacked Hofstede's work and pointed out two main fallacies affecting it: the generalization of a national culture stemming from the analysis of a micro-culture (IBM) is bound to be limited, and, according to McSweeny, unproven; and the broader generalization of a national culture is a problematic assertion in general, but more specifically it cannot be identified based on the set of questions Hofstede used in his survey. Other critiques, such as Myers and Tan (2002) focus on the positivistic aspect of Hofstede's survey: the survey instrument strips the culture from its rich contextual properties and leaves only the dominant cultural values that are represented throughout the model. Other, more individual, factors, such as gender, age, and ethnic group, are ignored in favor of overly simplistic assumptions. Similarly, Sun (2012) identifies an inherent problem in cross-cultural research that is based on survey instruments applied to scattered case studies without a systematic examination of the actual practice of action within a culture, and called for fieldwork to overcome Hofstede's survey's shortcomings. Harvey (1997) suggested that Hofstede's dimensions miss the actual practice of social activities within the culture because they focus on organizational aspects and are not generalizable to encompass the culture as a whole. Weisinger and Trauth (2003) posited that Hofstede's dimensions are useful for a high-level analysis of interaction, where a variety of factors can affect behavior, but are not useful in identifying specific characteristics of a given culture.

However, given the prominence of Hofstede's work in social science, the dimensions that he presents can be used as a useful starting point for cross-cultural study into the motivation of volunteers in collaborative projects (as will be described in Chapter 7).

2.2.3 Scientific culture

Just like other genres of culture, "scientific culture" is a highly divergent and somewhat fuzzy term, which is contested not only by the public, but also among scientists (Ziman, 1991). The practice of "doing science" is well documented (Finholt & Olson, 1997; Gilbert & Mulkay, 1984; Knorr-Cetina, 1981; Latour & Woolgar, 1979) and is built upon the idea of an individual being initiated into the scientific community through a long process of formal learning and apprenticeship (Star & Bowker, 2001). This life-long process is based on collective agreement on the proper processes for inquiry, data collection, analysis, and dissemination of results. These processes are domain based and can change from one scientific discipline to another, but in all domains, they are based on common understandings established by the "invisible colleges" of professional connections and interpersonal networks (Trane, 1972), and are validated through professional advancements (e.g., vetted publication venues, promotion processes, etc.). However, scientific culture may be a broader term than just "doing science." Godin and Gingrass (2000) suggest that the scientific culture reflects people's knowledge of science and their attitudes toward science and technology, as it is “the expression of all the modes through which individuals and society appropriate science and technology” (p. 44). In that way, Godin and Gingrass build on the common (if sometimes contested) definition of science as (1) “a corpus of conceptual and experimental methods that allow the investigation of objects pertaining to the natural or social worlds; and (2) as the body of knowledge derived from these investigations.” (p. 45). This body of knowledge provides a focal point for the scientific culture as it shapes the overall national attitude toward science and technology as expressed through the public’s cultural and economic development, the national level of innovation, and the public’s understanding of the social processes that affect modern society and enable citizens to engage in social debates regarding science and policy. Similarly, Durant, Evans, and Thomas (1989) saw scientific culture as dependent not only on interest in science, but also on the public’s understanding of science – both as a method and as a knowledge base – and Ross (2007) saw adherence to scientific reason as an indicator of an advanced industrial society.

Scientific culture can be viewed as an inclusive endeavor, extending beyond professional scientific work conducted in laboratories, universities, and other research institutions to encompass the public’s perception of science. This view opens the door to broader participation in scientific work. The minimal requirement for this level of engagement is a basic understanding of the scientific method, which can lead to a deeper and more intimate familiarity with scientific knowledge. Yet the scientific method does not lend itself well to inclusion of the public or to serving as a mechanism for enabling them to move beyond mere appreciation of science toward a stronger scientific culture. Studies conducted in both the United States and the United Kingdom show that a major gap exists between the public's perceptions of science and their actual understanding of science. One of the instrumental tools in assessing the scientific culture is the annual Science Indicators Survey conducted by the National Science Foundation (and its British equivalent, the Scientific Literacy survey). In 2012, the survey showed that 41% of respondents were "very interested" in science; 50% reported that they were moderately interested in new scientific discoveries (NSF, 2012a). Yet the level of factual knowledge about various scientific domains has remained relatively low and stable since the 1990s, and similar results were reported in Europe (NSF, 2012a).

This discrepancy can be attributed to several factors. First, scientific knowledge is not intuitive; rather, it is constructed through an ongoing interaction with scientists and their findings. Individuals who are not scientists need to make an active effort to read, internalize, and understand scientific findings. Yet scientific knowledge is highly contextual and begs for translation in order to be publicly available and understood (Durant et al., 1989). Professional scientists are committed to the traditional standards set by their individual scientific communities, and they contribute to the formal processes and structure of the scientific method in order to advance science and further their own professional careers (Cohn, 2008; Latour & Woolgar, 1979). Translating these practices into understandable formats that will be easily available to the public has proved to be difficult. Science and technology philosophers, like Harding (2005), claim that creating a scientific culture is a power-relations choice, which many scientists, policymakers, and "highly educated citizens" would rather avoid, since it will require them to extend their work beyond the laboratory or research facility, and they will become less "shielded from self-critical knowledge about the social origins and conditions of his or her instruments, empirical methods, and research applications." (p. 15). To avoid this and create a collaborative scientific culture that actively initiates the public into the understanding of science, there needs to be a proper process of scientific education that has not necessarily been available to the general public to date. No matter how strong or weak the scientific culture of a given society is, any analysis of the role of science and scientific institutions (including scientific collaboration) should address not only the details of the scientific practice conducted by professional scientists, but also aspects of ideology, policy, and practical application of scientific techniques that shape the particular scientific culture. The effect of the scientific culture is crucial not only because science affects almost every aspect of the public's life, but also because the scientific culture is the basis for public policy debates and decisions. As Michael (1992) said: "[P]eople are not solely disenchanted and disinherited in the face of science; rather, they discursively maneuver around in a variety of trajectories that can, on the one hand, sustain the mystique and the status of science and, on the other, undermine them", based on the scientific culture they experience and share (p. 330).

To summarize, scientific culture is "the expression of all the modes through which individuals and society appropriate science and technology." (Godin & Gingrass, 2000), and while it may produce the way professional scientists practice, it is more aptly applied to the way lay people experience and understand the way science is crafted and disseminated.

2.2.4 Collaborative culture

The concept of collaborative culture speaks to previously discussed topics such as peer production, mass collaboration, crowdsourcing, and collective intelligence; therefore, it will not be discussed at length. That said, all manifestations of collaboration are largely dependent on the existence of a collaborative culture that encourages individuals to contribute to the common good, so it is important to briefly review the unique properties of collaborative culture.

Collaboration is a popular topic in various domains ranging from marketing to anthropology and education. Tapscott and Williams (2006) reviewed cultural collaboration practices and noted that while collaboration can be traced back to prehistoric times and to the creation of civilizations, current collaborative practices and culture may be differentiated from earlier ones by their scale and by the fact that they are not limited by time or space. Therefore, some of the earlier ideas on which collaboration is based, such as the requirements of co-presence and mutual dependency do not address the way collaborative cultures are constructed today.

Looking for the ways in which collaborative cultures are structured today, we can borrow from the idea of participatory culture. Though Haythornthwaite (2009b) cautions that collaboration and participation are not synonymous (especially in that participatory culture refers to smaller groups engaged in mutual learning and practices), the idea of participatory culture offers an example of a certain type of collaborative culture, according to Jenkins (2006). Participatory culture entails “artistic expression and civic engagement… and some type of informal mentorship whereby what is known by the most experienced is passed along to novices. A participatory culture is also one in which members believe their contribution matters, and feel some degree of social connection with one another.” (p. 3). The main difference between it and collaborative culture is in the relationship between participants: collaboration is flatter and does not require mentorship or any hierarchical structure. It is based, rather, on distributed contributions of individuals acting independently to support the community or the task at hand incrementally (Boland & Tenkasi, 1995). An almost opposing view of collaborative culture was offered by (Thomson, Perry, & Miller, 2007), who saw collaboration as much more structured and organized than an environment allowing for autonomous interaction towards a shared goal. Their view of collaborative culture is that of a "process in which autonomous or semi-autonomous actors interact through formal and informal negotiation, jointly creating rules and structure governing their relationships and way to act or decide on the issues that brought them together, it is a process involving shared norms and mutually beneficial interaction." (p. 3). Their emphasis on governance, rules, and formal negotiation moves away from the idea of collaborative cultures as flat, self-governing, and non-hierarchical as established by Tapscott and Williams. In addition, Thomson and colleagues emphasized mutual interdependence, or shared interests, among individuals who are engaged in the collaborative effort, as well as norms of reciprocity and trust. While these are reflected in other discussions of collaborative cultures, it seems that Thomson et al. see collaborative culture as more time consuming (trust building and reciprocity demand time and ongoing interaction) and structured than others who see it as invisible and loosely structured (Haythornthwaite, 2009b; Malone & Crowston, 2001). In any case, collaborative culture stands on the basis of a mutually beneficial relationship between parties who contribute toward a common goal or agenda and share the responsibilities that this goal entails. In order to facilitate this goal, no matter how big or small it is, and how structured the culture is, trust, engagement, and commitment are crucial.

2.2.5 Culture – Summary

To actualize productive collaborative scientific projects, all three cultural aspects need to align so that the *national culture* will support both the *scientific culture* and a form of *collaborative culture*, such that public participation in scientific endeavors will be acknowledged, accepted, and understood. For that to happen, the benefits of scientific knowledge and collaboration need to match the specific cultural dimensions that characterize the particular nation.

2.3 Motivation

Motivation is the compilation of forces that direct human behavior toward attaining specific goals. It "concerns energy, direction, persistence and … all aspects of activation and intention." (Ryan & Deci, 2000, p. 69), and has been a central tenet in cognitive psychology, where numerous studies have been conducted to explain or alter human behavior. Participation in various types of social interaction – from personal interaction to large-scale collaborations – is extremely affected by motivational factors (Preece & Shneiderman, 2009). In order to fully realize the potential of collaboration, and specifically collaborative scientific projects, it is crucial to maintain a level of motivation that promotes active participation (Ling et al., 2005). One of the biggest challenges for tools and systems that facilitate such participation is to "allow participants at all levels to feel like full members." (Wenger, McDermott, & Snyder, 2002, p 57).

Researchers have found a wide variety of reasons, at both the individual and group levels, that explain why people participate in social activities. These include commitment to a larger cause, reputation gains, reciprocity, learning benefits, expression of self "efficacy," and empathy (Preece, 1996; Kollock, 1999; Lkhani & von Hippel, 2003; Preece, 1999;

Wasko & Faraj, 2000). This section will discuss some of the different motivational factors that are tied to collaborative practices and their applicability to scientific collaborative projects.

2.3.1 Motivational factors

Early theories of motivation, situated in social psychology, focused on understanding social behavior through the prism of cognitive psychology. Ostrom (1984) posited that a "cognitive approach to understanding social behavior has always ruled over social psychology." (p. 5). Slowly, motivational factors were incorporated into the social psychology theoretical paradigm. Abelson et al. (1968) suggested that a motive has to provide coherent relations among a person's different cognitions, which are based on various information processing goals. Higgins and Kruglanski (2000) postulated that without a thorough understanding of motivation, the cognitive approach "cannot explain the intricacies of human psychology" (p.1). This calls for a "motivational science" approach that should not only be concerned with behaviors that can be associated with cognitive goals, but also with personal experiences – in other words, it should examine the pain, joy, and satisfaction of wanting something and attempting to obtain it.

2.3.2 Intrinsic and extrinsic motivations

There are several foci from which motivation can be observed. One axis positions biological motivational factors (Hull, 1943) on one side and calculates cost-benefit motivational factors (Birch, Atkinson, & Bongort, 1975) on the other. Another way to look at motivational factors is to differentiate between intrinsic and extrinsic motivations. The intrinsic-extrinsic axis is especially helpful when discussing actions and situations that involve not just individuals, but also the groups they interact with and belong to.

Intrinsic motivations -

Intrinsic motivation stems from within the individual. It refers to doing something for the inherent satisfactions it generates, regardless of any external reward (Sansone & Harackiewicz, 2000). Intrinsic motivations are usually described as pertaining to the essence of human nature: "humans … are active, inquisitive, curious, and playful creatures, displaying a ubiquitous readiness to learn and explore" (Deci, 1975, p. 56). Intrinsic motivations incline people toward spontaneous interests and exploration of new frontiers of social development that create enjoyment and vitality (Csikszentmihalyi & Rathunde, 1993). The basic rule of intrinsic motivation is that the goal or activity needs to hold an interest for people, through challenge, novelty, or any other personal value, in order for the intrinsic motivation to be acted upon (Deci, 1975). External socio-cultural events that construct feelings of competency during action can enhance intrinsic motivation for that action. Accordingly, optimal challenges, positive feedback, and freedom from demeaning evaluations were all found to increase intrinsic motivations, whereas negative performance feedback diminished it (Deci, 1975). However, no less important is the autonomy or "internal causality" (deCharms, 1968) that is needed to facilitate these motivations. Such autonomy flourishes in contexts characterized by a sense of security and emotional attachment.

In technologically mediated settings, interactions satisfy many intrinsic motivations: users derive personal pleasure from participating in dyadic or group interactions, communicating with others, creating content, solving challenges, playing multi-player games, extending social opportunities, or observing views that affirm their own. Another form of intrinsic motivation related to mediated interaction that is extremely relevant to collaborative scientific projects is the concept of identifying with, or belonging to, a community of users or practitioners (Blanchard & Markus, 2002; McMillan & Chavis, 1986; Postmes, Spears, & Lea, 2000). Feelings of emotional attachment (Chavis & Pretty, 1999), security, efficacy (Carroll, Rosson, & Zhou, 2005), commitment, and interdependence (Hogg & Terry, 2000) are all intrinsic motivational factors and outcomes of the actions taken based on intrinsic motivations. They may be especially salient in interactions which call for a collective goal, such as collaborative scientific projects, and specifically those established through mediated channels.

Extrinsic motivations -

Unlike intrinsic motivation, extrinsic motivations derive their power from the social constructs in which a human operates. External motivating factors are the physical and emotional rewards which provide pleasure and satisfaction that the task itself does not necessarily provide. Other types of extrinsic motivations are those that promise or prevent a negative outcome (e.g., threats, directives, social pressure, etc.) (Ryan & Deci, 2000). While extrinsic motivations can persuade or dissuade people from acting in a certain way, they do not come without a cost. As Lepper et al. (1973) claim: “Reinforcement has two effects. First, predictably it gains control of [an] activity, increasing its frequency. Second... when reinforcement is later withdrawn, people engage in the activity even less than they did before reinforcement was introduced” (p. 161). Another aspect of rewards’ cost is that once a reward is offered, it may be expected any time the specific task has to be performed again. The cost of reward may even be expected to escalate in time.

The effect of extrinsic rewards might not be limited to motivating actions; studies of extrinsic motivations have shown that tangible incentives have a tendency to undermine intrinsic motivations (Deci, 1975; Cameron, Banko, & Pierce, 2001). When people are rewarded based on their actions, the rewards become controllers of their behavior and decrease their intrinsic interest and motivation in the task, undermining their feelings of agency and autonomy. According to Cameron et al. (2001), however, extrinsic rewards undermine intrinsic motivations *only* when the activities were intrinsically interesting to begin with. Activities that are inherently dull or exhausting may benefit from extrinsic rewards. This may be especially relevant to collaborative scientific projects that ask volunteers to engage in continuous data collection, a task that may be mundane, repetitive, or even boring.

In mediated environments that value contribution, extrinsic motivations are a double-edged sword: rewards, reciprocity, and status markers can heighten interaction, but they may also preclude it. Many online communities, social networks, and mass collaboration platforms present reputation and status markers based on the user's history of participation and contribution. On Wikipedia, for example, "barnstars" demonstrate important contributions to the repository (Kriplean, Beschastnikh, & McDonald, 2008). On the Encyclopedia of Life website, one's status (as a contributor, curator, or master curator) and experience warranting this status are found on the user pages, and follow users throughout their activities on the site, also allowing them access to various activities based on their reputation level (Rotman, Procita, et al., 2012). While the effect of such status markers can be translated into increased participation in order to obtain a coveted status, such markers may undermine the intrinsic motivations that users feel when interacting with each other. If identification, a comment, or another type of contribution bestows some kind of reward, why should users contribute their knowledge for the greater good? The current research does not provide a conclusive answer, though Kriplean et al. (2008) generally noted the importance of recognizing the effect of extrinsic rewards on intrinsic motivations (e.g., social support and dependency).

Critique of the intrinsic-extrinsic dichotomy -

As the previous section details, motivation does not grow in a void. Extrinsic factors affect intrinsic motivations and change the balance between the two. It was Bandura (1977) who first claimed that there is no situation in which no external motivational factors exist. According to him, a combination of physical and social stimuli influences, to a large extent, an individual's behavior. While these stimuli cannot be scientifically measured, their effect persists and can be observed. The complex interplay of intrinsic and extrinsic motivations, therefore, has to account for these stimuli, and a dichotomous differentiation between the two types of motivations is artificial.

In collaborative cultures, where both extrinsic and intrinsic motivations lead people to engage in various activities, extrinsic rewards will likely affect interaction and retention, depending on their overall effect: if they decrease intrinsic motivations but increase and deepen extrinsic motivations in a way that increases the overall motivational effect, they are likely to increase participation; if, on the other hand, the extrinsic motivations have the effect of decreasing intrinsic motivations without compensating for that by increasing the overall effect, participation will suffer.

2.3.3 Social-identity based motivations

Motivation drives the relationships between humans and affects different behaviors and goals; at the same time, motivation is affected by a given social context and the social norms and conditions that govern it. Emphasizing the social context of motivational factors, Lindenberg (2001) and Shamir (1991) argue that intrinsically motivated behavior can arise from the belief that one must behave in accordance with certain social or religious norms (which are not considered external rewards). Affirmation of social status, collective affiliation, or identity, does not adhere to the traditional intrinsic-extrinsic dichotomy; rather, it facilitates a different prism through which motivation is observed: a "social identity" based motivation. This type of motivation also speaks to the culture in which the individual is acting – be it a national culture, a scientific culture, a collaborative culture, or any other type of culture.

Developing even further the idea of identity-related motivation, and placing it within a wider social context, Batson, Ahmad, and Tsang (2002) identified four types of motivation – egoism, altruism, collectivism, and principlism – all dependent on the social context of behavior. *Egoism* occurs when the ultimate goal is to increase one's own welfare, regardless of the group. *Altruism* has the goal of increasing the welfare of another individual within the group, or that of a sub-group. *Collectivism* has the goal of increasing the overall welfare of the group. *Principlism* has the goal of upholding one or more principles. Underlying Batson et al.'s framework is the assumption that motives are goal-directed; specifically, the authors distinguish between *ultimate goals* (i.e., the final intended goal) and the *instrumental goals* (i.e., intermediate goals, or "stepping stones" that lead to ultimate goals). All motivations, and the ways in which they unfold, are strongly affected by social context and norms. This calls for a reassessment of the intrinsic-extrinsic axis in this context, as norms are particularly strong and potent regulators of behavior when they have been internalized through the individual's social identity (Ostrom, 2003).

One interesting aspect of the social context of motivation, especially in collaborative settings, is the issue of emotional affinity as a potent motivational factor. Group membership shapes people's behavior and motivates them towards specific actions, creating a fertile ground for interaction, support, and feelings of shared responsibility for helping each other and the group (Batson, 1997). Commitment to a specific social group and to individuals in that group was also found to be a positive motivational factor (Michinov, Michinov, & Toczek-Capelle, 2004; Sassenberg & Postmes, 2002). In mediated environments, for example, it was found that norms related to the frequency of interaction among community members determined, to a large extent, the level of motivation members demonstrated in building relationships with each other (McKenna, Green, & Gleason, 2002; Slater, Sadagic, Usoh, & Schroeder, 2000). Increased interaction and personal information disclosure contextualized the relationship and formed the social-identity that collaborators had, situating them within the community or increasing their affinity to others in the group (Hancock, Gee, Ciaccio, & Lin, 2008).

2.3.4 Motivation in collaborative environments

As collaborative cultures have become more prominent, the question of defining and addressing relevant motivational factors that would facilitate ongoing contributions has become increasingly important (Butler, 2001). Several studies have tried to address this question, usually taking the intrinsic-extrinsic perspective. A relatively fertile ground for examining motivational factors is the open-source software community. In their seminal study, Lakhani and Wolf (2005) examined the motivations of more than 600 open-source programmers working on more than 200 discrete projects. They found that the most crucial motivational factor affecting participation in open-source projects was intrinsic – the skills, creativity, and “flow” that programmers found in creating new code. However, social motivations such as commitment to the community and others’ expectation that they would give back to the community were found to be almost as important as intrinsic motivations. This work reinforced the notion that motivations affecting collaborative environments cannot be separated along the intrinsic-extrinsic axis, but almost always involve a mix of personal and social factors. Lkhani and Wolf also emphasized the inherent differences between various collaborative projects. By looking into a variety of open-source projects, they demonstrated that no one motivational framework can encompass “collaborative projects”; the projects vary based on the ideology behind them and their goals, the level of contributors’ identification with these goals, the skills required for participation, and the availability of extrinsic incentives (e.g., monetary rewards).

Collaborative scientific projects differ from open-source projects in many ways, as outlined in Section 2.1.2. Among those differences are the projects’ structure, the nature of tasks conferred upon volunteers, and the goals behind the projects. These differences may suggest that the motivational factors affecting participation in scientific collaborative projects are different as well. The nature and role of motivation in collaborative scientific projects have not been studied in depth. The few studies that have addressed this issue have looked mostly at quantitative assessments and the nature of commitment. Raddick et al. (2010) found that personal interest was the most salient motivational factor. Nov and colleagues (Nov, Arazy & Anderson, 2011a; 2011b) looked at collaborative astronomy projects (GalaxyZoo, BOINC) through the lens of participation in social movements. They broke down motivation into five factors: collective motives (speaking to the project's goals), norm-related (others' expectations from the contributor), rewards, identification with the group, and a hedonistic/enjoyment motivation. When comparing these factors with the time spent engaging with the project, they found that the most salient factor was the intrinsic enjoyment of the tasks offered by the project. The nature of the project and its goals were of importance, but significantly less than any intrinsic motivation.

A different route was taken by Rotman and colleagues (2012), who examined continuous engagement with collaborative scientific projects using a mix of quantitative and qualitative data that emphasized the role motivation had in constructing long-term collaboration between scientists and volunteers. This study is the basis for this thesis and will be discussed at length in the following chapters.

2.4 Summary

Collaborative scientific projects are becoming increasingly popular due to budgetary issues, the need for "big science," and the feasibility of conducting distributed projects through mediated tools. The data and findings resulting from collaborative scientific projects are beginning to gain recognition and validation within the scientific community, and the value of these projects is slowly becoming understood outside it (Rotman, Procita, et al., 2012). Fathoming the motivational factors affecting collaborative scientific projects requires the juxtaposition of several knowledge domains – scientific collaborations, culture, and motivation. This chapter grounded the study in the existing literature in these areas. Some of the topics discussed, such as culture, are fuzzy and open to interpretation as they cross disciplinary boundaries (i.e., “culture” is seen and used differently in anthropology, education, sociology, psychology, economics, etc.). Other concepts have not been extensively studied (e.g., volunteers’ participation in collaborative scientific projects), due to the fact that most research has focused on professional scientists’ perspective. Many collaborative scientific projects in their current form rely heavily on masses of volunteers who do piecemeal, sometimes tedious, tasks needed for data collection. Most modes of volunteers’ participation in collaborative projects involve data collection and do not advance beyond that to become more inclusive types of collaboration, which entail participation in all stages of the scientific work, including research design, data analysis, and dissemination of results. The use of masses of volunteers calls for comparison of collaborative scientific projects with other forms of mass collaborations, like crowdsourcing and peer production networks. However, the differences between these types of collaboration and collaborative scientific projects are evident in the structural and organizational aspects. This makes collaborative scientific projects an interesting case of mass collaborations, sitting on the continuum that ranges between loosely organized peer production networks and traditionally established volunteerism projects, surfacing different aspects and questions of motivation and participation. These questions are made more salient by the fact that many collaborative scientific projects are global in nature, transcending temporal and geographic barriers and raising issues of culture, norms, and the translation of local practices into global participation.

Figure 2-3 The relationship between different aspects of culture, motivation, and collaborative scientific projects

To facilitate broader, sustainable, and more inclusive collaboration between scientists and volunteers there is a need for designing collaborative environments that speak to the needs and motivations of broad audiences of volunteers, coming from different cultures. Current studies of motivation in collaborative scientific projects focus, for the most part, on specific projects. An understanding of cross-cultural aspects of motivation and the ways in which the dimensions of different cultural components affect motivation is largely missing from current literature. Collaborative scientific projects are clearly shaped by the different aspects of culture outlined earlier; at the same time, these projects are the product of efforts by both professional scientists and volunteers, who are guided by motivations that are in turn shaped by cultural norms. This interdependence is described in Figure 2-3. Given that distributed infrastructures enable global collaborative scientific projects, looking through the cultural lens of motivation is extremely important if we wish to design and sustain tools for collaborative science that will be usable and engaging for broader populations.

The perspectives that various interpretations of culture offer us suggest different effects on motivation. It is possible that one cultural aspect supersedes others – for example, national culture can shape or trump the way scientific culture is perceived. On the other hand, scientific and collaborative cultures may hold global properties, affecting motivation to participate in collaborative scientific projects more than national culture. A deeper look into the ways in which culture(s) and motivation are interlaced in the context of collaborative scientific projects is necessary because these projects are growing in scale and acceptance.

3 Methods

This chapter expands the research plan outlined in chapter 1. It provides a detailed description of the theoretical framework guiding this study and describes the research plan and study phases. Methods used to address the research questions are then introduced and the possible challenges and limitations to the study follow. The chapter concludes with a summary of the chosen methodologies.

3.1 Theoretical framework

Collaborative scientific projects span numerous domains and present an opportunity to explore various research questions that pertain to the scientific goals that they address and the usefulness of public participation in scientific work. This study focuses on a specific aspect of collaborative scientific projects – the motivational factors that affect the participation of volunteers in such projects, when viewed through a cultural lens. This scope provides the theoretical and analytical frameworks for this study; specifically, the study sits at the intersections of Batson and colleagues' (2002) work on motivational factors affecting social participation, and the cultural dimensions offered by Hofstede (1980, 2001). The study's goal is to examine the way motivational factors are actualized in different cultures and how the different cultures' characteristics affect motivations to participate in collaborative scientific projects.

Different theories of motivation, rewards, reinforcement, and habits aim to explain why people do what they do, and why they shy away from other activities. Differentiating precisely between the various motivations is difficult and, in some cases, impossible. While the dichotomy of intrinsic versus extrinsic motivational factors as determinants of activities is an interesting one, human activities are rarely directed by one specific motive, nor can they be placed neatly on the intrinsic-extrinsic axis. Activities are messy, noisy, and complex, and they must be placed within a social context, especially where participation in large-scale activities occurs and collaboration with others in involved. This is where Batson et al.'s work (2002) is especially useful (see Table 3-1). The four motivations that Batson et al. present in their work encompass a variety of social factors that pertain to both the individual and the group, moving away from the internal process that motivates an individual and allowing for social aspects to emerge.

Batson et al.'s motivational factor	Intrinsic vs. Extrinsic axis	Individual vs. Social
Egoism	Intrinsic	Individual – enhancing one's personal welfare
Altruism	Extrinsic	Social – enhancing the welfare of a group's member
Collectivism	Extrinsic	Social – enhancing the welfare of the entire group
Principlism	Intrinsic	Individual – upholding a specific principle

3-1 Comparison of the individual and social aspects of various motivational theories

In this study, motivational factors, and specifically the social aspects, will be juxtaposed against various cultural factors. A useful starting point for cultural evaluation is Hofstede's work. In light of the critique of Hofstede's work (detailed in Chapter 2), the survey instrument he developed will not be used in this study; however, the results from his original studies (1980, 2001) will be used as a valuable starting point from which to explore the three distinctly different cases of national cultures. The cultural dimensions offered in Hofstede's work, along with the current literature on motivation, provide the loose theoretical framework from which this study will commence.

3.2 Research plan

The overarching research question guiding this study is:

How can we motivate volunteers to continuously collaborate with scientists towards large scale biodiversity projects, in different cultures?

From this broad question, the following sub-questions are developed:

- *RQ1 – What brings volunteers to contribute to ecology-related collaborative projects?*
- *RQ2 – Do volunteers' motivations change over time?*
- *RQ3 – Are the motivating factors similar in different cultures?*

These research questions guide a comprehensive analysis of volunteers' motivation to engage in collaborative scientific projects, approaching motivational factors from several cultural perspectives. The research plan includes three distinct cases of national culture were selected to enable cross-cultural examination of the way individuals' motivational factors unfold within their cultural settings. From a methodological standpoint, the research plan consists of an overarching level of case studies, with a mixed-methods approach used to examine each case. The following sections will discuss the rationale behind use of case studies in general and the specific cases that were selected for this study, as well as the choice to use mixed methods to study them.

3.3 Case studies

The purpose of this study is not to present a representative sample of volunteers involved in collaborative scientific projects, but rather to focus closely through a selected purposeful sample (Patton, 2002) on volunteers' individual and collective social experiences, their motivations, and the cultural factors that affect them. Case studies are useful for understanding an entire system of action (Feagin, Orum, & Sjoberg, 1991); they are also ideal for describing emerging phenomena, such as collaborative scientific projects, where current perspectives have not yet been widely studied (Eisenhardt, 1989; Yin, 2008). Finally, case studies offer a way of investigating a phenomenon in depth and within its real-life context, lending high external validity to the findings. Case studies are based on a variety of data that enable triangulation of findings, in a flexible research process in which data collection and analysis occur concurrently (Perecman & Curran, 2006). In this way, case studies resemble mixed methods studies; yet unlike studies that focus solely on applying mixed methods to a specific case, the benefit of case studies is that they allow for comparison not only within an individual case, but also across cases that share some similarities, but also surface differences (through what was termed by Perecman and Curran as "within-case" and "across-case" analysis).

The goal for the case selection in this study was to identify individual cases that vary across cultural aspects so that they would span the various dimensions offered in Hofstede's work, and specifically present comparative cases of power distance, collectivistic vs. individualistic culture and masculine vs. feminine culture. The United States, India, and Costa Rica are located at different positions on these scales and offer variation in the ways in which national culture is both experienced and shapes motivations. Figure 3 summarizes the placement of each of the three countries on Hofstede's dimensions:

- *Power distance (PDI)* – India leads as the culture with the most pronounced power distance between different strata (10/53), with the United States and Costa Rica quite close to each other, far lower in the power distance index (United States – 38/53; Costa Rica – 42/53).
- *Individualism vs. collectivism (IDV)* – the United States is ranked as the most individualistic (1 of 53 countries), India is ranked in the middle range (21/53), and Costa Rica is among the most collectivist countries (6/53).
- *Masculinity vs. femininity (MAS)* – the United States is most masculine (15/53), followed closely by India (20/53), while Costa Rica has the most feminine culture (48/53).
- *Uncertainty avoidance (UAI)* – Costa Rica is ranked higher in security seeking (10/53); the United States and India are close to each other and far behind Costa Rica (US – 43/53; India 45/53).
- *Long vs. short term (LTO)* – India ranks highest in long-term affinity (7/23), with the United States ranked lower (17/23). Costa Rica was not ranked.

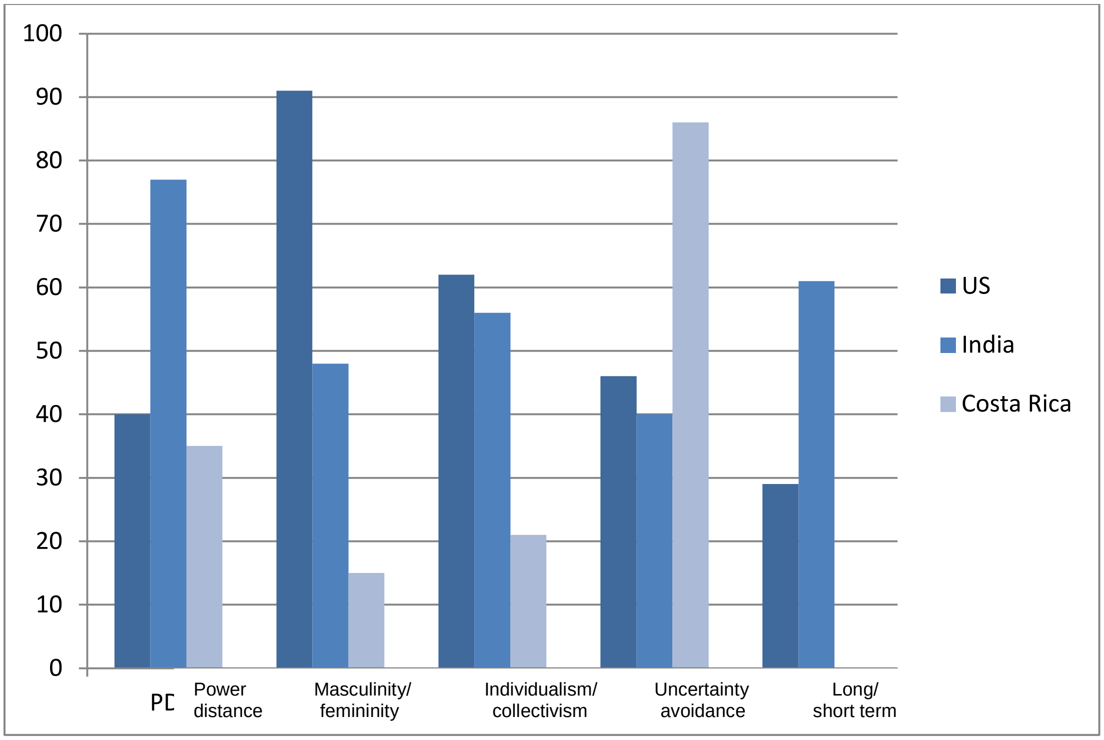


Figure 3-1 A comparison of Hofstede's dimensions across the three countries in the study

From Hofstede's dimensions and placement on the scales (Figure 3-1) we can learn that the three countries represent fundamentally different cultures, making the way collaborative scientific projects unfold in each of the countries particularly compelling to study. This is especially interesting where Hofstede's dimensions speak specifically to issues of collectivism and individualism, which are salient in mass collaborations. It is also important to note that within each culture there is wide variation in the nature, scope, and infrastructure of collaborative scientific projects, which will be briefly detailed.

3.3.1 Collaborative scientific projects in the Unitede States

The United States is a prime example of collaborative scientific projects based in industrially developed countries that have strong traditions of civil engagement and well-developed environmental movements. Collaborative scientific projects in the United

States exist across academic domains, from astronomy (Galaxy Zoo, Cerberus), biochemistry (FoldIt, ChemSpider), geography and climatology (Old Weather Tracking, history (Civil War Diaries & Letters Transcription Project, FamilySearch, The Great War Archive), and to archeology (Ancient Lives). The website scistarter.com lists more than 400 collaborative scientific projects in the United States alone. It is estimated that hundreds of thousands of people engage annually in collaborative scientific projects (NSF, 2012b). Many ecology-related collaborative scientific projects cut across local boundaries and are done across the country (e.g., eBird, Dragonfly Migration, and The Great Sunflower Project – measuring migration routes and population size of species across North America; IceWatchUSA – monitoring ice accumulation across the United States in an effort to understand how climate change affects local ecosystems, or Tiny Terrors project – monitoring an invasive insect species that attacks pine trees across the country); however, some projects are local in nature, focusing on the immediate community or locality of volunteers (e.g., LA spider survey – which follows the arachnids population around Los Angeles, Cricket Crawl – mapping the distribution of crickets in DC/Baltimore, and ReDDY - Reptile Early Detection and Documentation project – detecting and documenting invasive reptile species in Florida). In most collaborative scientific projects based in the United States are supported through research programs in universities, conferences (e.g., 2012 Conference on Public Participation in Science), government agencies (e.g., U.S. Geological Survey, National Park Service), and NGOs. Some projects are funded through the National Science Foundation. A minority of projects are supported through local organizations, extension services (e.g., Master Gardeners in Maryland), and state governments (at local and state parks). The long standing tradition of collaborative scientific projects in this country has resulted in well-honed protocols and educational materials. That, as well as the existing infrastructure and funding sources that support these projects make it possible for a variety of projects across domains to succeed, and for some collaborative projects to go on for 10 and 20 years, providing scientists with invaluable datasets. At the same time, more recent projects are smaller and local in scope, often less funded and not as technologically advanced as long standing ones, yet they benefit from the experiences and knowledge gained from previous projects.

3.3.2 Collaborative scientific projects in India

India is the seventh largest country in size and second in the world in population density, with 17% of the world's population living within its borders, estimated at 1.241 billion people in 2011 (World Bank, 2012). In terms of ecology, India has 94 national parks and 501 wildlife sanctuaries. The social system in India – and the effects of its post-colonialist regime – have had a substantial effect on the way collaborative scientific projects are constructed and implemented. The distinction between castes, and the differences in linguistic, religious, regional, social, and economic groups, have trickled down and made collaboration among the different groups difficult. The notion of "official knowledge" as opposed to "people's knowledge" propagated the idea that only officials (e.g., professional scientists) hold what is perceived to be the truth, and local grassroots familiarity with natural resources, biodiversity, and ecological changes is less valuable and therefore disregarded. Campaigns such as the "people's science movement" in the 1960s were part of a grander social revolution initiated by secular intellectuals from the upper castes who wanted to engage individuals from lower castes in a broader action that related to the local governance of environmental issues through a network of grassroots projects (Kannan, 1990). Not supported by local governments or the national institutions, this campaign did not have a substantial effect on local communities or on their environments. It wasn't until the mid-1990s that countrywide collaborative scientific projects began to evolve. The People's Biodiversity Register (PBR) was one of the first collaborative scientific projects implemented across India. It aimed to support rural communities' and individuals' understanding of their ecological setting, document local ecological changes and leading to local resource management and countrywide documentation of these actions. The PBR program is, to date, one of the largest collaborative scientific projects in India (Gadgil, 2006), having both local and national effects. Following PBR, the Indian government formed "Biodiversity Management Committees" that created biodiversity registers in consultation with the local people, which led the way to broader collaborative scientific projects and to the acceptance of local "people's knowledge" as an enhancement to the "official knowledge" (Gadgil, 2006). Another grassroots change is the growing involvement of students in biodiversity and climate monitoring activities on a larger scale than in the past. This is supported through a national curriculum change, but also through initiatives taken by university professors and other educators. However, no national infrastructure for ecology-related collaborative projects exists (Gadgil, 2006), and most collaborative scientific projects are initiated through the efforts of local NGOs and local governments. The only two nationwide projects (which are not government sponsored, but are government approved) are MigrantWatch and SeasonWatch. MigrantWatch monitors the timing of bird migration to and from the subcontinent and has approximately 1,200 registered participants from across India. Season Watch is a budding volunteer network that monitors the timing of flowering, fruiting, and leafing of plants. Both projects are managed through The National Center for Biological Sciences. There are also smaller collaborative scientific projects across India. Among the leading projects are forest monitoring programs that combine an educational curriculum with field observations (Barker, Phillips, Kusek, & Thomas, 2011), local, small-scale projects that monitor fauna and flora around rural communities (http://indiabiodiversity.org/), and technology-mediated tools for documenting observations and collecting occurrence records and distribution maps of various species (thewesternghats.in). Most of these projects are based on a handful of volunteers, the largest of which reported having 350 people involved in its various stages

(http://knowledgecommission.gov.in/recommendations/agriculture.asp).

3.3.3 Collaborative scientific projects in Costa Rica

Costa Rica is one of the smallest countries in the world at 51,100 sq. km (State, 2012) with a relatively small population (just over 4 million people), but it has one of the world's richest biodiversity areas as it holds 4% of the world's species and one of the largest systems of protected areas in the world (more than a quarter of Costa Rica consists of protected areas). One of the most important decisions regarding conservation and public participation in collaborative scientific projects was made when Costa Rica dissolved its army in 1949 and reallocated much of its defense budget towards conservation and eco-tourism. Since then – and especially since the national park system was established in 1970 – a strong collaboration among the Costa Rican government, private organizations, and individuals has shaped Costa Rica's conservation policy and, as a result, the nature of collaborative scientific projects (Evans, 1999). In addition, Costa Rica places a strong emphasis on national education, part of which is focused on conservation and biodiversity. Biodiversity is also seen as a resource that can lead to economic prosperity: the monetary and economic value of conservation is emphasized by educational institutions and governmental organizations alike, leading to various projects that range from eco-tourism, to reforestation, to educational activities (David, 1992). For example, Costa Rica has a broad program that provides direct payments to private landowners for environmental services such as air and water purification, carbon sequestration, and recreation (Snider, Pattanayak, Sills, & Schuler, 2003). The country supports the use of private lands as natural reserves and environmental education centers through subsidies and direct payments (Langholtz, Lassoie, & Schelhas, 2000). This deep commitment of both government and private organizations to conservation is a fertile ground for collaborative scientific projects focused on biodiversity. The projects range from observing and documenting species (e.g., surveying nesting birds, monitoring sea turtles) to rescue (toucan rescue program, turtle release programs), and reforestation of lands (data collection and long-term monitoring of coffee plantation reforestation). Funding for the projects comes from various governmental agencies (Costa Rican Tourism Institute, Ministry of Environment, Ministry of Education), NGOs (Asociación Ornitológica de Costa Rica, INBio, and international organizations such as the World Wildlife Fund and The Nature Conservancy), private institutions (eco-tourism outfitters, banks) and, in some cases, local communities (Guanacaste Dry Forest Conservation Fund, El Bosque Eterno de los Niños). While there are no current statistics for the number of individuals participating in collaborative scientific projects, it is estimated by

INBio that more than 1% of Costa Rica's population is involved directly in collaborative scientific programs (private communication with Alejandro H., December 2012), positioning Costa Rica as one of the leading countries in collaborative scientific projects.

3.3.4 Summary of comparative case studies

The cases for this study were chosen because they differ in their placement on the cultural dimensions proposed by Hofstede, but more importantly because they represent different histories of collaborative scientific projects and various levels of experience, breadth, and support for these projects.

	Size and population (compared to other countries)	**History of collaborative scientific projects**	**Number of projects**	**Institutional support and funding**	**Estimated number of volunteers**
United States	3rd largest in size, 3rd in population	Since the 19th century	Over 400	Government, NGOs, educational institutions	More than 100,000
India	7th largest in size, 2nd in population	Since the 1990s	2 national, several dozen local	NGOs, few educational institutions	Less than 10,000
Costa Rica	127th largest in size, 121st in populations	Since 1970	Several hundred	Government, local and global NGOs, local communities, educational institutes	Around 50,000

Table 3-2 A comparison of various properties of collaborative scientific projects in the United States, India, and Costa Rica

As noted previously, Figure 3-1 summarizes the different points of Hofstede's dimensions on which each country is situated, and Table 3-2 summarizes the differences among the countries in regard to their support of, and experiences with, collaborative scientific projects. Because the countries vary in size, attitude towards collaborative scientific projects, and prevalence of such projects, they offer fertile ground for comparisons. The methods by which the three cases were examined are detailed in the next section.

3.4 Data collection

As described in the research plan (Figure 1-1) and in the research questions detailed in Section 3.23.2, this study takes a mixed-method approach, whereby quantitative surveys are combined with qualitative inquiry through interviews to present a comprehensive picture of the issues defined in the research questions. The triangulation of methods and the support they offer each other provides thorough answers to the research questions that were outlined. Because each method has its shortcomings, the use of both methods allows them to compensate for each other's limitations: a "mixed method way of thinking" offers "multiple ways of seeing and hearing, multiple way of making sense of the social world and multiple standpoints on what is important…. [mixed methods] rest on the assumption that there are multiple legitimate approaches to social inquiry and that any given approach to social inquiry is inevitably partial" (Greene, 2007, p. 20). Combining different data collection methods enables a deep look into volunteers' own narratives of engagement and motivation, and provides a comprehensive view of these motivations juxtaposed against cultural aspects. According to Creswell, Plano-Clarck, Guttman, and Hanson (2003), the basic tenet of mixed methods research is the collection, integration, linkage, and multifaceted interpretation of data derived from various sources. Data can be collected concurrently or sequentially, and mixing the different types of data can be done at one or more stages of the research process. Variations in mixed-method research design originate from the sequence of collecting data (Morgan, 1998), the priority and weight given to the different types of data (Tashakkori & Teddlie, 1998), and the potential for transformational value or outcome (Creswell et al., 2003). This study consists of quantitative surveys and qualitative interviews in two of the countries (The United States and India), and qualitative interviews in the third (Costa Rica). In terms of structure, it follows the "concurrent triangulation" route for the qualitative data: data collection was done concurrently, and the results of both collection methods were integrated during the interpretation phase, allowing for comparison and cross-validation of the findings. Temporally, the surveys were disseminated, collected, and analyzed prior to the interviews, and were used as a basis for crafting the interview protocols. However, it should be noted that the qualitative inquiry superseded the quantitative analysis in that the latter is used mostly to support and guide the deeper qualitative work, and most of the findings are based on the qualitative work.

Most of the data that was collected focused on volunteers rather than on their collaborators, the scientists. The reason for that is twofold. First, scientists and their practices of collaboration have been studied extensively. Looking into the less-explored population of volunteers sheds new light and also complements and supports the perspectives offered in previous works. Second, volunteers' motivations may be substantially different from those presented by professional scientists, and it is important to differentiate between the two (Rotman, Procita, et al., 2012). Therefore, where data was collected from scientists it was done in order to reflect on volunteers' perspectives and offer a different viewpoint that complemented that of the volunteers.

3.4.1 Interviews

Qualitative interviews are widely used in social science research. Interviews are best suited to facilitate an understanding of the world from the participants' perspective; they also aid in uncovering the meaning of people's experiences (Kvale, 1996; Kvale & Brinkmann, 2009; Weiss, 1994). Using qualitative interviews benefits the study in several ways:

- Providing holistic descriptions – qualitative interviews allow for the development of rich descriptions and an understanding of the meanings participants assign to acts within the context of their world (Kvale, 1996). As such, they present a comprehensive picture of their world that cannot be otherwise obtained.
- Integrating multiple perspectives – qualitative interviews that are not tightly structured can elicit a range of different responses from various people, adding to the richness of the data and providing new points of view (Weiss, 1994). They also provide an opportunity to understand the interpretation of an action or event, hand in hand with understanding the occurrence itself.
- Enriching the quantitative analysis – interviews supplement the data gained from surveys, and are used to cross-validate them, explain them, and enrich them (Denzin, 1978).

In this study, interviews were conducted to capture volunteers' experiences and their reflections on issues of motivation and culture. The interviews were first conducted in the United States as part of the Biotracker project (Rotman, Preece, et al., 2012), and later in India and Costa Rica. In the United States, individuals who completed surveys were asked to supply their email addresses if they wished to be interviewed, and of the 142 participants in the original survey, 46 agreed to be contacted. All 46 respondents were sent an email invitation to participate in the study. Of those, 9 agreed to be interviewed. The attrition rate was similar in India, where of 156 survey respondents, 22 were ultimately interviewed. In Costa Rica, the process was somewhat different. Because the survey did not elicit as many responses as was expected, recruitment for the interviews was based on personal connections with Costa Rican scientists and through professional affiliation (Encyclopedia of Life). This resulted in nine interviews. The selection of potential interviewees was based on "purposeful sampling" (Patton, 2002). Purposeful sampling ensures that the general framework for analysis will provide an information-rich data set (Kozinets, 2002) because it cuts across participant variations in a way that portrays different demographics, interests, participation types and engagement levels, but does not aim to create a representative sample. In addition to directly inviting survey participants to take part in the interviews, snowball sampling (Babbie, 2010; Biernacki & Waldorf, 1981) was also used in the cases in which interviewees pointed to others who could potentially provide rich information and/or were relevant to understanding pertinent issues of collaboration and motivation. Where snowballing sampling was used, the chain of referral was continued until "conceptual saturation" (Patton, 2002) was obtained.

In all cases, the interviews were semi-structured, based on a general list of predefined concepts and probes (Rubin & Rubin, 2005) used by the interviewer in order to maintain control of the direction of the interview (a full version of the interview protocol is enclosed in Appendix A). In some cases, the interview protocol was modified slightly to address cultural sensitivities (see Figure 3-2 for an example of the way a specific question evolved from one country to the other while maintaining the same core ideas). The core concepts of the interviews were iterated and continuously developed throughout the time in which interviews were conducted. Important concepts that were brought up in the first interviews were emphasized in later interviews, and in order to maintain similarity across populations, the same experiences and meanings were sought in the different cultures. The interview protocol was reviewed and approved by the University of Maryland Institutional Review Board.

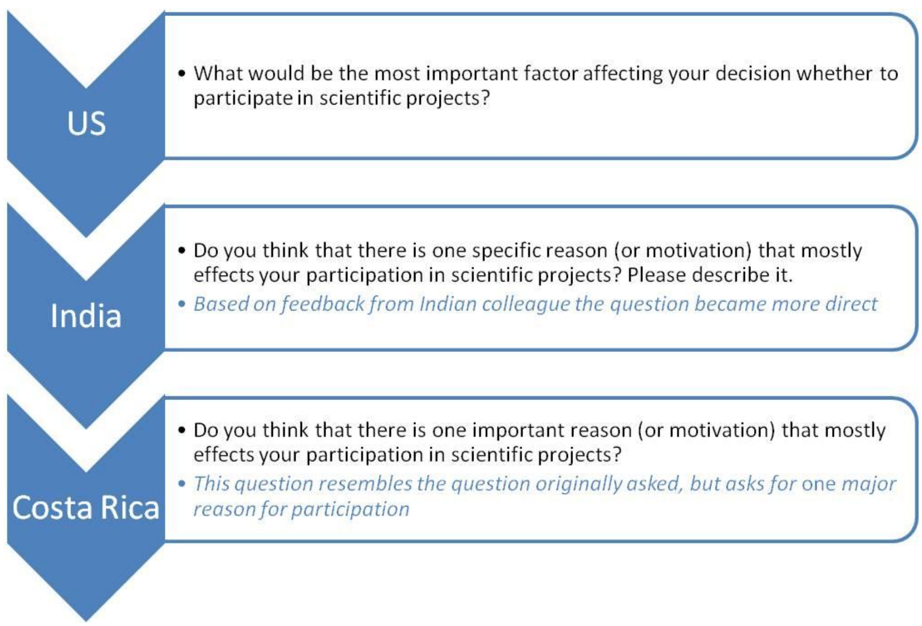


Figure 3-2 The evolution of the interview protocol based on cultural properties

All interviews began with questions about the interviewee's experience with collaborative scientific projects, but their end-points changed according to the interviewee's narrative. Many interviews (especially in India and Costa Rica) became a journey across personal narratives of the interviewee's history and personal development through participation in collaborative projects, and presented an individual story rather than reflection on the broader concept of public participation in collaborative scientific projects. This caused a change in the protocol to reflect more personal questions and at the same time emphasize questions that focused on the study topics.

The interviews ranged from 30 minutes to 120 minutes. The interviews in the United States were conducted in April and May 2010; in India in December 2011; and in Costa Rica in August-November 2012. Due to the geographic distance, most of the interviews were conducted over Skype. The only exceptions to this were one interview conducted in the United States, and all of the interviews that were conducted in India. The latter were conducted face-to-face as part of two events: a birders' meeting in Bangalore, and YETI – a student conference in Guwaharti (in the state of Assam in northeast India). Before, during, and after the interviews, artifacts such as personal and project websites, databases, articles, and documents that were relevant to the topics, institutions, and projects that were discussed in the interviews were collected. In addition, notes were taken throughout the interviews. While these are not "field notes" in their original sense (Emerson, Fretz, & Shaw, 1995) since they did not accompany an in-field participant observation, they were used to highlight topics that came up during the interviews. All interviews were recorded and transcribed. A few of the Costa Rica interviews were done in Spanish (per the interviewees' request) and were translated before they were transcribed. All other interviews were conducted in English.

3.4.2 Surveys

Surveys offer the benefit of collecting a relatively large amount of data quickly and in an unobtrusive way (Babbie, 1990; Lazar, Feng , & Hochheiser, 2010). However, surveys are limited because they collect "shallow" data and allow little opportunity to ask follow-up questions or dive deep into specific issues. In this study, quantitative survey items were used to represent and measure the motivational factors affecting volunteers' and scientists' participation in collaborative scientific projects. As mentioned earlier (in section 3.4.1), the qualitative interviews took precedence over the quantitative surveys in terms of the role they have in the analysis. However, in each country the surveys preceded the interviews and created the framework from which the topics that were covered in the interviews emerged.

The surveys were initially developed for the Biotracker project (Rotman, Preece, et al., 2012) to be administrated in the United States. They were later adapted and administered in India and Costa Rica. The administration of all surveys was the same: the survey was edited off line and then uploaded to a web-based survey tool (SurveyMonkey) under the University of Maryland iSchool account. Recruitment was done on line: a permanent link to the survey(s) was sent to relevant populations, through groups of interest engaged in conservation and biodiversity, and through personal contacts in the United States, India, and Costa Rica. The surveys were also published in social media outlets (e.g., Facebook, Twitter), and on the Biotracker website and the Encyclopedia of Life communications.

While response rate is not available due to the recruitment method, response numbers and other demographic data can be reported, and they are as follows:

	Gender	Position	Overall response
United States	M – 88 F – 59	Scientist – 63 Volunteer – 84	N = 147
India	M – 103 F – 54	Researcher –73 Student – 42 Naturalist – 41	N= 156
Costa Rica	M – 19 F – 10	Scientist – 17 Volunteer – 12	N = 29

Table 3-3 Overall number, gender, and position of survey respondents

Because the survey aimed to capture the notions regarding collaborative scientific projects of both scientists and volunteers, both populations were asked to participate in it. The survey items for both professional scientists and volunteers included four major segments: demographic information (age, gender, profession, scientific experience (where relevant), and level of expertise), experience in scientific collaborative projects, motivation, and data needs and technological requirements. Both populations were directed to the same survey but were first asked to self-select one of the groups (see Figure 3-3), in what Babbie (1990) termed a "contingent question." Accordingly they landed on the appropriate version of the survey.

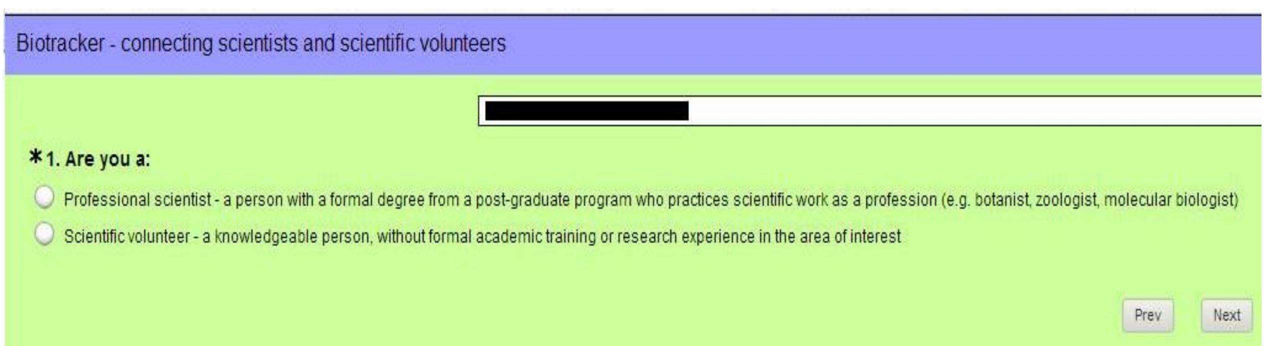


Figure 3-3 Question 1, differentiating the various populations in the survey. The answer to this question directed respondents to different versions of the survey

The survey questions were slightly modified to reflect these differences (e.g., where scientists were asked to rate the following phrase: “Collaboration with scientific volunteers helps **educate them** about scientific methods”; volunteers were asked to rate this phrase: “Collaboration with scientists helps **me** learn about scientific methods”). Most of the questions were closed, requiring the respondents to select one or several answers. Some questions (such as those pertaining to geographic location or institutional affiliation, and those where explanation was pertinent – e.g., preferring a specific technology for coordination of collaborative scientific projects) were open ended. Questions of motivation were presented on a Likert scale and required one answer per question. The full version of the survey is presented in Appendix B.

The original U.S. survey was first validated as a pilot study. A group of 10 scientists and 10 volunteers, all of whom took part in curating the Encyclopedia of Life (EOL), were asked to fill out the survey and provide us with feedback on its structure, clarity, and any technical or logical difficulty they have had in completing it. Based on the comments, the survey was slightly modified (i.e., some questions were re-phrased). Respondents to the pilot survey were excluded from participating in the actual survey based on the email addresses they provided as they exited the survey.

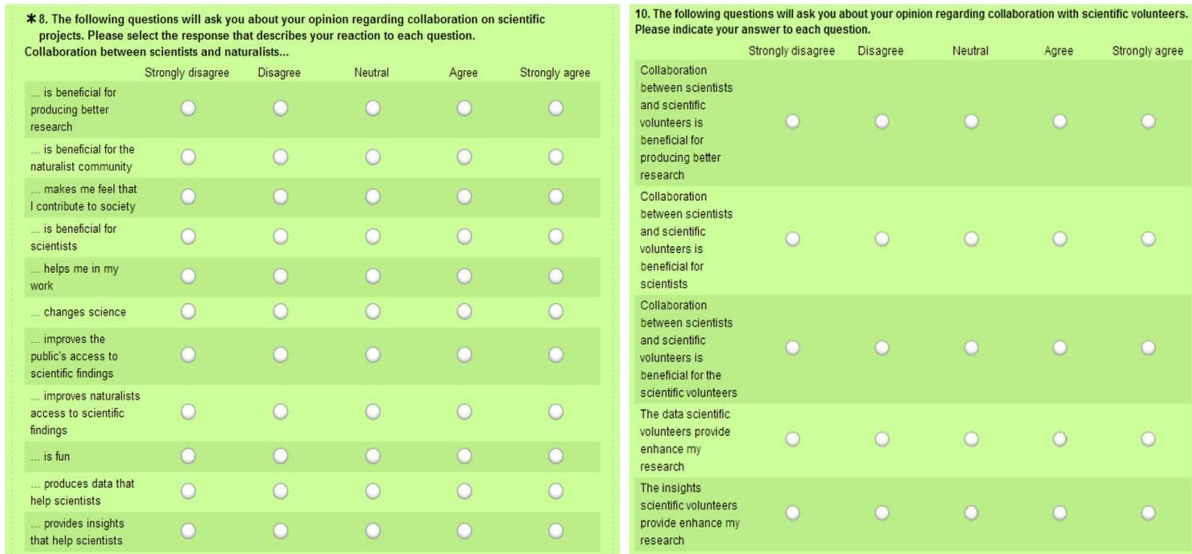
3.4.3 Modification of the survey to reflect cultural differences

Through the pilot testing and discussions with collaborators in India and Costa Rica, it became apparent that some cultural and practical adjustments to the survey were needed. These adjustments included wording and structural changes that reflected cultural differences, while leaving the original segments and questions similar to those that were included in the survey administered in the United States, so that valid comparisons could be made.

The changes that were made were as follows:

Language – In India, most prospective respondents spoke English, so there was no need for translation; in Costa Rica, the situation was reversed: most prospective respondents were not fluent English speakers, so the survey had to be translated into Spanish. To do that, I consulted with a native Costa Rican colleague, who translated the survey and checked the accuracy of the translation with a Costa Rican scientist. Another aspect of language related to the definition of the different participants in collaborative scientific projects. Status plays a significant role within Indian society; therefore, it was important to the Indian colleagues with whom I consulted that the term "volunteers" be replaced with "enthusiasts" or "naturalists." Specifically, "volunteers" connotes people who are requested by an authoritative person or institution to perform tasks without payment, and this term is not used in scientific circumstances. Using the acceptable term of "naturalists" prevented confusion when filling out the survey. In Costa Rica, the accepted term for volunteers in collaborative scientific projects is "Ciudadanos científicos" or "urban scientists."

Structure – Although the directing of scientists and volunteers to their respective forms was done automatically and discreetly, based on the answer they provided to the first question (see Figure 3-4 (a) and (b)), it was important to the Indian colleagues that both populations used the same survey. While this did not change the four segments of the survey or the essence of the questions that were asked, it did require some modifications to the actual language of the questions.



(a) **(b)**

Figure 3-4 Comparison between the different versions of the survey, based on cultural differences between India and the United States

Figure 3-4 shows a part of the survey that discusses motivation and the relevant phrasing changes. On the form used in India, both populations were asked to respond to all the questions regarding motivation, and the differentiation between scientists and volunteers was made during the analysis phase. In Costa Rica, no similar request was made, but to enable accurate comparison, the format of the questions was similar to that administered in India.

3.4.4 Benefits and limitations of web surveys

Web surveys and web surveying tools (e.g., SurveyMonkey) offer many benefits, but also present many limitations. In their extensive review of web-survey methodology, Fan and Yan (2010) and Evans and Mathur (2005) described the benefits of web-based surveys: they are global in nature and allow diverse populations to participate in the survey, therefore broadening the response base; they are of relatively low cost to distribute and administer; the process of administration, data collection, and data import into databases is quick and efficient; they are flexible and allow for interactivity of instrument design and for question diversity; they prevent respondents from looking ahead to the following questions, thereby minimizing response bias; and they can require completion of the answers, thus eliminating non-response. Nevertheless, there are many known limitations of the web-survey formats and instruments (Carini, Hayek, Kuh, Kennedy, & Ouimet, 2003; Gosling, Vazire, Srivastava, & John, 2004) that should be taken into account. Some of these are the skewed attributes of the Internet-using population (i.e., male, educated, upper socio-economic status) that affect the representativeness of the responses (although it should be noted that these factors may be rapidly changing as far as gender and race are concerned (Pew, 2012)). Lack of information about respondents can affect the validity of the responses; on the other hand, privacy and anonymity may be compromised where the IP address or the email address is known to the researchers. Design flaws and lack of understanding of how web surveys work may also present a barrier to participation and cause some responses to be incomplete or inaccurate. Computer configuration, interoperability, and internet connection speed also affect the administration of web-based surveys.

Some of the most important issues related to administering web-based surveys are those of sampling frame and coverage error, and the response rate to the survey. Coverage error is considered "the biggest threat to the representativeness" (Couper, 2000, p. 467), as web-based surveys directly violate the principle of probability sampling. Coverage error, or the mismatch between the general population and the sampling frame, is created by the inherent exclusion of those who have no access to the Internet (Andrews, Nonnecke, & Preece, 2003), or those whom the survey didn't reach. This is especially true in developing countries where internet infrastructure is not always comprehensive. Coverage error renders the online population almost impossible to statistically sample, leaving non-probable sampling – and primarily self-selection – as the favored sampling methods. Here, respondents self-select to participate in a study presented to them by the researchers (either in a recruitment email or at the beginning of the survey). As Andrews et al. note (2003), "To infer for a general population based on a sample drawn from an online population is not as yet possible and will not be possible until the online and offline populations reflect each other" (p.10). Acknowledging the lack of generalizability while very cautiously suggesting principles based on the findings derived from web surveys is possible but should be done with care. Another issue is that of the unknown response rate, due to the recruitment method. Web-based and email-based surveys are notorious for their relatively low response rate (in comparison to surveys conducted by phone or in person), due to lack of incentives offered to participants and potential technical difficulties (Couper, Traugott, & Lamias, 2001; Fan & Yan, 2010). When using social media tools to promote a web-based survey, there is no way to be sure how far the call for participation in the survey has spread, how many people were exposed to it, and what was the actual response rate. While this is certainly a weakness of web-based surveys, I could not find any systematic academic review or study that directly addressed this issue and suggested ways of ameliorating the limitations it presents to the survey's validity. Maintaining the validity of the survey was done by emphasizing the demographic data provided by the respondents and through cross-validation of the data across the countries in which it was administered. At the same time, combining qualitative and quantitative findings should provide a broader framework that will enable certain, albeit limited, level of generalizability.

3.4.5 Additional data

In addition to the qualitative and quantitative data that was collected, several secondary data sources were used to gain a comprehensive understanding of collaborative scientific projects and the roles volunteers take in them:

- I followed the YETI ("Young Ecologists Talk & Interact") mailing list for more than a year. This mailing list discusses collaborative scientific projects, opportunities to participate, and conferences and publication outlets for Indian scientists and naturalists, with an emphasis on budding scientists. The list is quite active, with 2 to 5 daily messages. It offers a different perspective on the way in which collaborative projects take shape in India, augmenting the experiences that were discussed in the interviews.
- I participated in a workshop (at Duke University, May 2011) of scientists from various domains that discussed the concept of Cyberinfrastructure for Collaborative Science. In this workshop the idea of collaborative scientific projects was discussed from the standpoint of scientists, and the topic of motivating scientists and volunteers to collaborate was discussed at length.

While neither of these sources can be quantified or qualitatively coded, they provided me a deeper understanding of the inner workings of collaborative scientific projects, their backgrounds, and the contexts in which they are situated. They also familiarized me with some of the different terms used by both scientists and volunteers when discussing collaborative scientific projects.

3.5 Data analysis

Throughout this study, the data analysis was an iterative process in which each type of data supported the other. But as was mentioned earlier, the qualitative data took precedence over the quantitative data.

3.5.1 Qualitative data

The interviews were analyzed using grounded theory (Strauss & Corbin, 1990). Grounded theory calls for inferences that arise from the data in a bottom-up fashion to be refined in an iterative process involving repeated mutual or axial referencing of the concepts that arise from the data. As such, it departs from traditional ethnographic practice (Geertz, 1973) which stresses the researcher's subjective interpretation of meaningful human activities. Coding data according to the principles of grounded theory is a reflexive process in which people's accounts emerge from the artifacts that are collected by the researcher. The process is focused on the "settings, style, images, meanings and nuances presumed to be recognizable by the human actors involved" (Krippendorff, 2004). The coding process was done manually, based on the interview transcripts. A color coding scheme based on the codes that came up from the data was used (see Figure 3-5), and relevant comments were attached to them. These comments were later used to create a codebook that was used in later iterations of the coding.

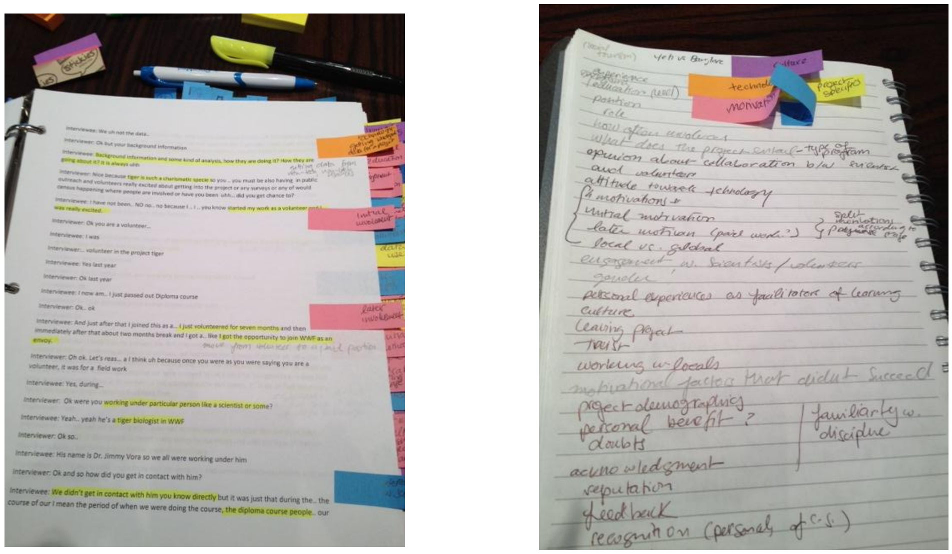


Figure 3-5 Manual coding process

Interviews from each of the three countries were coded separately. Within each country interviews were first coded independently of each other to reflect major concepts (e.g., "motivational factors," "initiating collaboration," "work patterns," etc.), and then synthesized according to emergent themes (e.g., "cycle of collaboration"). Themes from all three countries were then grouped into a codebook (Appendix C). This codebook was modified and refined throughout the coding process to reflect emergent concepts. The codebook went through several iterations as the analysis unfolded and new concepts were incorporated into it. Once the codebook was finalized, the interviews were re-evaluated and coded according to the themes that were pre-defined. The themes were then compared between and across cases. To aid in the analysis process notes, citations that were drawn from the interviews, and drawings and visualizations of the relationships between codes and themes were used. The interviews were analyzed until conceptual saturation (Corbin & Strauss 2007; Morse, 1991) was achieved and no new concepts or findings were found.

3.5.2 A note on writing conventions

Anonymity - in order to protect the privacy of the study participants their identifying details were removed, and instead they are identified by individual alphanumeric sequence that denotes their country, their role, and the order in which their data was analyzed. For example, "USV2" is a volunteer, located in the United States, whose interview was the second one to be analyzed. "IS20" is an Indian scientist. The only exception was Costa Rica, in which some participants held various roles (some were both scientists and volunteers) thus they were identified only per their country and the sequence in which their data was analyzed.

Quotes – throughout the thesis I have used quotes from the interviews to explain and emphasize the important themes that were discussed. Quotes are brought in parenthesis, in quotation marks, and are italicized. The quotes are presented verbatim in most cases. One notable exception is the quotes from the interviews conducted in India. These interviews posed a substantial challenge: despite the fact that they were conducted in English, the use of the language and the way participants answered the questions is extremely different from the questions and answers format prevalent in the United States. Participants were intent on telling their complex personal stories as they were responding to the interview questions. This led to an incredibly rich corpus, but one that is difficult to follow and to easily incorporate into the manuscript without overburdening the reader with extremely long and circuitous dialogue. Therefore, some of the quotations that are used in the India case study were shortened or edited for clarity. Such editing was done carefully so as not to change the actual discussion, and in order to maintain the context of the conversation.

3.5.3 Quantitative analysis

The survey data was collected through SurveyMonkey and downloaded to an Excel database. The data was cleaned of missing responses and errors (e.g., duplicate responses by the same participant as determined by the provided email addresses). The analysis was done using SPSS v.18.

In the survey, participants were asked to rank on a Likert scale (1-5, where 1 is *strongly disagree* and 5 is *strongly agree*) statements that reflected their views regarding collaboration between scientists and volunteers. The statements were inspired by Batson et al. (2002) work, and were similar for all populations, with the necessary adjustments made to address each population (as noted in section 3.4.3).

Since this study looks at cross-cultural aspects of motivation, the analysis addressed both a comparison of the different cultures and the way motivation transpires within the culture in different groups (scientists, volunteers). To do that, comparisons of motivational factors within groups were performed using Friedman's test (the non-parametric test for differences between groups across multiple conditions); comparisons of motivational factors between groups were performed using the Mann-Whitney test (the non-parametric test for two independent samples). For both tests, the level of significance was set at 0.05, and Bonferroni adjustment was used in both cases to account for multiple comparisons.

3.6 Reliability

Major parts of this study are based on qualitative analysis of content. As such, the study is prone to raise concerns about the reliability of the analysis and its outcome (LeCompte & Goetz, 1982), as "reality can be interpreted in various ways and the understanding is dependent on subjective interpretation" (Graneheim & Lundman, 2004).

The case for qualitative analysis suggests that in order to establish reliability, the research has to be credible, dependable, and transferrable (Graneheim & Lundman, 2004; Guba, 1981; Lincoln & Guba, 1985; Patton, 2002; Sharp, Rogers, & Preece, 2007). To attain these properties, I followed several steps laid out by Guba (1981) and Graneheim & Lundman (2004):

- Justifying the selection of context, subjects, and methods that were used to illuminate the research matter ("audit trails"), and selecting the most meaningful unit of analysis through a purposeful sampling process. The essence of grounded theory is in detailing the research process, starting from concepts, to codes, to categories and higher level theories. The use of grounded theory structures the study in a way that will allow readers to understand how it evolved and how the findings relate to the research questions, providing ample evidence as to the selection process. As detailed in the data collection section, three individual and different cases were used to highlight the variation in collaborative scientific projects and the motivation behind them. A purposeful sample of interviews was used to ensure that various points of view and characteristics are accurately portrayed. Internal validity of the findings was enhanced by ensuring that the concepts and themes provided an authentic representation of the reality documented, both within and between cases.

- Engaging in a prolonged research process. The current research process is based on two previous studies that initiated me into the field and increased my knowledge of collaborative scientific projects (Rotman, Preece, et al., 2012; Rotman, Procita, et al., 2012). In addition, the study was relatively long (began in 2010, completed in 2013), and required deep engagement in the field that made me, as researcher, aware of changes in the field or other external circumstances that may affect the credibility of the study.
- Collecting rich data and providing thick descriptions of the phenomena researched and the culture and context in which the data was situated. Interviews, reflections, artifacts, and data pertaining to collaborative scientific projects were compiled in detail to ensure that other researchers can apply the results of this study to similar situations.
- Triangulating methods and detailing the research process, including how and why different methods were used. Throughout the research process, qualitative and quantitative methods were used simultaneously to ensure that findings were validated.
- Keeping textual and audio notes and reflexive memos as part of the research process and making them available to others. This encourages personal reflection throughout the research process and also supports critique and comments.

Another aspect that should be carefully noted is the impact of the researcher's culture and personality on the study (Davies, 2008). This is crucial in cross-cultural studies that bring the researcher face to face with cultures that are foreign to her, and calls for careful cultural awareness and accounting for this "foreignness" in both the research process and in reporting its findings. Some of the potential pitfalls are the difficulty of gaining access to relevant informants, understanding of cultural codes, creating fruitful rapport with participants from other cultures, and over-generalizing findings that do not accurately represent the culture (Marshall & Batten, 2003). One way to prevent this is to be aware of potential incongruence between the researcher's views or theoretical framework and the actual ones experienced by the individuals in the culture that is researched. Acknowledging these differences and respecting them, understanding that there is no possible way of understanding completely the researched culture, and reporting all these in the research products can alleviate some of the problematic issues associated with such "foreignness" (Marshall & Batten, 2003). To do that, I took care throughout the study to consider my cultural identity and values and tried to ascertain that they were not reflected in the analysis to prevent possible bias. In addition I consulted with colleagues in India and Costa Rica to make sure that my cultural assumptions were kept in check.

3.7 Summary

This study focuses on volunteers' motivations for participating in collaborative scientific projects through dual lenses – motivation and culture. To do that, a comparative case study approach was used in which data was collected using a mixed-method approach. The three countries that were selected for comparison represent different properties, in term of culture, and in the characteristics of the collaborative scientific projects that are prevalent in each of them. The data that were collected were similar for each country, comprised of quantitative surveys and qualitative interviews. The data were analyzed iteratively and concurrently to reveal concepts and themes that were later used for comparison across cases and within each culture, and which contributed to addressing the research questions outlined in Chapter 1, and to the formation of an updated theoretical framework, which will be discussed in Chapter 7. The validity of the study was maintained through several steps, including detailed audit trails and particular attention to the cultural differences between the researcher and the foreign cultures that were studied.

4 Case study - the United States

The United States offers a prime example of collaborative scientific projects based in an industrially developed country with strong traditions of civil society and well-developed environmental movements. The website scistarter.com lists more than 400 collaborative scientific projects in the United States alone. It is estimated that hundreds of thousands of people engage in collaborative scientific projects each year (NSF, 2012b). Some collaborative scientific projects cut across local boundaries and are done across the country; however, many projects are local in nature, focusing on the immediate community or locality of volunteers. The richness and variety of collaborative scientific projects done in the United States represent a long-standing tradition of volunteer participation second only to the one existing in the United Kingdom. The success of established projects has provided a broad foundation of well-honed protocols and educational materials. These, as well as the existing infrastructure and funding sources that support these projects in the United States, make it possible for a variety of projects across domains to succeed, and for some collaborative projects to go on for 10 and 20 years, providing scientists with invaluable datasets. At the same time, numerous projects fail, some due to various motivational issues. Drawing on extensive survey and interview data, this chapter explores the motivational challenges which collaborative scientific projects in the United States face.

4.1 Communities of participants in collaborative scientific projects

Participants in collaborative scientific projects in the United States vary in their backgrounds, in the tasks they undertake, and in the types of projects in which they participate. Volunteers come from heterogeneous backgrounds, ranging from school kids going on fieldtrips with their teachers and families, to university students, to retired adults. Some volunteers passively contribute their computational resources, others spend time in the field, and yet others work from home doing tasks that do not require travel. In addition, many collaborative scientific projects are local in nature, and rely on extension services and community-level organizations for financial and organizational support, differentiating them from country-wide and international projects, where volunteers act within more structured and deeply funded organizations such as universities, government agencies, and NGOs. This study aims to capture as broad a picture of volunteers as possible, bringing diverse views offered by volunteers working within different ecology-related, projects and in different capacities.

4.2 The United States survey

In order to capture volunteers' and scientists' views regarding motivation to participate and work together in collaborative scientific projects, a quantitative survey was administered in January-April 2011. The survey was based on the four motivational factors outlined by Batson et al. (2002), and was administered online (via SurveyMonkey) and on paper; paper results were later imported into the SurveyMonkey database. Prior to disseminating the survey, a pilot survey was conducted and tested in December 2010 with 20 participants. Based on pilot study results, the survey questions were modified and updated. Snowball recruitment was done by publicizing a link to the survey on the Encyclopedia of Life (EOL) newsletter, and by directly contacting various groups interested in biodiversity, conservation, or collaborative scientific projects. Social media was also utilized for this purpose, as links to the survey were published on the Biotracker project Facebook page and on Twitter.

	Scientists	Volunteers
N	62	80
Gender		
Male	38 (61.2%)	45 (56.2%)
Female	24 (38.8%)	35 (43.8%)
Age		
<18	0	0
18-25	7 (11.2%)	19 (23.5%)
26-35	17 (27.4%)	37 (46.2%)
36-45	21 (33.8%)	13 (16.2%)
46-55	12 (19.3%)	9 (11.2%)
56-65	5 (8%)	1 (1.2%)
>65	0	1 (1.2%)
Position*/Years of Experience*		
<1		9
1-3		21
4-5		7
6-10		7
>10		18
Senior	14	
Junior	9	
PhD student	12	
Lab technician	3	
Masters student	8	
Undergraduate student	2	
Intern	0	

Table 4-1 Demographic characteristics of the U.S. survey respondents (* denotes questions that did not require an answer, and some participants skipped)

In all, 148 responses were collected; 6 surveys were not included in the final analysis due to duplication, technical problems, or not answering the required questions, leading to a final sample of N=142. While calculating overall response rate for the survey is impossible given the methods of recruitment, completion rate for participants who began filling out the survey was 54% (for both scientist and volunteer groups combined).

The survey began by providing participants with definitions of the terms “professional scientist” and “volunteer” and asked them to self-identify with either group (scientists n=62, 44%; volunteers n=80, 56%). The majority in each group had more than one year's experience engaging in collaborative scientific projects (75% of scientists and 56% of volunteers). Participants' level of expertise was determined for the scientists based on their position within the academic world (e.g. doctoral student, lab technician, tenured and tenure track researchers, etc.), and for volunteers, by years of participating in collaborative scientific projects. The male to female ratio was similar in both groups (61.2% of scientists were male, while 56.2% of volunteers were male). Most participants were between the ages of 26-35 (N=54), with the next age group being 36-45 (N=34). Only one volunteer was over the age of 65, and none under 18. There was no significant difference in the age distribution between the volunteers and the scientists groups. Respondents' characteristics are summarized in Table 4-1.

4.2.1 Statistical analysis

Participants were asked about the motivational factors that affected their inclination to take part in collaborative scientific projects through a series of statements describing their feelings about the causes and results of participation in these projects, based on Batson et al.'s (2002) work, as was described in Chapter 3. Participants were asked to rank on a Likert scale (1-5, where 1 is *strongly disagree* and 5 is *strongly agree*) statements that reflected their views regarding collaboration between scientists and volunteers, and the related motivational factors. Statements were similar for both populations, with the necessary adjustments made to address each population (see Table 4-2). The total number of statements per motivational factor was constant for both groups. A composite score was obtained, reflecting an individual subject's attitude toward each motivational factor by an arithmetic average of all the individual scores per factor; missing responses were not imputed.

Motivational factor	Scientists	Volunteers
Egoism	The data volunteers provide enhances my research	Collaboration with scientists enables me to open my horizons to new ideas and knowledge
Collectivism	Collaboration with volunteers can be helpful to others in the scientific community	Collaboration between scientists and scientific volunteers is beneficial for the volunteers
Altruism	Collaboration with volunteers helps educate them about scientific methods	Collaboration between scientists and scientific volunteers is beneficial for scientists
Principlism	Collaboration with volunteers is worthwhile because I believe that all scientific knowledge should be accessible to everyone, regardless of their expertise	Collaboration with scientists is worthwhile for making scientific knowledge accessible to the public and outside the scientific community

Table 4-2 Sample motivational statements by motivational factor addressed, and relevant survey population

To analyze the data, several non-parametric statistical tests were used:

- To compare responses across genders, the Mann-Whitney U test was used;
- To compare between age groups, years of experience and research roles, the Kruskal-Wallis test was used (with post-hoc pairwise analyses adjusted for multiple comparisons using the Bonferroni correction);
- To compare between motivational factors (among the same group), Friedman's analysis of variance was used, (with similar post-hoc pairwise comparisons).

P values were adjusted for multiple comparisons, and $p<0.05$ was considered significant.

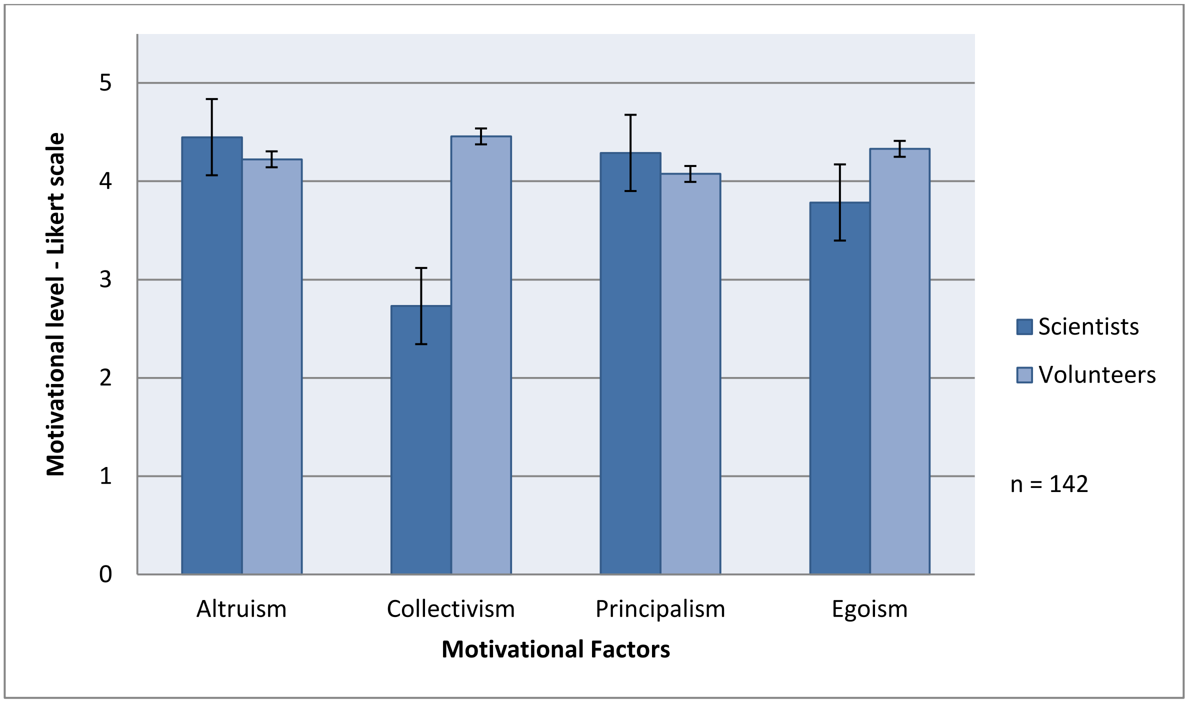


Figure 4-1 Scientists' and volunteers' attitudes towards motivational factors affecting their participation in scientific collaborations

Figure 4-1 represents the results of the survey and draws a comparison between the motivational factors leading scientists and volunteers. Among volunteers, the average response rating to each of the categories was similar (average scores ranging between 4.08 and 4.46). Scientists valued altruism (average score 4.45) and principlism almost similarly (4.29), but valued egoism (3.78) slightly less. Collectivism, or increasing the welfare of one's group, (2.73) was valued significantly less as a motivational factor by scientists (Friedman's test, with post hoc Wilcoxon Signed-Rank test, $df=3$, $p < 0.001$).

When comparing between groups (Mann-Whitney test), there was a small but statistically significant difference between scientists and volunteers in the way they valued *egoism* (mean response 3.8 for scientists vs. 4.2 for volunteers, U=250, $p < 0.001$), making egoism a slightly more salient motivator for volunteers; however, there was a marked difference in regard to another factor – *collectivism.* The mean response for scientists was far lower than for volunteers (2.732 vs. 4.456, U=68.5, $p < 0.001$).

	Role				
	Scientists		**Volunteers**		
	Mean	SE	Mean	SE	*P*
Egoism	3.78	0.709	4.28	0.760	< .0001
Collectivism	2.78	0.378	4.46	0.894	< .0001
Altruism	4.45	0698	4.22	0.820	0.261
Principlism	4.29	0.726	4.08	0.791	0.137

Table 4-3 Summary statistics for motivational factors based on the role of the respondent*

***Scale ranges from 1=strongly disagree to 5=strongly agree**

The compilation of within groups and between groups differences in regards to collectivism suggests that volunteers believed collaboration with scientists would benefit the volunteer community more than scientists believed it would benefit themselves (i.e., the scientific community), but also that scientists valued collectivism less than other motivational factors. Specifically, altruism and principlism were deemed most important by scientists, reflecting the notion that science is made to benefit the greater good. Age, gender, and level of expertise did not significantly influence the responses of volunteers or scientists (*p* value was found to be non-significant).

4.3 The United States interviews

Thirteen individuals were interviewed in the United States. Nine of them were contacted based on their participation in the survey, and four were recruited through recommendations, personal contacts, and social media. Interviews were semi-structured, conducted via telephone, Skype, and in one case face to face. Interviews lasted between 30 and 60 minutes. Of the interviewees, three were professional scientists ranging from Ph.D. students to senior faculty, and ten were volunteers. Volunteers' experience ranged from several months and participation in a few projects to more than 10 years' experience and deep involvement with consecutive projects. Most participants (9) had more than 3 years' experience. One participant was a professional scientist who began his career as a volunteer, thus presenting both viewpoints. Seven interviewees were female and six were male. Their ages ranged from early twenties to late fifties, though most were in their thirties and forties. All engaged in conservation, ecology, and natural history-related projects.

4.4 Participation practices and motivational factors

Based on the survey results in which volunteers acknowledged the importance of the four motivational factors laid out by Batson et al. as almost equal, the expectation was that volunteers would exhibit a comparable view in the interviews. A more fine-grained analysis of the interview data revealed that these motivations were not equally salient, and also did not occur at the same point in time. Volunteers by and large presented a range of self-related reasons as the initial and most substantial motivation for their engagement in collaborative scientific projects. Other motivations – based on Batson et al. principles of collectivism and altruism – were missing from the initial decision to join a collaborative project and participate in it, but surfaced at a later stage, effecting long-term engagement.

The various motivational factors and the points in time in which they surfaced, as well as the intricate relationships between various motivations, will be discussed in this section.

4.4.1 Personal interest

"I think personal interest comes first. Personal interest and personal gain, with information" (USV6)

Across all interviews, the same recurrent theme was applied to volunteers' initial decision to join a specific collaborative scientific project: some type of personal interest, which led them to seek opportunities that would match these interests. Personal interest preceded any decision to join a collaborative project, no matter how appealing, influential, or important the project seemed (*"I would be less inclined to participate in something I had little interest* [sic] *even if it was a worthy endeavor"* (USV2)). The general theme of personal interest could be broken down into several aspects ranging from fun and enjoyment to scientific curiosity. Collaborative scientific projects were seen as a potent platform to offer volunteers opportunities to pursue their interests, but in addition they offered volunteers an opening to extend these aspects and situate them within hands-on experiences related to nature. Thus, their interests and hobbies did not remain confined to solitary experiences (such as hiking trips or bird watching) but were grounded within a broader framework that allowed them to pursue their favorite activities while adding another layer of learning and gaining expertise. Not surprisingly, the volunteers who were interviewed demonstrated a deep commitment to nature, conservation, and sustainable ecology, regardless of their actual level of participation in collaborative scientific projects. Both seasoned volunteers and newcomers, and even the ones who were standing on the threshold of joining a project but had only limited participatory experience, emphasized this commitment to nature, regardless of the role collaborative scientific projects played in their lives (*"Most of the people have some inclination towards biodiversity, and conservation connection to them. So eventually [participation] becomes a greater good kind of thing"* (USV3)). When discussing actual collaborative scientific projects, the themes of "fun", "curiosity," "enjoyment," and "interest" were recurrent, demonstrating that many volunteers came to participate in collaborative scientific projects as an outlet for their commitment to nature, intentionally seeking opportunities that would match their interests in a way that would be enjoyable. However, as could be expected with a wide variety of volunteers from diverse backgrounds and with interests in many domains, the definition of what constitutes an interest or is fun varied as well. For some, it was the interaction with nature, the opportunity to be outside, or to do some nature-related, hands-on activity (*"People are interested in being outside, and they are committed to it… there's tons of people out there that just want to do something extra with their evening, they have a chunk of time that they want to get into something and really do something worthwhile, and I think that that could be anything as long as it's something they had initial interest in"* (USV7)). For others, it was not the overall experience set in natural surroundings, but the tasks they were asked to do; some volunteers appreciated opportunities to observe phenomena (e.g., bird watching or documenting morphology patterns) or to track and retrieve specimens – something that they would not otherwise do. As with the various views as to what was considered enjoyable, the foundations of personal interest and curiosity also varied across participants: for some it was the familiarity with a specific species, natural phenomena, landscape, or a process (*"I'm one of those arachnids geeks"* (USV2); "*I see a lot of insects interacting with the plants and, to understand plants better, I need to know what those insects are*" (USV10)). In other cases, their interest was shaped through previous experiences; for example, some volunteers had the opportunity to engage in collaborative scientific projects on a smaller scale at school, while visiting national parks, or through local organizations. These incidental experiences made them aware of other opportunities to satisfy their curiosity and engage in fun activities through the broader framework of pre-designed, structured collaborative scientific projects ("*I don't find birds interesting at all, but a lot of people love bird watching. I don't get it at all, I look at a tree and I don't see a bird but I look at a piece of coral and I can spot the fish; a different eyes [sic] I suppose"* (USV8)).

A different type of initial interest was related to a pre-existing or developing hobby which was not directly tied to participation in collaborative scientific projects, but was supported by such participation. According to several volunteers, hobbies such as photography, painting, and other artistic endeavors were better done while exploring nature. In the same manner, hiking and travel, which were a natural part of some volunteers' routines, became more engaging and meaningful where they were coupled with contribution to collaborative scientific projects. However, in most of these cases, if a conflict arose between the original hobby and the participation requirements set by the collaborative project's needs, the hobby took precedence over participation. For example, if a photographer wanted to explore a specific geographic area and document it, she would be less likely to change her travel plans to fit a specific collaborative scientific project that was set in a different area. (“*I started looking for a way to share pictures so that I could learn more about butterflies… and what started four or five years back is that some of the scientists said ‘OK we keep going for field work, and please go here and there.’ I do that when I can but only if I can also get the pictures that I want or at the time that the light is good. Not always”* (USV3)). This was different from the experience of volunteers who participated in collaborative scientific project because of a previous interest in a specific area or species: in these cases, they were more willing to invest substantial time and travel in projects that matched their specific interest in nature (*“Some people have favorite places, like this person wants to visit a particular forest very frequently…people tend to have that kind of affinity and they like to extensively document… they always want to record all of the spices seen in that area, they will always be interested in finding out some new discovery”* (USV3)). In all cases, some element of personal enjoyment was crucial in order to make volunteers even consider partnering with a collaborative scientific project and participating in it; lacking such motivation, they were not inclined to consider it.

4.4.2 Personal benefits

“There’s a little bit of ego involved in ‘I do that and it’s pretty cool’ that other people realize.” (USV9)

Participation in collaborative scientific projects offered volunteers an opportunity to harness this knowledge toward building their reputation and their career. Although most volunteers set their participation in collaborative scientific projects within the boundaries of discretionary and leisurely activity, some found these projects to be an opportune outlet for improving their status and building a career path related to nature and science. This was especially true for volunteers who came from a scientific background, such as college students and graduate students. They often saw participation in collaborative scientific projects as a career-building step that offered a significant addition to their curriculum vitae, and an opportunity to interact and build relationships with scientists who could positively affect their budding careers. *"[My motivation is] gaining the experience and seeing what it is, maybe having something for my resume*" (USV10); "*Since I started majoring in biology I've looked for a couple of opportunities in my area, to kind of expand and get involved in more things*" (USV6)). In other cases, volunteers who didn't seek a professional career in science saw collaborative scientific projects as an opportunity to build up their extra-curricular activities, which would afford them status and recognition (*"It really impresses me when people are interested in what I'm doing, and this happens all the time, when I tell people about what I do in terms of questions and they want to know more about it"* (USV7)). Those volunteers sought projects that enable individuals in different roles to advance and take upon themselves growing responsibilities, sometimes even leadership roles. In these cases, the potential for fulfilling such roles was a key motivational factor, and projects that did not offer such opportunities were viewed negatively by potential volunteers.

4.4.3 Social benefits

"We're like the inner-circle of the diving group, so you have to sort of continue to stay motivated because it's a good group or you like the people" (USV9)

An important motivational factor that significantly affected volunteers' inclination to join a collaborative scientific project was the social experiences and social benefits the project offered them. This motivational factor was evident at two temporal points of the project – at the initial involvement stage, where volunteers selected whether to join a project, and if so, which particular project should they join; and, to a lesser extent, when volunteers decided whether to continue and participate in the same project over long periods of time. The manifestation of the social benefits motivation was inherently different at those two times.

Initial social benefits – Volunteers spoke of participation in collaborative scientific projects as an opportunity to spend quality time doing something important with family and friends ("*I have to be honest, I have a partner I never saw, because he was always involved with bats, and I thought 'can't beat him, join him.' And that's what I did basically. And now we run the group between us"* (USV12)). These volunteers sought projects that were inclusive, offering opportunities to people with various backgrounds and interests, and of all ages. Where couples could participate in projects together, or parents could do activities along with their children, projects held more appeal. For example, projects that could be done in the backyard, along with kids – like counting ladybugs – were more motivating for young families; projects that required nightly outings – like documenting owls – were appealing to couples who wanted to spend time together after work, or to groups of friends. This participation pattern characterized volunteers whose schedules were full of other activities – work, raising a family, studies; surprisingly, it was also common, though to a lesser extent, with retired volunteers who found collaborative scientific projects to be an opportunity to meet with existing friends or meet new ones (*"Certainly at my stage in my life it means a group of people doing something together. I'm not really going out and meeting other people in order to take* *part in activities. You know, I'll talk to people I see, ask them what they see, about what I've seen"* (USV1)). In these cases, the initial decision to join a project was heavily influenced by the social opportunities the specific project offered. Volunteers also mentioned that holding key positions in such projects was viewed favorably by their acquaintances and families, so although they did not gain direct professional benefits from their participation, the social benefits that participation in collaborative scientific projects offered was meaningful enough to afford them a coveted social status and warrant participation.

Creating social relationships – This motivational factor surfaced at a later stage in volunteers' participation, but was one of the most important and profound ones. Some projects offered volunteers opportunities to go beyond their existing social circles and cultivate new relationships with like-minded people. Meeting other volunteers (and in some cases, scientists) who shared the same passion for a species, an activity, or a cause often led to the creation of personal relationships that went beyond the specific projects, and deeply affected motivation and commitment (*"You could get your friends to join or it would make it easier to find other people interested in the things you're interested in and they could connect you to other people and they could expose you to other projects that maybe they're involved in and you are not… the social aspect [is important] so you're not just alone in getting the data, you're with other people and can talk about it"* (USV6)). Volunteers reported on one-on-one relationships, but also on more intricate relationships with groups of volunteers who were collocated or spread over distant locations ("*I think it's social support as well. I've got a lot of friends who are in various owl groups around the country, and we give each other a lot of mutual support. There's a* *lot of asking: "I've found this owl, haven't you found it yet?, so it's a real community feel to it… you meet up over the weekend, you also get on Facebook and keep in touch*" (USV13)). In the latter case, interaction was mostly mediated and worked though the collaborative project's technological infrastructure or external social media (e.g., mailing lists, online communities, and Facebook). Volunteers liked to have personal meetings with other volunteers and were appreciative of projects that offered them opportunities to do so, but at the same time, they were content with mediated interaction with others, as long as they had some common ground that enabled interaction and cultivated friendship.

In a few cases, the ability to initiate social relationships was one of the initial motivations that led volunteers to seek opportunities to participate in collaborative scientific projects *("I think [that I'd like] being a part of a community, because I've seen groups of friends or families volunteer together, that's kind of the activity they could do, a social thing*" (USS7)). However, more often this motivation surfaced at a later stage, when volunteers were already familiar with the project's goals and with some of the other participants with whom they could interact. Not surprisingly, in this context volunteers looked favorably on projects that drew experienced participants (either volunteers or scientists), rather than mass projects that recruited large numbers of volunteers who were by and large less knowledgeable (*"I like getting to know the people and I always like these forums where people are sure if they send a picture they will most likely get it identified"* (USV3)). The opportunity to spend time with insightful individuals who shared the same interests and passions was seen by many as invaluable, leading to longer lasting participation than in projects that did not offer such opportunities ("*You have to sort of continue to stay motivated because it's a good group of people because you like the* *people"* (USV8)). For the most part, this type of social interaction happened only among volunteers. Except in a few rare cases, scientists were not part of this social interaction and remained external and aloof (see Section 4.5.2 for more discussion on this topic).

Enhancing volunteers' social status – Participation in collaborative scientific projects had effects beyond the project itself. Especially in cases where volunteers had some previous interest in nature or science, and people in their social circles were aware of that interest and how volunteers pursued it by joining collaborative scientific projects, the actual participation in the projects placed them in a semi-professional light. Many times their communities outside of the collaborative project were appreciative-of and impressed-by their participation. Volunteers reported that they were approached by co-workers, friends, and families for advice regarding their domain, and in some cases others who knew of their interest made sure to point them to relevant news, opportunities, and information, or asked them for such information ("*People have a tendency to ask questions or call…because they know I'm going to leave you with some information about the animal… enough [so] you can read between the lines and [next time] help it yourself*" (USV13)). Although people who did not take part in collaborative scientific projects were mostly unaware of the exact aims and structure of such projects, volunteers mentioned that they were often asked about their roles and responsibilities, and the more they became involved in the project or took on key roles (e.g. training or leading others), the more they were appreciated by their community. Such status changes, although external to the project itself, were highly valued by volunteers, and the more they felt appreciated – and even famous - in their communities, the more they were inclined to participate in collaborative scientific projects over extended periods of time. That said, this was not a motivation that guided initial participation, but surfaced at a later point in time, when the volunteers already had some experience that could be reflected in the interaction between them and their communities.

4.4.4 Ease of participation

"*It's not that birds are particularly more interesting. I think it's just that they are easier to observe*" (USV1)

Bearing in mind that most volunteers initially wanted to participate in collaborative scientific projects for leisurely purposes, fun, and enjoyment, it is not surprising that one of the most important motivational factors was the ease of participation. While some volunteers were interested in challenging, complex, projects that allowed them to engage in demanding tasks, they represented a minority. Most volunteers offered an alternative viewpoint, finding structured projects that asked them for incremental contributions that did not place substantial demands on their time or resources much more appealing (*"It was a very simple thing that did not require a great level of expertise: 'when you have seen the first leaves on what tree,' 'when is such and such fruiting, flowering,' 'when is it in berry,' and I did start looking at that, a long time ago, 10-15 years ago"* (USV1)). This was especially true for volunteers who had limited time due to other commitments (e.g., jobs, studies, families), and who volunteered in their spare time. Positioning projects in the immediate vicinity of the volunteers, such as their backyards, neighborhoods, or in places that did not require extensive travel, made it easier for them to participated and motivated them further ("*I'll go out in my yard for an hour or two and see what kind of species I have in my back yard. And for me, I found well over 80 species in a couple trips and that kind of proved to me just how biodiverse, how many insects and* *things are just out in the backyard. There's a lot that you don't realize until you just go out there and take a look"* (USV6)). Short-term projects (e.g., bioblitzes) or projects that were broken down into scalable segments (e.g., observing the same area for 10 minutes a day for a given period) motivated volunteers more than projects that were overwhelmingly demanding ("*We had actually weekend workdays for volunteers and they'd come in for a Saturday, and we'd go crazy for the whole day, sorting and preparing data so that then people like me who know butterflies can look at them more easily, later"* (USS4)). Similarly, projects that offered volunteers easy ways of contribution and data input were valued more highly than those that were complex or required volunteers to learn new methods and complex systems. At this point, technological infrastructure and tools became critical in encouraging volunteers to participate in collaborative scientific projects. Where these tools offered them easy ways to input the data, follow the project advancement, and communicate with others, or where technology enabled scaffolded contributions, it was seen as a major motivational factor affecting participation positively *("If there is a small, maybe web-based interface, or even if there is a small software piece that I have to install, than I could enter my observations into that and then I could see, OK, and then I could send them to the group that was collecting them. That gives me more interest than just sending them in and saying 'OK, record your things and send me a Word file or an Excel file, or whatever'"* (USV3)). The theme of ease of participation was present both when discussing volunteers' initial motivation, because demanding projects often alarmed potential volunteers and pivoted them away from such projects; and, in the continuous participation phase, where projects that were found to be too taxing or complex suffered from a higher attrition rate.

4.4.5 Acknowledgement

"It was nice to get something back, because people aren't going to keep on doing that unless there's something coming back" (USV1)

For volunteers who were already involved in collaborative scientific projects, one the most crucial motivational factors was acknowledgement. Unlike the somewhat fuzzy social benefits that volunteers could gain from participation, acknowledgement was perceived as a hard currency that was structured and expected. Although acknowledgement could take various forms, and volunteers had personal preferences regarding the mode of acknowledgement they found most beneficial, all variations were expected and accepted, with volunteers valuing projects that afforded them any type of acknowledgement that fit their contributions. Although volunteers clearly accepted the distinction of roles between themselves and scientists ("*It's not always collaborative, it allows people to contribute their ideas to solve a problem, but it's usually the scientists that yank the problem and put them out there to their community*" (USV13)), they nonetheless felt an intense need to be recognized and appreciated for their contributions, however big or small. With all the specific projects that were discussed, there were a few recurrent types of acknowledgement that were repeatedly mentioned:

Attribution – Attribution happened when individual contributions were singled out by scientists and explicit credit was given to the volunteers who collected, analyzed, or curated data. One volunteer articulated his expectation of attribution, which was echoed by many others, as a major motivational factor. ("*I'm not really, obviously, objected to glory. I do expect attribution… I would like people to use it [the data he contributes] but I would like attribution…I would always like to be the first one to put a photo up there...it's got to count somehow*" (USV11)). This type of recognition was especially important where selected artifacts (e.g., photos, samples) or specific data contributed by volunteers were used by scientists in publications. For recognition purposes, volunteers, unlike scientists, did not differentiate between peer-reviewed and open-access publications; they considered both valued uses of the data they contributed. (*"If a name ends up in the acknowledgments, the name ends up in a poster, it's a positive feedback thing. It's a measurable thing…if it had a public front to it: ongoing research, ongoing publications, that aren't exactly peer reviewed, there's an outlet to see – here, this is good stuff... they can show the family members and make it more of a positive experience"* (USV2)). Attribution was crucial for sustaining participation: projects or scientists neglecting to do so were prone to experience a higher attrition rate, especially where volunteers learned of the way their data was used in retrospect. Where data was used with no attribution (specific or general) many volunteers became upset and discouraged, as they felt under-appreciated and used by scientists. Volunteers wanted to become an integral part of the project, and from this perspective, they wanted the affirmation that the data they contributed was valued, and that their role in obtaining the data was clearly communicated.

An important type of acknowledgement that was mentioned solely by volunteers was not directly related to the actual contribution of data, but rather referenced the time and efforts volunteers spent participating in the project. It was understood by all that participation in collaborative projects was aimed at obtaining data or helping scientists in research-related tasks; however, volunteers saw value in their actual participation even if it did not always produce valuable findings. They were strongly aware that their qualifications and abilities differed greatly (in many cases) from those of professional scientists; they wanted to be recognized not only for their actual contributions, but also for the effort they put into the project even if that didn't amount to a significant addition to the research project (*"If they [scientists] want me to keep doing, I would think, 'OK, how do I know, how do they know I'm not wasting my time?' They have to understand the level of time commitment I invest"* (USV3)). Unfortunately, this expectation was seldom met by the scientists, who all viewed participation through positive contribution and did not measure it by the level of effort that was made.

Feedback – Feedback differed from recognition in that it was not associated with a particular contribution, but rather addressed the overall contribution of a volunteer, a group of volunteers, or the outcome of the entire project. Feedback mechanisms were expected to create a communication route between scientists and volunteers, but they also became prominent motivational factors. Volunteers sought feedback and were appreciative of those scientists and projects that had taken proactive steps to facilitate this ("*It's not about spending time or money. It's more about the constant feedback to the volunteers that what we're doing is useful and being used*" (USV8)). When scientists were not cognizant of providing periodic feedback to their volunteers, volunteers felt peripheral, became de-motivated, and tended to forgo future work on those projects. ("*I've done other stuff and you know you don't get feedback, like 'here is what we did* *with the work you did,' and so you don't feel like it's being used well and you don't feel like you want to continue to contribute*" (USV13).

Feedback took many forms, including impromptu updates about the research and its outcomes, or prescheduled periodic meetings with groups of volunteers to provide them with updates about their work, research procedures, and the way their work affected the scientific project. Alternatively, feedback was given personally, but unlike 'recognition' it did not focus on the individual contribution but more on how volunteers as a group contributed to the research and how the data they collected was used.

4.4.6 Volunteers' learning process

"There's a lot of people out there that may be interested in birds, and the next thing you know they are looking at butterflies and the next thing you know they are looking at bees, and the next thing you know they are looking at the whole picture" (USS4)

Most volunteers saw participation in scientific projects as an opportunity to extend and expend their personal knowledge of specific domains and species. The role of this motivational factor was highly dependent on scientists' attitudes towards the volunteers. When scientists acknowledged the need to educate people and not "treat them as dumb," as one volunteer put it, volunteers embraced the opportunity to learn more and widen their scientific horizons ("*We had a chance to sit down with a lot of the scientists who were in the field, and [we] could ask any question. You wanted to go down there with a magnet attached to your brain and try to absorb everything they had to say*" (USV10)). Through interaction with scientists and other more advanced volunteers, volunteers were continuously involved in a learning process that enriched and motivated them. Projects that offered structured learning environments, or opportunities to extend volunteers' knowledge (e.g. meetings, conferences, in-field discussions, and training) were valued substantially higher than alternative projects that did not include these interests. In this context, training held a special role: an invitation to participate in scientific training organized by the scientists was deemed to be a major motivational factor. While scientists saw training as an essential teaching process that ensured a minimal benchmark for data quality, volunteers viewed training as an opportunity to be initiated and accepted into the scientific world, and be recognized for the value of their contribution ("F*rom a volunteer standpoint there is a pretty big hurdle in getting through volunteer training… you have to go through all this extensive training. But, to be honest, I like it more than [another volunteer project] I looked into… because [the other project is] a lot less thorough and to me that makes it a lot less scientific… because people going through the thorough training feel like they're contributing a lot more because… I think they understand what the [scientists] are doing*" (USV6). Repetitive training, such as annual reaccreditation, or seasonal meetings, was also seen as a ritual reinstating their commitment to the scientific project. Rigorous training needed for some projects was noted as more prestigious than "come as you wish" volunteer projects. ("*Our training is very extensive. It's a 2-3 years commitment, because of our short season. I haven't gotten certified yet but I went through partial training and so I'm proud to say I'm recognized by the local chapter of the [zoological] trust"* (USV10)).

A different aspect of learning was the opportunity to share and receive data from the scientists. Although in many projects data sharing was a one-way process by which volunteers contributed data to the project but did not receive data (or access to data) in return, some projects offered volunteers limited access, mostly to the data they contributed ("*At times it happened that I give the data to someone, and I don't hear anything back from them and I'm not even sure what is happening, so that kind of de-motivates me to participate more, but if it is transparent, if I know OK, I have contributed 50 records and there are 1000 other records or individuals and now I can see them all together, or see them in whatever form, really, could be a website, could be a publication, but it has to be transparently seen"* (USV2)). In many cases, volunteers' wish to gain access to the data was met with suspicion and hesitation: scientists were protective of data quality and hesitant to share the data with others who might publish it before them, or just didn't see the value in sharing their data with masses of people. This was the common view offered by most of the scientists who were interviewed, but a slim minority felt committed to the learning process of the volunteers and saw data sharing as an important aspect of engaging volunteers in continuous participation. And, indeed, this motivation was relevant only where long-term participation was considered; data access was never brought up as an initial motivational factor. The importance of data sharing became apparent after volunteers were already engaged in a project and understood the value of their contributions, as well as the stewardship processes needed to maintain the data.

4.4.7 Community-related motivations

"Initially, it was doing something for my own good, because I just wanted to know what those bugs were. But continued participation I would say is more a mix of that and doing something for the larger community" (USV12)

Community involvement was not mentioned as an initial motivation leading to participation in collaborative scientific projects, even when the project had a substantial effect on the volunteer's local community. However, once volunteers were already involved in such projects, the impact of their work on their local community became an influential motivating factor ("*It's the combination of being an effective citizen scientist and seeing the community thrive… people really care about their natural resources here*" (USS5). Some volunteers stressed their continued commitment to collaborative scientific projects that were taking place in their area because of their potential effect on their community, and they preferred projects that had foreseeable results to that effect. The effect of collaborative scientific projects could be seen in educational opportunities offered to people outside the project which increased volunteers' sense of self-efficacy ("*The ability for me to be able to teach new groups and new people, which, you sort of, as you teach your learn more yourself and you get better in that*" (USV9)), or organizing local groups, ranging from a handful of participants to hundreds, with whom volunteers shared their knowledge and experiences (*"We started organizing something called a 'meet' where a bunch of people go together on a fieldtrip and collect a bunch of data.. Slowly this group started growing and now we have more than 100 members and a lot of interaction"* (USV3)). A different example of community involvement was a water contamination monitoring project in the Northeastern coast of the United States, where volunteers collected samples from streams and rivers that were previously deemed not fit for commercial harvesting. When contamination levels lowered and these areas reopened for commercial fishing, the local economy prospered. Following that, volunteers' participation in related collaborative scientific projects rose steadily. A different type of community involvement spoke again to the social aspect of participation, but in a different manner: volunteers found collaborative scientific projects as a prime opportunity to engage others from their community in causes that were dear to them (e.g. pollinating local flora), or ones that would have an imperative effect on the community. This happened mostly within geographically collocated communities (*"I've started conversations with people locally who are just very knowledgeable, it seems to easily slide into a community [involvement], though by community I mean more 'neighborhood'*" (USV1)).

Advocacy was a different community-related motivation. In this context, advocacy was seen as a collectivist motivation, which spoke to the relationship between volunteers and the communities in which they were situated. Advocacy was a motivational factor that did not influence the initial decision to participate in collaborative scientific projects, but became important as volunteers considered their ongoing participation. Most volunteers embraced the opportunity to understand better the issues pertaining to environmental policy that affected them and their communities through their participation in collaborative scientific projects (*"I want to be kind of a liaison between the scientific field ... and the common person who has the questions and doesn't know how to ask"* (USV9)). They saw this newfound understanding both as an educational benefit from which they personally gained, and as an asset that they could leverage to their local or distributed communities ("*It's the perfect opportunity to help people understand their environment … [I] hope that something that you say will make [a] dent and make them more curious and they'll go home and pick up a book or they'll call you back…it gives them a touch of what belongs to their environment*" (USV11)). A special emphasis was placed on children's learning (*"[small mammal walks are] a really good way to get kids engaged with the natural world. [it ends] their sort of disconnection with the earth which I think personally is what drives most of us"* (USV13)).

However, one volunteer mentioned advocacy as being the exact opposite, or a "*big turn-off*" because "*the day we put an opinion or try to do advocacy our data becomes compromised…and that's something I think scientists need to be really careful of*" (USV6)).

Effective advocacy was highly dependent on the related and relevant knowledge base the community had. Education as a tool for creating knowledge was one of the more important motivational factors that led to volunteers' long-term participation. Volunteers wanted to extend their knowledge to others as a way of increasing ecology-literacy, and also the public's thinking about science, relevant fund appropriation, policy decision-making, and the role of science for the greater good. ("*I don't think people can make good decisions, be it policy or environmental or anything else, unless they understand how things work. This provides the opportunity to educate people through a valid citizen science program. So when they go to the polls they can become active in their communities about something that they care about*" (USV11); "T*hey [people] need information, and we say, 'Hey, have you looked around, have you looked for a nest,' and then they kind of go on their own and ultimately they may have a personal investment,* *and we've created a good thing. Teaching people about it, they're going out there, they're trying to conserve spiders, they're going out to construction sites removing spiders"* (USV2)). Education also took a surprising trajectory: it influenced not only the volunteers' community but also the scientists: by working with people coming from a different knowledge base, the scientists gained a different perspective about their work. ("*A lot of master gardeners know more than I do about certain aspects of plant phenology. I know pieces of it better than they do, but I can learn from them, too*"; and "*it is nicer to work with people in a different atmosphere than the research community…just getting out of the little bubble that we're in*" (USS5)).

The view of what constituted an ideal level of community involvement changed from one volunteer to another, as some preferred just knowing that their contributions had some effect on their communities and did not want to pursue any active steps beyond that, while others earnestly sought specific opportunities to advance their community knowledge base and make it an effective player in policy-related challenges. Despite the variance of community involvement routes, one common thread went through all community-related motivations – the focus on volunteers' immediate community, and not extending volunteers' involvement into other communities.

4.5 Culture

Identifying one singular United States culture that pertains to collaborative scientific projects is difficult. The heterogeneous nature of a country as big as the United States, as well as the variety of projects, tasks, geographic areas, and relationships between volunteers and scientists offer a complex picture of particular examples that are difficult to fold into one holistic culture. However, two prominent themes that present aspects of culture came up from the data: the importance of locale, and the structured relationship between scientists and volunteers.

4.5.1 Locale

"There is a phenomenon in coastal towns…every once in a while you have a big boat sitting offshore waiting for berth and mysterious things happen overnight, and the next thing you know we start getting oily cormorants, and nobody seems to know what happened." (USV13)

The United States offers multiple opportunities to engage in collaborative scientific projects that stretch across the country (and sometimes across the continent). Although volunteers did not discount the importance of such projects, and some even took part in them occasionally, most emphasized local projects that were closely tied to their area as the most important and motivating projects. The emphasis on locale was pronounced not only in regard to the way collaborative projects may affect the community (see section 4.4.7), but also bounded volunteers' interests and their view of effective participation. The vignette above demonstrates that USV13 became interested in collaborative scientific projects because of the environmental impact she experienced within her community. Although she was later trained in saving wildlife from extreme biohazard events, like the BP oil spill, she never explored opportunities to engage in collaborative scientific projects outside her immediate community, believing that working within her community would maximize her effectiveness as a volunteer, while simultaneously benefiting the community she belongs to. Attachment to local phenomena, flora, and fauna was just as important as attachment to the local community. Some of this was probably due to volunteers' familiarity with the local environment and their existing knowledge base. Yet another perspective that they offered was the fact that small-scale projects that were local in nature offered them a greater sense of accomplishment and self-efficacy. Volunteers constantly negotiated between the grand idea of the greater good and local implications to which they were closely connected (*"Who is the immediate community? Is it just my friend circle and if I contribute some data they are going to get some help, or other persons who is [sic] going to put the data into good use, but I don't know [that person]"* (USV3)). They saw local and small-scale projects as pieces in a greater puzzle that would include similar projects from other areas. Yet while they saw great value in that, they were mostly interested in projects related to their locale as a way of better understanding the environment in which they were acting. In many cases, the volunteers that were interviewed came from small towns or communities, and they were deeply rooted in their communities. As such, their engagement was grounded in the local environment *("I think every small town should have a citizen nature network where they have specific speakers come in who work with specific animals they may never in their lives come into contact with… they can get in touch with the natural world immediately around them"* (USV10)). Some deemed the support they got from local organizations and from the local community was more important than any formal institutional support *("[volunteers were] contributing to their community effort, and working with local and state officials to clean out [estuaries], we've seem very high level of involvement in environmental protection by the local community, people really care about their natural resources here, people come for the natural beauty, so it's being a part of something local and successful"* (USS5)). In most cases, volunteers did not seek projects that had broader geographic impact or were remote, deeming that the most valuable projects were those that had an impact that they and their community would experience. In their view, projects situated in the immediate locale offered more intimate and beneficial outlets for the products of collaborative scientific projects.

4.5.2 The relationships between volunteers and scientists

"Credible data can be collected by volunteers, I've proved it over and over again. However it takes a lot of care and feeding" (USS5)

An interesting cultural aspect that was brought up often in the interviews was the delicate relationship between scientists and volunteers. Both groups noted that the American culture highly values formal and informal education, and supports it, but places professionally credentialed individuals and those who lack formal credentials on different scales. Volunteers, knowledgeable and appreciated as they were, were not considered equivalent to scientists, though sometimes they were viewed as having better qualifications than other contributors (e.g., lab technicians and beginning students). The formal structure of relationship between scientists and volunteers, which was not often circumvented, added a layer of mutual hesitation to the interaction between the two groups. According to scientists, the volunteers' role in collaborative scientific projects ranged from data collection (e.g., photos, specimens, samples, and observations), to fewer examples of data analysis (e.g., classification of collected specimens, database management), and in several unique cases, even included contributions to scientific or popular science publications. However, in most cases, scientists preferred to have volunteers remain within the ascribed role of field data collectors; cases in which volunteers were engaged in other roles were few and exceptional. ("*I see them as most helpful in making accurate observations… they are basically the field component*"

(USS5); *"basic science is very under-funded, it's impossible to get out to the field these days so it [collaborative scientific projects] saves a whole bunch of time and money"* (USV2)). Although some scientists mentioned that they would be happy to find enough interested volunteers who would be willing to take upon themselves more complex roles that would contribute to data analysis, they didn't expect this or "*see that as common or easily found [as field work]"* (USS5). In most cases, from the data collection onward, and more pointedly in the latter stages of the research, the scientists asserted themselves as leaders of the research and the ensuing publications; they did not see a place or a role for volunteers in these later stages. Therefore the primary motivation for their collaboration with volunteers was to maximize the useful products they could gain from the collaboration; thus limiting it to what one of them termed "*valuable but limited*" volunteer contribution. Volunteers were well aware of the roles that were assigned to them by scientists, and the limited scope of contribution they were expected to make, and were often weary of initiating interaction with scientists ("*I think that the most challenging thing is to say to scientists that you want to do something, without some of the fear they will consider you to be some annoying amateur"* (USV12)). The formal imbalance between the two groups led volunteers to express their hesitation of professional scientists. They repeated sayings such as "S*cientists [are] intimidating*" (USV12), "*Scientists speak a different jargon*" (USV1), "S*cientists have a reputation of being arrogant*" (USV6), or *"They are just so unfriendly"* (USV3). While volunteers were eager to aid scientists, they were also in awe of them, and overcoming this initial awe was difficult. Some volunteers felt that bringing their own ideas to the research table would not be positively accepted by scientists, but the few who reported that they had indeed broached the subject and offered input were pleasantly surprised when the scientists were cordial and even excited about these ideas.

From their perspective, scientists were wary of the volunteers' level of commitment and quality of work. In general they held positive views regarding collaboration, but the technicalities of obtaining high-quality data from volunteers were a reason for concern. "Quality assurance" and "quality control" were two of the most recurrent themes in scientists' accounts. They stressed the need for getting as much information as possible about the volunteers' expertise, participation in previous projects, level of training, and level of commitment, as preliminary requirements in order to deflect unwanted volunteers from joining their projects *("You don't really know with citizen scientists how good they are at first, it depends more on their level of training, and we try to deal with that… we go through exactly how the sampling scheme was designed, and why, and make sure people understand… we go through all that so we make sure that they're not, you know, incredibly biased out there"* (USS4)). This was also their way of ensuring that only "good" data will be delivered by volunteers. Some scientists had mechanisms to support that, by requiring paid-for training, assuming that uncommitted volunteers would not bother to pay for participation; others administered online tests, assuring the knowledge base of the volunteers and predicting their success in collecting data. Others preferred to cast a wide net, but slowly "retire" volunteers who did not uphold the rigid scientific standards ("*You train them, you observe them… and if they're not capable they have to get another job*" (USS5)).

For both scientists and volunteers, creating a sustainable collaborative environment necessitated trust and credibility. But building such trust was a long and delicate process that required good faith on both sides and explicit expressions of such trust through public engagement and acknowledgement ("*People won't come back if there isn't that loop of credibility and things that they can see that are being accomplished as a result of the data that they are collecting*" (USV9)). The process of trust building was largely dependent on both sides fulfilling each other's expectations and addressing their motivations. One problem with establishing this trust was that the two groups did not always explicitly convey their expectations and motivations to each other. Despite the fact that volunteers were familiar to some extent with the scientists' work and motivations, when scientists were asked about volunteers' motivations, most did not recognize volunteers' prevalent motivations. They mentioned motivations stemming from "*Wanting to be outside*," "*Wanting to do something meaningful*," and "*Working with their friends or family [on scientific projects]*" but many scientists failed to recognize the initial interest volunteers had in scientific problems as their primary motivation. Further, while volunteers identified attribution and recognition as important to them, their importance was downplayed by several scientists despite the role they actually played in volunteers' engagement. ("*I find that people don't want to stand out… people are put off by highlighting certain [contributions] we don't do it in a huge way… recognition can backfire*" (USS5)). This gap undermined the two groups' ability to reach the desired trust, and to attain a higher level of collaboration. The delicate, and sometimes contentious, relationships between scientists and volunteers reflected to a great extent the existing cultural perspective of how each group is positioned within the scientific world, and underscored the importance of understanding many of the other motivational factors that dictated volunteers' engagement in collaborative scientific projects.

4.6 Attrition

Despite the fact that collaborative scientific projects drew many volunteers to contribute and take part in various tasks, not all projects were successful and even those that did succeed suffered from a relatively high attrition rate. Although one scientist presented a project in which people were involved for 8-10 years, all other interviewees, both scientists and volunteers, mentioned the changing levels of volunteers' commitment as one of the major obstacles to success. Attrition happened when volunteers lost interest in the project, found the project to be too demanding or difficult, or did not receive a positive response to the motivations that prompted them. Attrition rate was estimated at over 80%, in some cases. Others did not mention exact percentages, but estimated that for most volunteers, participation was a one-time event, or at most, took place over a series of consecutive days, after which they lost interest. Yet others suggested that in order to have a sufficient number of volunteers committed to the project, scientists should cast a wide net and train a great number of potential volunteers, of which only a few will remain ("*You've got to go and train 100 people if you want 15 to show up on a regular basis, because you can't expect 75%. I think you can expect more of a 15% regular, active participation rate"* (USV8)).

4.7 Summary

The United States presents a rich perspective of various collaborative scientific projects that take place in different geographic areas, with different participants, and under different circumstances. Though the interviewees brought various perspectives depending on their roles and the projects in which they acted, several recurrent themes cut across most – if not all – interviews. First, personal interest was the major motivational factor that led volunteers to initiate participation. Second, the role of social relationships, within the project and outside it, among volunteers and between volunteers and scientists, and among families, friends, and communities, was a highly important motivational factor that led to volunteers' participation, not only in its initial stages, but also throughout the participation life cycle. Other factors that influenced volunteers' long-term engagement were the effect they had beyond the project – on their communities – and how participation in the project translated to education and advocacy efforts. The implicit cultural aspects that were woven into the discussion of motivation addressed two issues – the locale of activity, as most volunteers situated their contribution within the geographically proximate environment, and the structured power-balance between scientists and volunteers, which pulled in two disparate communities, affecting volunteers' motivation.

5 Case study - India

Collaborative scientific projects in India are mandated by various structural forces. As a federal republic India has several governance structures that affect the level of nature conservation and attitude toward collaborative science. This determines the extent to which each local institutions allocates non-monetary support and appropriates funding for these purposes (by establishing parks and conservation area, allocating personnel to develop these areas, funding educational efforts and supporting academic and private initiatives towards conservation, etc.). As such, it would be expected that the variation in programs, opportunities, and attitudes towards collaborative scientific projects would be great. However, the rigidity and bureaucratic nature of Indian institutions, as well as some cultural aspects that vary across the country, make for some high barriers for developing and implementing collaborative projects, and pose difficulties for motivating volunteers to engage in them. This chapter will detail these issues in the context of ecology-related collaborative scientific projects taking place in India. This will be done through two major examples: The Bangalore birding group (IBP), and YETI – Young Ecologists Talk and Interact, which are briefly described below.

5.1 The Bangalore birding group

Initiated by a group of avid bird-watchers, who come from both scientific and non-scientific backgrounds, the Bangalore birding group was created around 2008 as an opportunity for bird-watchers to meet on a periodic basis, to explore and document various species of birds in the Bangalore area. The group's meetings are supported and coordinated through a blog (http://bangalorebirding.blogspot.com), that aggregates the data collected during the outings, and provides members with information towards future outings; a Yahoo! mailing list, and an online portal that provides photos, identification keys and various data about Indian birds to allow for easier identification (http://www.indiabirds.com/).

While the group does not have a formal structure, several of its members are veteran birders, who draw other enthusiasts in their wake. Most members of the group are professionals working in the high-tech industry, and see birding as a hobby. They and do not have a formal scientific background or practice science as a profession. All participants in the group are male – probably due to the relatively rigid social norms that prevent women from participating in co-ed outdoor activities. The Bangalore birding group is unofficially supported through the Ashoka Trust for Research in Ecology and the Environment (ATREE), a private foundation focused on biodiversity conservation and sustainable development.

5.2 YETI - Young Ecologists Talk and Interact

YETI is a volunteer organization, supported by various private and public NGOs (e.g. ATREE, WWF-India), and public institutions (e.g. academic institutions). YETI supports budding ecologists towards greater involvement in biodiversity and conservation efforts. YETI was founded in 2008, as part of a networking effort initiated by ecology students across India, and has since grown to be a country-wide organization. As part of its mission, YETI conducts an annual meeting, in which participants present their work (in a manner similar to academic conferences), learn about research methods, are offered training in various aspects of data collection, and hold collective sessions in which they share their experiences and reach out for collaboration with others. YETI meetings are intentionally held in remote areas that offer compelling ecological conditions and allow for interaction with nature. At the last meeting reported (2010) more than 450 students from across India participated (see Figure 5-1).

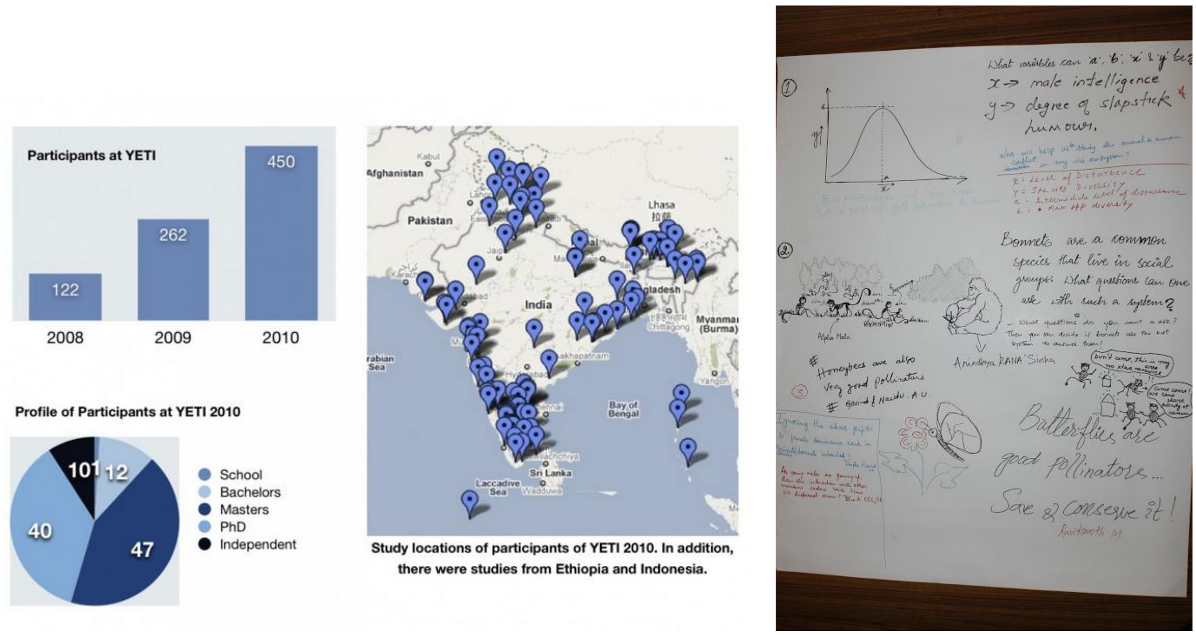


Figure 5-1 YETI annual conference 2010 demographics, and one of the posters that were presented (source: www.meetyeti.com)

Between the annual meetings, YETI operates through a Facebook group and several mailing lists, which support discussions and communications in regards to potential ecological projects and relevant resources, announcing funding opportunities, academic positions and non-academic jobs, and maintaining connections between YETI members. There are no formal requirements (e.g. level of education or institutional affiliation) for participating in the mailing lists or in the annual meeting. The 2011 annual meeting was held in December 2011 in Guwahati, Assam (in the northeastern part of India). The three-day meeting offered an invaluable opportunity to interview participants ranging from enthusiasts with no formal education or experience in collaborative scientific projects, to students and budding researchers, to established scientists. The participants in this meeting represent a different demographic from that of the Bangalore birding group, not only in the representation of both genders (although men outnumbered women about 2:1), and in the experiences and education levels they bring with them, but also in the range of the projects that they are involved in (from fishery monitoring to tiger documentation), their socio-economic status and geographic origin (rural and urban locales), the size of the projects they are involved in (from a singular participant to projects based on several dozens of participants), and in the experiences they've shared (being kidnapped by terrorists while doing scientific work). In that, interacting with YETI participants offered a complementary (and sometimes completely different) viewpoint to that offered by the Bangalore participants.

5.3 India survey

A quantitative survey was disseminated in India, and preceded the qualitative interviews. It was based on a series of questions adapted from the United States survey (see chapter 4) that captured participants' views as to their involvement in collaborative scientific projects, their experience, and the motivational factors guiding their participation. While the essence of the survey remained similar to that of the United States survey, the language of the questions was slightly modified to address cultural differences between the two countries. A more detailed explanation of the differences is provided in chapter 3.

The survey, disseminated through an online platform (SurveyMonkey), was open for a period of more than a year, and elicited the response of more than 170 individuals, mostly from IBP and YETI, as well as other respondents who were exposed to the call to participate. Participants were asked to provide various demographic details, including age, gender, and years of experience in collaborative scientific projects. In addition, they first had to identify themselves as belonging to one of three groups – scientists, students, or nature enthusiasts (or "naturalists", a term that was used interchangeably with "enthusiasts"). This self-selection category was used to differentiate between the various groups of participants in collaborative scientific projects. The data was cleaned of duplicates and entry errors, leading to a final sample of N=156. Since the survey was disseminated online, response rate could not be calculated, but completion rate was 73.5%.

N	156
Gender	
Male	103 (66%)
Female	53 (34%)
Age	
<18	2 (1%)
18-25	62 (40%)
26-35	65 (42%)
36-45	16 (10%)
46-55	9 (6%)
56-65	2 (1%)
Research Role	
Scientist	73 (47%)
Student	42 (27%)
Naturalist	41 (26%)
Years of Experience	
<1	52 (34%)
1-3	41 (27%)
4-5	21 (14%)
6-10	21 (14%)
>10	19 (12%)

Table 5-1 Demographic characteristics of the India survey respondents

The survey began by asking participants to self-identify themselves based on their role: 76 identified as scientists, 43 as students, and 41 as naturalists (as mentioned in chapter 3, these definitions based on cultural input from Indian colleagues, and differed from the role assignment used in the United States). Males comprised 66% (n=103) of the respondents, females comprised 34% (n=53) of them. Gender distribution did not differ between groups. Most participants were between the ages of 26-35 (42%, n=65), students were younger (79% below the age of 25) compared to both scientists (26%) and naturalists (29%); No participants were over the age of 65. Due to IRB requirements, 2 participants (a student and a naturalist) under the age of 18 were excluded from the data set, and their details were discarded. The majority of the participants (60% overall) had between a few months' experience to three years of experience taking part in collaborative scientific projects, although 12.3% (n=19) had more than 10 years' experience. As expected, scientists were more likely to be experienced, with 67% of the group having more than 4 years of experience in the field, compared to 10% of students and 23% of naturalists. Demographic data of the survey participants is provided in Table 5-1.

5.3.1 Analysis process

Participants were asked about the motivational factors that affected their inclination to take part in collaborative scientific projects through a series of statements describing their feelings about the causes and results of participation in these projects, based on Batson et al. (2002) work, as was described in chapter 3. A given statement may have been assigned to altruism for subjects with certain research roles but to collectivism in other roles (for example, a statement stating that "Collaboration between scientists and naturalists improves naturalists' access to scientific findings" was coded under "collectivism" where the respondent was a naturalist and for "altruism" when the respondent was a scientist). However, the total number of statements per motivational factor was constant for all research roles. The statements were rated on a 5-point Likert scale (1=*strongly disagree*, 5=*strongly agree*).

A composite score was obtained, reflecting an individual subject's attitude towards each motivational factor by an arithmetic average of all the individual scores per factor; missing responses were not imputed. To analyze the data several non-parametric statistical tests were used:

- To compare responses across genders, the Mann-Whitney U test was used;
- To compare between age groups, years of experience and research roles, the Kruskal-Wallis test was used (with post-hoc pairwise analyses adjusted for multiple comparisons using the Bonferroni correction);
- To compare between motivational factors (among the same group) Friedman's analysis of variance was used, (with similar post-hoc pairwise comparisons).
- *P* values were adjusted for multiple comparisons, and $p<0.05$ was considered significant.

5.4 Motivational factors

The first step of analysis compared the effect different motivational factors had on the willingness of participants holding different roles to take part in collaborative scientific projects. Motivational factors were grouped into four categories according to Baton et al.

(2002); comparison was done within groups (for the different motivational factors) and between groups for each motivational factor.

	Role						
	Scientist		**Student**		**Naturalist**		
	Mean	SE	Mean	SE	Mean	SE	*p*
Principlism	3.99	.072	4.14	.082	4.08	.087	0.387
Altruism	4.06	.065	4.30	.073	3.77	.085	0.00
Collectivism	3.54	.062	3.58	.078	4.40	.090	0.00
Egoism	3.45	.059	3.61	.078	3.78	.081	0.002

Table 5-2 Summary statistics for motivational factors based on the role of the respondent*

*Scale ranges from 1=strongly disagree to 5=strongly agree

When comparing between the three roles of participants and the specific motivational factors, it was found that research role did affect the reported attitude towards different motivational factors. Generally, it could be said that researchers and students demonstrated similar (or close) attitudes, while volunteers differed slightly. One major point of difference was in regards to altruism ($p < 0.001$), where naturalists saw this motivational factor as far less important than the two other groups of respondents (scientists $p = 0.041$; students $p < 0.001$) (Figure 5-2).

Students had a slightly higher altruism score than scientists but the difference was not found to be statistically significant (4.3 vs. 4.1, $p = 0.08$).

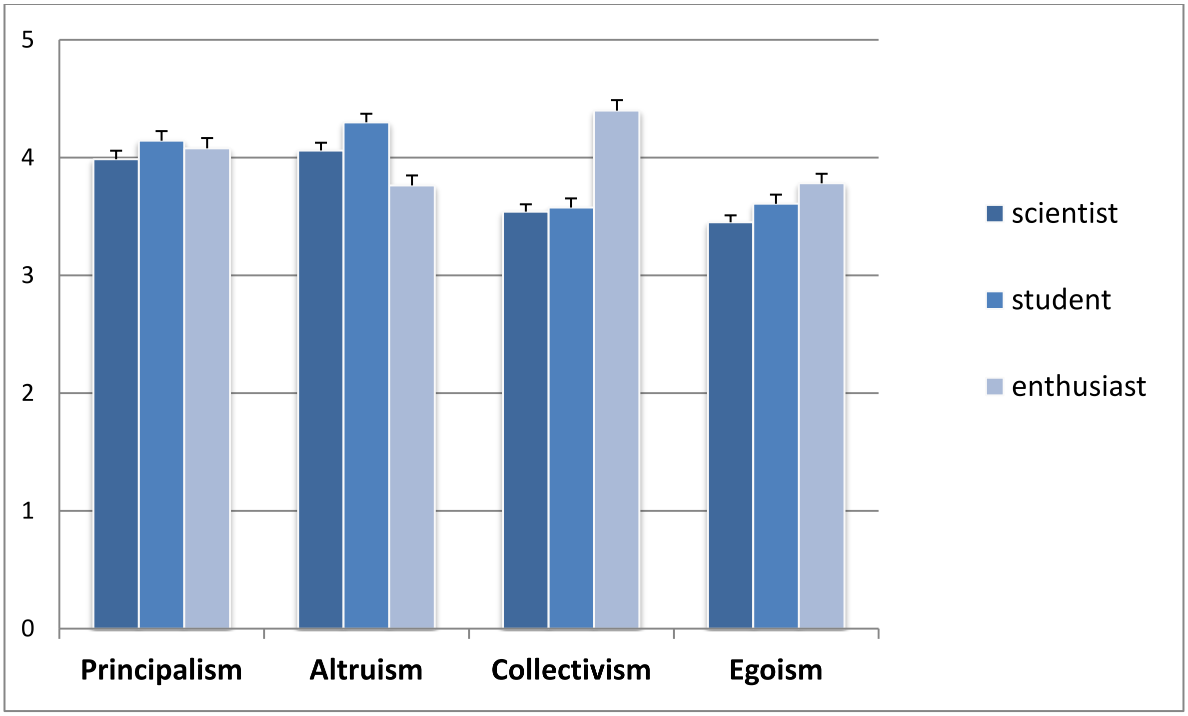


Figure 5-2 Comparison of attitudes towards motivational factor based on roles

Collectivism was another case of difference between the roles. Here, as well, there was a marked difference between naturalists scores ($p<0.001$) and students and scientists ($p<0.001$ for both comparisons with scientists and students). For egoism ($p=0.004$), the average score for students (3.6), was lower than naturalists (3.8) but higher than scientists (3.5). Statistical significance was only achieved when comparing scientists to naturalists ($p=0.003$). Principlism scores did not differ between the groups. The responses to each motivational factor were not different when subjects were stratified according to age, gender or years of experience.

It is interesting to note that scientists and students had similar scores for altruism and principlism ($p = 1$ for both scientists and students) and for collectivism and egoism ($p = 1$ for both); however, the altruism and principlism scores were significantly higher than those for collectivism and egoism ($p<0.001$ for all pair-wise comparisons, for both groups). In contrast collectivism was the main motivational factor for naturalists, with principlism following it ($p=0.02$, adjusted $p=0.133$) and altruism or egoism achieving lower scores ($p<0.001$ for comparisons with collectivism). The dominant factor was not different between subjects according to age, gender or years of experience.

The respondents were then asked to rank the single most important motivational factor that would affect their participation in collaborative scientific projects (Figure 5-3).

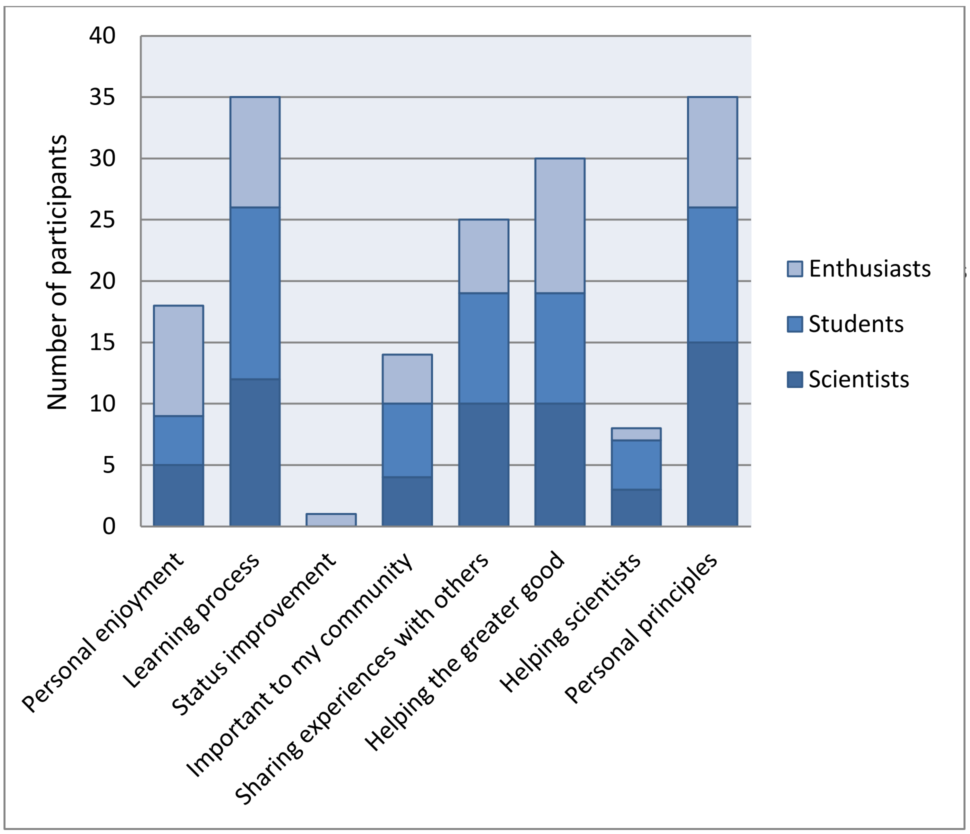


Figure 5-3 The most important motivational factor affecting participation in collaborative scientific projects

Based on the previous findings noted above, it was not surprising to find that participants (across all roles) ranked principlism ("I believe everyone should take part in something that benefits society") highest, followed closely by an egoistic motivation of a desire for the learning process associated with participation in collaborative scientific projects.

Surprisingly, the most blatant egoistic motivation ("It helps me improve my status") was reportedly the least important motivation, exhibited only by a handful of enthusiasts.

5.5 India interviews

All interviews with participants from both the Bangalore birding group and YETI were held in December 2011. Twenty-two interviews were conducted over a period of 6 days: eight in Bangalore and fourteen at YETI. Of the 22 interviews 6 were with professional scientists and 16 were with a range of volunteers – from students at different stages of their studies (Bachelor's, Master's, or PhD) to non-academic volunteers. The interviews aimed to bring a broad variety of voices and ranges of experience portrayed by the volunteers.

Another important issues was gender: only two interviews were with women and the other twenty were with men; recruiting women to be interviewed proved to be extremely difficult – while in Bangalore there were no women involved in the birding group, their presence was more pronounced at YETI, yet many of them refused to be interviewed, and it was difficult to discern the reasons for this refusal.

5.6 Communities of participants in collaborative scientific projects

In order to unpack the intricate issue of how motivation shapes involvement in collaborative scientific projects in India, first we have to define who the participants in these projects are. The two immediate populations that come into mind are professional scientists and volunteers, but the range of volunteers in ecological collaborative projects in India is broader, and so is the way volunteers define themselves – some see themselves as assistants to scientists, others as amateur scientists (this applies mostly to volunteers who have some relevant educational background), while yet others define themselves as enthusiasts or naturalists. When scientists were asked about volunteers, most of them referred to this population as "enthusiasts" or "naturalists" (in the case of the Bangalore birding group). The interviews surfaced another population that often becomes involved in collaborative projects – locals, who are not necessarily interested in ecology or volunteerism. Unlike volunteers who have an interest in biodiversity and ecology, locals are often less educated, less involved in societal causes, and present different characteristics. Due to India's size and diversity, many collaborative scientific projects take place in rural areas, where the population is dependent on natural resources for a living (by hunting and gathering their food from forests, fields, and water bodies), and is often poor and under-educated. The main impetus for this population's participation is, in most cases, some tangible reward – whether that reward can be realized immediately (e.g. payment), or affects their locale in the long run (e.g. resource protection). In most cases, the first rather than the latter is the reason for their participation. Many rural communities are so poor that a relatively minimal monetary reward (50 Rupees = less than $1) will equal a month's worth of wages. That makes it easier for scientists to "employ" rather than "engage" locals without a large investment. This also changes their relationship, and the motivational factors that affect locals' engagement in collaborative scientific projects. Therefore, when discussing motivation in the next sections, I will address the two groups separately: the volunteer group will be that comprised of enthusiasts who see participation in collaborative scientific projects as valuable in and of itself, and the local group, which engages in scientific projects because of the immediate rewards they get, and not due to the value of collaboration or scientific achievement *per se*.

5.7 Participation practices and motivational factors

Participation in ecology-related collaborative scientific projects does not come from a void. A basic reason, or motivation, stands at the basis of the decision to join either a specific project or the general framework of scientific collaboration. This initial motivation may (or may not) develop later longitudinal motivations that dictate continuous involvement, In this section I will look into the various participation practices and motivational factors that shape engagement throughout the participation cycle, starting from the initial motivation, and continuing throughout the lifecycle of the project, with an emphasis on the temporal points in which various motivational factors surface.

5.7.1 Personal benefit

"Before I joined this group, I was interested in things for my personal interest, and now there's a much larger cause that I care for" (IV5)

The interviews conducted in India surfaced that the most important motivation that led to an initial participation in collaborative projects was personal benefit. This was evident across all interviews, whether with the Bangalore birding group, or with YETI participants. Although a few volunteers were passionate about nature, conservation, and ecology ("*Some people work sincerely for the purpose. I think that this must be their passion that keeps them going*." (IV17)), lacking some personal benefit they were not inclined to initiate participation – or even be involved - in collaborative scientific projects. Some beneficial aspect beyond mere interest in nature, had to be present in order to actualize participation ("*I want to help this organization, I want to do this analysis for two reasons [sic], I want to help them; number two it will benefit me to increase my knowledge and number three for my experience for my future prospects or any other*." (IV13)).

In most cases the initial interest was related to several stages in the volunteer's life:

- Early childhood – when future volunteers were first introduced to the enjoyment of nature by their parents, families, and educators
- Adolescence – working toward building a future career or studies that were ecology/science related
- Adulthood – establishing their career, creating reputation, and fostering personal relationships

For some volunteers the initiation into the ecological field was done early in their childhood, either by parents or educators ("*From childhood my father always took me to morning walk, then I observed lot of wild animals, trees…. He teaches me a lot, my grandfather also taught me a lot, not tradition but everybody aware about different wildlife, animals, etc.*" (IV16)). Those who were initiated by their parents came mostly from rural communities in which the relationship between their community and nature was robust, and natural resources were heavily used by the community (e.g. fishing, hunting, gathering of plants or medicinal herbs). As they were growing up, they followed in the footsteps of their elders and became, or were expected to become, interested in broader aspects of ecological relationship with their immediate environment. In other cases, an official job or profession, that is related to ecology was seen by the volunteers' community as an opportunity that would push the volunteers onto higher social strata. The role of parental initiation in ecological activities was also considerable within the group of urban, upper class, volunteers. However, it manifested differently: here volunteers did not necessarily maintain an everyday relationship with nature as a way of sustaining themselves, but saw nature as either an important societal resource or as something to enjoy, a hobby ("*They said 'this is a nice hobby, you know, but you can't get a career out of It'*." (IV13)). Educators had a role in initiating interest in ecology as well: where educators, mostly in primary and secondary schools, were involved and effective in the volunteer's upbringing, volunteers were encouraged to participate in projects that would offer them social and professional advancement opportunities ("*Most of the students are walking with the[ir] career in their mind… for most of the students, girls or boys, first they think about their career, they think about a big career due to their parents*." (IV16)). These volunteers were very calculated and well-planned in the projects they chose: these projects could not be just "interesting" but had to have some properties that could be translated into a personal benefit, whether in building a stronger application packet for university studies, or as a way of finding a paid job. As such, they preferred structured projects that were supported by formal institutions (e.g. NGOs, universities, government institutions) over grass-roots projects that offered them less in the long run.

Some volunteers began their involvement with collaborative scientific projects when they were in secondary school or before they applied to university. In these cases, chance opportunities to be involved in collaborative scientific projects were the primary way for these volunteers to become involved. The project could be mundane, even boring, but the value it offered was in adding a line to their CV, creating reputation, and building their status within the relevant scientific community ("*After I finish my master's I will try to pursue a PhD in ecological field… so for now I think some exposure like how people work, what is the approach of people, attitude of people and what are the conservation issues I need to address, these are the things I need to be aware of. These don't just come by reading a book and giving examples, so that's the reason why I participated in these kinds of projects*." (IV22)). In some cases participation in collaborative scientific projects built up a more general interest in conservation and ecology, in others it was seen merely as a tool. In all cases volunteers emphasized the importance of reputation building, and their selection of projects that would best serve their interests in the long run. However, many places in India do not offer a large selection of volunteering projects, so volunteers had a limited selection from which they could choose. In these cases they were inclined to choose a project that would best lead them to future opportunities involving known researchers or institutions.

Many volunteers mentioned personal connections and relationships as an important motivation for their decision to join (or pass) a project. Personal relationships that were built through participation in collaborative scientific projects were seen not only as a benefit in and of themselves, but also as a valuable asset when planning their future ("*You get to meet new people, not only on the mailing list, but also during the outings. Then you make new friends and they're from different backgrounds, especially considering the particular people involved*." (IV5)). They saw the personal relationships they forged with leaders in relevant fields as an honor and were extremely proud in their becoming an organic part of the collaborative team. This was especially notable in the Bangalore birding group, which was comprised of many professionals coming from other fields (mostly high-tech workers) who did not see birding as a career advancement opportunity, rather as a hobby, but one that would be socially appreciated. Being able to claim a personal relationship with well-known scientific leaders in other fields was seen as asset that can be used within their immediate social circle, however removed it is from the scientific community ("*In the workplace, when people come to know that I do go out on weekends, I do go to these different places to monitor and bird watching, they will come to me and tell me, take me the next time you go in there, I'll come with you*." (IV1)). Just like in the case of leveraging their experience in collaborative scientific projects for professional advancement, here personal relationships were used to leverage social status, as scientists were considered by many as influential and high-ranking individuals. This motivation was discussed mostly by higher-class volunteers, which may be due to the cultural norms that dictate the nature of personal relationships among different classes in India, where some of the lower-class volunteers could not expect to forge relationships with higher-class individuals.

5.7.2 Tangible rewards

"People are very poor. They need to have a certain supply of protein and animal meat does have that protein, and to have some replacement for that if they can't [hunt]."

(IV15)

A different type of initial motivation was extrinsic: tangible rewards. This was a fundamental aspect of lower-class participation in collaborative scientific projects: as was mentioned earlier, many of the lower-class participants in collaborative scientific projects were dependent on their environment for their and their community's livelihood. Under such circumstances monetary rewards, or their equivalent in goods, were essential for collaborative ecological projects to succeed. In some cases the monetary rewards were used to offset the effects and outcomes of collaborative scientific projects which minimized the use of natural resources. Lacking any form a monetary or equal compensation, the community would not have any incentive to participate in projects that directly alter their livelihood ("*In the case of communities, you may have to provide some kind of financial assistance, you have to support them, may not have to provide everything, but support them to come up in something, so that they can earn something from that*." (IV17)). In these cases, the monetary rewards are used to fuel the projects and compensate for any loss of resources. They were directed at the community at large, but also at the volunteers. In many cases the rewards are minimal, set by the standard of living in the relevant areas ("*They are not rich, they can do anything for you just for 50 Rupees, they will gather every information for just 50 Rupees*." (IV15)). One example detailed how less than $10 a month was seen as a generous compensation for refraining from capturing highly sought after endangered sea-turtles in Eastern India. In rural communities the equivalent of monetary rewards was also accepted – T-shirts, hats and other project-related souvenirs were highly valued, not only because they signaled that their owners participate in the project, but also because of the inherent value they held in poor communities ("*We provide them with small gifts, shirts, actually you know just 300 Rupees shirt might not be very costly for us but might be you know be very dear to them*." (IV15)). By supplying participants with non-expensive article, project managers and researchers created a two-fold effect – both an outward statement about the existence and importance of the project and a different level of commitment from its participants, who became dependent on the rewards. This action had another effect: many participants mentioned the expectation of lower-class participants of some form of compensation. Without such rewards participation diminished or did not happen. This begs the question whether participants who expect rewards and would not participate in a collaborative scientific project lacking these rewards can be considered volunteers at all ("*For collecting data we are not paying and therefore they are not giving the data, people have changed in such a way that unless they get some money, they won't do anything. It has just become a practice now. So nature loving is something voluntary otherwise it won't work but if you can, if you give money and then asking them to do, they will do for the sake of getting money*." (IS20)). This issue will be discussed in chapter 7.

Another type of reward was funding of volunteers throughout the project, or, in some cases, funding their education. Funding came to be in various ways – from food and lodging to travel costs. In many cases the projects required extensive travel, due to India's enormous size. Some volunteers were extremely interested in the subject-matter of the project, but lacking funding they were not able to participate in it. The availability of funding made participation easier and affected volunteers' long term retention. Although in all cases that were described, an initial interest in ecology and collaborative scientific projects preceded the discussion of funding, participation was – in many cases – dependent on the availability of such funding. Scientists who experienced the difficulty of getting interested volunteers to actually participate in collaborative projects that demanded a substantial time investment pushed for funding as a way of motivating volunteers to engage in the projects. In some cases the funding was directed at volunteers who may later become professionals (students or employees), with the premise of creating long-term commitment ("*Our college is having nearly 15% of students admitted from among the fishermen. That is one of the rarest of the rare opportunity, their fees are completely waived, part of their hostel fees is being paid by the government and we try to give them the maximum support because such people will have more obligation towards the conservation programs or the fisheries program*." (IS20).

5.7.3 Personal value

The motivation of a personal benefit in the form of social advancement or academic/work gain was present throughout the volunteers' participation in the project, and not just when they made the initial choice to join the project or not; however, where long-term participation was involved, the forms of personal value took were more complex. Where no measurable or obvious personal benefit could be gained from participation, the retention rate of volunteers plummeted. For some volunteers, one-time or intermittent contribution was enough to put on their CVs, present as a personal achievement, or be used to initiate contact with influential figures. They did not need more than that, and soon after they reached their goal they dropped out of the project. Similarly, volunteers who participated in collaborative scientific projects only to attain some extrinsic reward (monetary or an equivalent of) continued to participate only as long as their participation offered them the same benefits. As soon as the project did not offer them similar rewards they stopped participating altogether. Things became less clear for long-standing volunteers. When interviewees were asked about the type of personal benefit they sought from long-term participation, they presented a range of motivational factors. Some of them repeated the initial idea of personal gain, over and over again, within the same project or in different projects ("*What do I get out of the whole thing? What is there in it* *for me? And to get the benefits is what you need to tie to this project if you want me in*". (IV2)). But in most cases, the initial personal benefit shifted towards establishing a volunteer's position within the relevant community. The difference between initiation and establishment led to emphasizing different personal benefits at this stage: the advanced steps of reputation-building through recognition and acknowledgement were seen as the natural steps that follow initial participation in collaborative projects, and as the most important factors affecting long-term motivation from a personal perspective. To create noticeable value volunteers had to become a valued part of the project, if not an essential part of it. This required the volunteers to overcome the rigid social barriers that exist in the Indian society between different castes, between different positions and professions, and between genders. This required a lot of effort – and sometimes courage - on part of the volunteers. In many projects volunteers were seen merely as a data-collection "tool", or manual laborers who facilitate the technical aspects of comprehensive data collection ("*So we simply use people to collect data to further our professional careers, so you give us your data. We do everything else and we take the credit*." (IS6)). In these cases, the expectation of going beyond fleeting acknowledgment by the scientists and becoming a natural part of the project, were limited at best.

Secondly, volunteers had to create awareness as to their value. Again, this was uncharted territory for most of them ("*I am just collecting it for him and giving it to him and a part of the... analysis that giving out the thing I wouldn't do it… I am not doing my personal research or research which I am directly leading."* (IV11)). Very few projects offered volunteers opportunities to prove their worth beyond manual labor, often leaving them frustrated and de-motivated. ("*I find that I'm not really motivated to go back and submit* *data, in principle I think it's a great idea but to take the data from me and not give me something in return. I guess it's going to vary from person to person. Personalized stages where they can get something out of just their own data, I think that might really work well from my personal opinion*." (IV7)).

Having a positive reputation was considered by volunteers as the ultimate goal and an important factor in sustaining motivation. Reputation meant that someone noticed the work that a volunteer has done, the data he/she contributed, and the value of said data. Due to the inherent difference between scientists and volunteers, it was often difficult to build reputation in the scientific world. Understanding and accepting this social structure, volunteers sought an alternative ways of building reputation, through various types of acknowledgment and attribution.

Feedback - Volunteers were in constant need of feedback about their work. Feedback was seen as a major motivational factor, one that made the difference between incidental, one-time contribution, and long-term contribution ("*I am just speaking frankly that I don't think people will put their pictures on [a data base] without thinking of any other benefits, of course they do expect some things, like someone saying 'you did good here'*" (IV17)). Yet, despite the importance of feedback, very few scientists bothered with providing it; where they did volunteers appreciated it even more, because of its rarity. Feedback need not be very detailed or complex: a mere mention of the volunteer's name, and the fact that the data he/she contributed will be used for scientific analysis, was enough for most volunteers. Others mentioned more detailed settings in which the feedback included details of how and for what purpose the data will be used as something they were looking forward to getting. The difference between guessing that the data is useful, and actually knowing that the data was useful and was used, was appreciated ("*We used to take part in the waterfowl census, then at the end of each year they would send a report and in that report each participant's name would be mentioned, and we were quite thrilled about it. And they can see their name being associated with the collaboration or data collection, and being quite happy about it*." (IV2)). The word that came up many times during the discussions of feedback was "pride"**.** Volunteers who received feedback, especially when that feedback included a personal address felt more proud and personally connected to the project. Later projects that did not offer such feedback were dismissed as less appealing or interesting to them ("*Recognition is very important. Suppose if a person comes up with something, I mean it can be a new species or something like that… all the procedures and the attention, and it happens actually, so finally the scientists may take half the credit. [and] the person who had spotted the … of course he will feel the disappointment. [These] kind of things happen.*" (IV17)).

Attribution - Volunteers also diverged from the traditional academic scheme of being acknowledged through academic publications, presenting at conferences, or other formal ways of acknowledgement ("*You know it is such a big institute it's very difficult to monitor who is sharing data where, but what, what you do expect is individually every faculty should make sure that if somebody [uses] the data that I have collected, if somebody is using it I should be made aware of it and at least I should be acknowledged*." (IV21)). Though some of them were familiar with this form of attribution, they were also aware of the social and institutional rigidness that would – in the vast majority of cases – prevent it from happening. In the outstanding cases this did happen, the acknowledgment was in the "thank you" section, never in the author's list, even if the role of the volunteers was far more substantial to the project than that of other authors; the cases where volunteers' contributions were attributed to them were seen as rare and not exemplifying the overall pattern of acknowledgement. Being well-aware of this rarity, volunteers offered alternative ways of gaining attribution through project-specific internal reputation mechanisms. One example was having the scientists who use the data notify the data collectors of the value of the data, and creating a mechanism that will support these notifications within the project, creating awareness to their work, and highlighting the value of the contribution made by a specific volunteer. Some volunteers hoped that such attribution will leak beyond the specific project to create broader recognition for them. ("*Just a name and this X and that Y was contributed by this or that person. Something simple thing [sic] is like a big thing for a normal person, this kind of thing make it very personal things, and that way we encourage them all to do it more, and they will be encouraged to go to different place [sic] and find new species.*" (IV22)). Even if this attribution is done only internally, within the project, it was enough to motivate volunteers to contribute more. The tighter the connection between a volunteer and the specific data he contributed, the deeper the effect it would have had on motivating them. Another way to facilitate acknowledgement was through personal meetings with scientists. According to the volunteers, in many cases there was disconnect between the scientists and them, such that they never even met those who use their data. Volunteers appreciated any opportunity to meet with scientists – whether that was in formal meetings where the work was presented; in the field throughout the data collection; or, in training sessions where they were trained in appropriate data collection methods and learned about data quality issues. In this case, the meetings were used to affirm the volunteers' status, acknowledge their work and support their reputation within the project ("*What kind of credit one looks for is something very important… and some people may be looking for their name or some people… may be looking at the data, that is the reason for the whole project, that they can use, some just want to meet and get in touch with the scientists, learn from them that is*." (IV2)). Training sessions were both a need and a motivational opportunity – they could be used to improve data collection and data quality, but also to increase the value of the data the volunteers brought to the project, and – in turn – increase scientists' perception of the volunteers' value. In several cases the volunteers admitted that meeting others and telling them about their contributions made them feel more valuable, and helped them gain recognition from the immediate project community *("[different] fishermen groups face the same problems, but [it is difficult] to unite groups from all over the country because what the guys are doing in Gujarat is so different from what they are doing in Tamil Nadu, but nevertheless they are all fishermen.. together they share their heads together, then there were all this little idiotic things that they would do that would get them to bond and have a sense of [being] a group… we [came up] with interactive training sessions, video film documentation workshop, so I did feel they left with a greater sense of solidarity and community*." (IV13). The meetings also created a sense of bonding and attachment to the specific project and to the other participants.

5.7.4 Volunteers' learning process

> "*If people contributing data have some control over how [the data] is used, I think if that's made clear to people that might encourage people to really contribute a little more*." (IV7)

A different motivational factor affecting long term participation related to the data the volunteers collected. Some volunteers expressed a wish to have open access to the data they contributed, for various purposes, such as creating and maintaining reputation and status, but also as a way of extending their knowledge beyond the participants in the project, to broader audiences.

As volunteers' interest in ecology and biodiversity increased throughout their participation, many sought opportunities to publish their data online through personal or collective blogs or websites (the Bangalore birders' website http://bangalorebirding.blogspot.com/, the Himalaya Initiative http://biodiversitymedia.ning.com/profiles/blog/list?user=0fnqwsd72me7q, and the India Tiger Blog http://blog.indiantiger.org/ were some of the examples that were brought up), or even share it freely by creating online platforms to do so. Self publications implied recognition of the volunteers' knowledge and expertise, and highlighting the value of the projects they participated in ("*You know what the recruitment rate was? The response? Hundred percent. Hundred percent. And this surprised me. Because nowhere in conservation [do] you get a hundred percent response. And we got a hundred percent response and the success rate was because of only one thing: we put the full framework and our data out on a platter. Anybody could copy and it was circulated with a note that people could copy it*." (IV2)). Here, they faced a problem: while data such as photos can easily have multiple copies that can be used for various purposes, entries in data sheets (or electronic databases, where such existed) were not easily copied for personal use. Such databases/data sheets were exclusively accessible to scientists, maintained by scientists, and the data entry was made in such a way that once an individual datum was entered the volunteer had no way of accessing it (even changing erroneous entries was a cumbersome process); in many, if not all, projects, once the project ended volunteers had absolutely no chance of gaining access to the data, as all ties with them were severed by the scientists ("*In most cases the people who contributed the data actually didn't have a copy of their data because they sent it to their organization and it was combined [with other data] and disappeared*." (IV11)). Moreover, many scientists regarded the concept of open-access, whether to raw data or to analyzed one, as unwanted and unacceptable. They viewed all data, including that collected by volunteers, as their property that could only be shared under very strict conditions, and only after they have exhausted its use and published all they could get from it ("*Suppose I am doing one project and there are many people involved OK, not a problem. But if it is overall my project and some other people are volunteers I would like to keep the data to myself. Suppose I have a data and conservation skill it needs to spread so that people know about it, then of course it is accessible to all, people will come and use it, yeah, you can use it for your own work, not for publishing. But if it is valuable data I am very possessive about my data. I want my data. I want to add some more to it and proceed my work and then I want to publish. It's better not to trust anyone and put it on the web or something*" (IS20)). Where mechanisms for data-sharing did not exist, volunteers felt that their work is important only insofar as it applies to the research of a particular scientist, and became frustrated

(“*I’ll get nothing out of it and you’re going to get immense funds from whomever and you’re going to fly around the world while here I am going to contribute so much data to you*.” (IV11)). Enabling data-sharing was understood as a message to the volunteers saying ‘we value your contribution as more than just manual labor’, creating a sense of pride and accomplishment among volunteers, and a leading to long-term participation.

It should be noted, that unlike the pervious motivational factor that related to personal benefit, this issue was discussed only by a specific group of volunteers – students and seasoned volunteers (mainly from the Bangalore birding group). It was not brought up by others, perhaps due to the fact that they were less experienced or because not everyone expects equality in data sharing or see value in having access to their data.

5.7.5 Ease of participation

> “*Initially everybody’s enthusiastic and with time participation level keeps dropping down. It’s a very small percentage that continues giving information*.” (IV2)

Many participants emphasized time constraints and ease of participation as major de-motivational factors, and related them to the high attrition rate they reported (retention rate was estimated to be around 10%-20%). Where a collaborative project required volunteers to spend long periods of time entering data or organizing it, and where this process was cumbersome or took away their free time or the time they needed to spend in their workplaces, they became reluctant to participate in it, and slowly dropped out of the project (“*What these collaborations demand [is]one of the most important design [issues] because, again, it depends on how much time I have to contribute to this project. The best thing is where I can just log in a few seconds or minutes the information that I want to* *pass on and I'm very happy to do that, but if I spend about hour or two to even send a particular record and all the details, maybe I want to take a rain check…[I want to spend] as little time as I can. [If] it's going to impinge on my own work time, that's something I don't want to do*" (IV12)). Projects that offered solutions for the time-commitment issue, whether these solutions were based on technology or on an alternative process (such as breaking tasks into small, repeated time-increments, and positioning them in areas that are close to volunteers' workplaces or homes), were valued higher by volunteers, and affected their retention rate ("*It should be rather as far as effortless, it should not spend too much [of] our time trying to key in the data as something that… if you can make the query forms of the data input very simple… that should be very, very useful*" (IS2)).

5.7.6 Community-related motivations

"*Environmental education I see it like kind of drugs, you know, I had [to] inject [sic] into the kids, catch them young from that day, you have to inject that kind of drug or something. They will never be able to go away from this and they will never be able to do against nature." (IV17)*

For long-term volunteers other motivations that extended beyond the self surfaced. These motivational factors related to the effects the collaborative scientific project had on the local community from which the volunteer came or on the community in which volunteers worked. However community-related motivations had to be preceded by some form of personal benefit. In some cases temporal precedence of personal benefit to collaborative or altruistic motivations was not enough, and volunteers had to see a continuous personal benefit combined with the latter community-related motivations, in order for the long-term participation to happen. Lacking some personal benefit, community related motivations were not enough to warrant participation in collaborative scientific projects.

Community empowerment - The umbrella term under which all community-related motivational factors can be grouped is the concept of community empowerment, meaning that the local community regains and increases its control over what is happening in the natural world around it. In the context of community empowerment as a motivational factor most volunteers referred to education and policy changes as the primary themes that motivated them, while only a few referred specifically to creating awareness of ecology and conservation issues, and to formally building grassroots initiatives.

Education – Many volunteers noted the disconnect between local communities that rely on nature as their prime source of food and income, and their knowledge of ecology and science ("*There is always a gap between the researchers and [the] general public so then whatever research they get, the scientists just… it's like it's not reaching the public, they are unaware of the things that are happening in the country, this gap should be filled, actually*." (IV17)). Through collaborative scientific projects they wanted to bridge this gap and make the formal scientific knowledge accessible to the locals. And, in some cases, synthesize formal knowledge (which is highly respected and trusted) with indigenous knowledge (local traditions generated in the field and passed on from one generation to the next), to create a deeper body of resources that can be used by locals and professionals alike, with the needed adjustments for either population. Education of local communities was also seen as an opportunity to engage younger kids (i.e. school age) in meaningful learning that they will "take home" with them and slowly affect their parents as well; as one volunteer defined it: "C*atch them while they're young, and the family will follow*" (IV5).

Although only a few volunteers mentioned this explicitly, the implicit assumption was that the overall purpose of any educational effort made by volunteers was to create awareness: to nature, to the dangers the various natural resources and elements faced because of human overuse and abuse, to the needs of the community as it acts within nature, and to creating a more caring community. Many volunteers saw educational efforts as something they "owed" the community, and especially in two cases: if this community was the community in which they grew up or lived or if this rural community was extremely different in terms of socio-economic status. In several cases educational opportunities were found in formal learning settings such as collaborating with local schools, and coming into the class to teach about various aspects of science, ecology, conservation, and sustainability, ("*We had started a small team and our main idea was to educate. I tried to bring as many students as possible. So we used to go up to different schools, and for three years running we had conducted a program [called] "in the spirit of Gaya", and we have [sic] more than 50 schools participate*." (IV5)). Yet, in most cases, education happened in informal interactions in the field while data collection ensued. Since many of the locals, especially in rural communities, were dependent on the natural resources surrounding them, chance meetings and interaction while volunteers were collecting data were inevitable ("*I get an opportunity to meet with community people, and also in my area go to people and to look at the changing perceptions and what are the perceptions that they are having, problems that they are facing actually, indeed, because in many conservation activities we often tend to forget that they are the* *people who are living in and around protected areas. If their requirements are not met, they will of course use [it] again and again, legally or illegally. They are not educated, they are not properly counseled, if we will tell them don't kill, they will stop for one month, after that they will start again.*" (IV15)). Many projects were not originally planned to address such encounters but this informal rapport enhanced the sense of purpose volunteers had, and acted as a strong motivator to enable long-term participation of volunteers in collaborative scientific projects.

Awareness – An important role of that informal education was not only to deepen the locals' knowledge of formal scientific principles and data collection methods, but also to connect these abstract concepts to locals' daily lives. Polluted waterways that were previously used for fishing, over-harvesting of sea-life, killing of large mammals that threatened the local crops, and hunting and trapping of endangered species, were all practices that were popular among various communities for many years. And while these practices made sense locally, and were supported by traditions, they made conservation difficult. Several volunteers saw awareness raising as an ancillary duty they hold ("*Making them understand really works wonders but once you tell them that the land is not theirs [because of land rights] they actually get furious. OK. They will listen to you everything that don't kill, don't hunt this, they say OK OK OK, but once they should [sic] hear lands' rights they will get furious, so what, I think community education is [a] must, then the people, those people, they are not educated [so] how can we expect that they will not do anything bad?*" (IV15)). However, raising awareness was not a simple task, and several times volunteers felt defeated when local traditions overcame their awareness building efforts. In the few cases they felt that they, indeed, managed to make a change, it acted as a strong motivator to continue their work with locals.

Advocacy and policy change – Several volunteers mentioned civic engagement as the next natural step for an educated and aware community. The idea of social change translated into advocacy and a push for policy adjustments. This could be accomplished through grand projects, like advancing major policy changes through petitioning the local or central governments to establish sustainable practices ("*For nine years we were out counting birds and plants, and that is one thing I do because it helps us understanding …because the benefit that we got is that it made us be more available to the species that we are looking at. And as the habitat reclaim system. And that information has come very handy in fighting legal battles so save those wetlands and the planning, designing, conservation of wetlands and those aspects*." (IV2); "*Our later concern was to get as much data as possible so that we can convince the government to do something [about the bird species]… so we were bringing it back to them [the community] so they can process [the data], after that we are seeing government action that came out of that report. So that kind of result is what you like to see*." (IV5)). However, most volunteers who discussed civic engagement and policy changes did not aim that high. They did not actively push towards action, but saw their role as facilitators of awareness towards civic action ("*By participating people feel a larger sense of our mission… and it would slowly hopefully gradually effect change [so] that the more and more people feel a greater sense of ownership of the natural world*." (IV6)). Their motivation stemmed from the knowledge that they can empower the community by offering it tools to better understand external processes and effects. Where actual change took place, volunteers felt rewarded and were motivated to extend their participation in the collaborative project or engage in other projects. Even when the volunteers did not see actionable outcome from their involvement with the local community, but felt that they provide the community with relevant tools, through education or by creating awareness, it acted as a strong motivator towards long term engagement.

5.8 Culture

> "*This is really hard to bring cohesion too, because in India you have differences in language across different states ... They are probably composed of different people from different castes and backgrounds, different ethnic backgrounds, religion not so much but definitely caste and backgrounds, different ethnic backgrounds. To get them to bond with each other is really hard"* (IV12).

Cultural diversity in India is immense. The size, population, and variety of religions as well as the caste stratification in India make for an extremely heterogeneous society that reflects various cultural practices and understandings. When looking at motivation and the way collaborative scientific projects are shaped, the role of culture cannot be over emphasized – from the data it became apparent that India was not a culture that encourages collectivism and volunteerism, especially not when these efforts pertain to greater good of the Indian society as whole, and not to the immediate community or locale, as is the case in many collaborative scientific projects ("*We don't have a culture… the culture in our country hasn't developed off volunteer participation. Volunteering generally is very rare in India for anything, but I think it's one of the things that goes into positive feedback but we haven't reached that stage where it's obvious to people that, yeah, of course, I'm doing that. It just takes little more of my time and there's a huge* *value addition to that. And so people are thinking more, I think, in terms of what they get out of participating than perhaps in some other cultures where that culture is more highly evolved and more widespread. We haven't even taken [sic] the first step just to get people interested in putting together their efforts in the first place*." (IV6)). Personal benefits from data stewardship, and keeping data to oneself were prevalent practices, while sharing information was not credited or appreciated ("*The culture of attribution and crediting of source is not always reliable, this can be discouraging*" (IV17)). This led to difficulties in recruiting participants, and in maintaining their participation for extended periods of time. Another aspect that contributed to that was that in many rural areas scientific literacy was minimal, often leading to misunderstanding of the roles of participants in collaborative projects and to the delivery of erroneous data or sharing data that should have been attributed to others. The most prominent themes related to culture were social stratification, trust, language, and institutions, which will be discussed in the following sections.

5.8.1 Social stratification and hierarchy

"*I am sure you will notice that somewhat hierarchy of society so people won't often express [their feelings]*" (IV13)

Indian culture is based on a strong sense of social stratification that affects every aspect of life, including the roles individuals took within collaborative scientific projects, and the relationships between participants. Some of this surfaced in the distance between scientists and volunteers, where scientists were seen as those with true knowledge, holding the absolute truth, although volunteers – and especially those who come from local communities located in the studied areas – were the ones with the indigenous knowledge that was often more accurate and relevant than the theoretical premises of professionals ("*There's been a friction also in the professionalization of ecology in India until two decades ago. Most people who worked in naturalist ecology were amateurs. Certainly the Brits were all amateurs. The policemen, the postmaster general, they did these things on the side. So actually [in] that culture often an informed amateur, an enthusiast, an amateur enthusiast was very strong. Once these things had been professionalized, and, I should put this on the record, that professional ecologists in my field have not done themselves a service in their interactions with amateurs because there's a strong feeling that we're the professionals and we know what's what. And you're an amateur and you don't, and so an amateur including what I call pro-amateur, and they want help or resources or access to libraries of collections they will deny us because you are an amateur. And, that leads to a tremendous amount of ill will. So, there's been this division, this suspicion between professional ones and amateurs, of course professionals don't think they need amateurs and amateurs have been bitten*" (IV6)). Stratification had other aspects as well: individuals with seniority (whether coming with age or professional titles, such as a well-known expert in a specific area) were highly regarded, and their approval of– or better yet, participation in– collaborative scientific projects made these projects more respected, and valued by volunteers and scientists alike. Seniority was present in the relationship between scientists and volunteers, in the terms that they used ("*I am just the ... the apprentice*" (IV12)) and in their practices ("*I have to take the permission of my seniors*" (IV19)), but also in of personal opinions and findings if these did not match those wanted by individuals from higher status.

Social stratification was present in more traditional ways as well: many of the scientists and volunteers saw locals as coming from “backwards classes” or “commoners”, derogatory terms that repeated throughout the interviews and were meant to distance the speakers from lower castes and locals. They often admitted that they needed locals for collecting data and making sense of local occurrences (“*Whatever conservation we want to achieve, at least in a state like Kerala where it is thickly populated, unless there is participation of stakeholders or the people are residing around we cannot do anything, we cannot protect*” (IV9)), but at the same time kept their distance from them and made sure that the social hierarchy was meticulously kept.

5.8.2 Trust

“It’s not about fully trusting them but we do go into that area and actually… cross checking, cross study is always advisable.” (IV12)

The Indian culture calls for a categorical distinction between professional scientists and those who are not. This distinction creates an inherent sense of distrust, since scientists see volunteers as lacking expertise, and suspect their practices and their motivations (“*Why is he showing his interest so much? He is eager for his fellowship money, than I have to think 100 times, but if he is eager for the knowledge he wants [sic] to gather, than most welcome… undergraduate level professional interest is good but not so much good, if undergraduates, if he or she does not have any personal interests so he or she cannot do that. Professional is needed in our daily life, it isn’t necessary everybody is a professional but the professionality should have a limit*.” (IS14)). The volunteers, on the other hand, sense this suspicion and at times feel demotivated because of it (“*It is wrong to think that if you give them [volunteers] more freedom they will not use it properly. Its* *true sometimes they don't but you need to, it's up to you now, that is why you are the supervisor*" (IV1)).

This inherent distrust reflects on how data is collected, validated and shared. Scientists often recognized skewed data that volunteers delivered as being the result of limited knowledge of research methods and data collection, but also as an outcome of cultural practices that are meant to appease higher ranking officials or those who are perceived as coming from upper castes ("*It's very difficult to know what's going on in the mind of the person who is responding now… it is …. Some of the respondents before you ask the question they know what to say the next question is going to be, they are enough smart now so certain times… certain number of times I have seen that some of the responses are actually… may not be actually true. They may have 6 kids but they just say 3 because they don't want to say that they have so many kids*" (IV21)). Similar stories were shared by the majority of the scientists, and some volunteers, and were the ultimate reason they suspected, and needed to validate, any data collected by local volunteers. But this distrust was broader and extended to students who were supposed to be well-versed in research methods and data collection ("*If you send students and without judging them properly before you are accepting that there may be some cases of manipulation about things, those things come because I have seen people doing that kind of thing. I mean it matters how much conscience, how much responsible you are*" (IS19)). Volunteers felt unwelcome, and that their role in the project was reduced to manual labor, both aspects diminishing their motivation ("*Scientists are determining the research question, handling the protocol, citizens probably won't do that. And, the scientists, again, crunching the data and going back and forth saying "these are the projects". It's not very realistic in* *many cases to expect everybody to participate in all of these actively, but there are actually some amateurs whose training along the way, and whose interest has made them good as any scientis*t" (IV6)). On the other hand, many scientists could not see the value of working with volunteers to improve trust, due to the strongly hierarchical nature of the Indian scientific community and the distinctive difference between professional scientists and all those who are not. Facilitating trust between scientists and volunteers seemed to be one of the most difficult barriers to overcome, on both the practical and the motivational levels. The lack of trust affected volunteers' motivation to participate in collaborative scientific projects, and where trust was not built with time it led to a high attrition rates.

5.8.3 Language

"*There are people who cannot understand English, especially when it comes by itself, so we try to collect both names… people will go more and learn if we use common language…*" (IV5)

There was a broad agreement among interviewees as to the importance of engaging locals in collaborative ecological projects ("*I really don't believe that conservation will be a success without the help of these people. That is the most important thing …. You have to get all the knowledge about everything [about] that habitat*" (IV17)), but also in regards to the difficulty of doing that. When scientists and students ventured into local communities they often faced innate cultural barriers that affected their success in carrying out their project, due to the wide diversity of dress codes, gender roles, religious beliefs and practices, greetings and etiquette, and most of all – languages. India has 18 official languages and at least 122 recognized local dialects, and over 1500 mother tongues. The primary official language is Hindi, with English a close second. However, the prevalence of these languages is mostly within the large cities and central India, while languages in rural areas – where most of the collaborative ecological projects take place – are local and varied. The range and diversity of local languages and dialects make it difficult to permeate local communities and engage them in the projects, especially for those researchers and volunteers who are not local ("*They [locals] have been difficult to engage. I'm not entirely sure why that is. I think one of the reasons could be that there is no one in that community who is within that group who is their spokesman in a common language so it's been difficult for those of us who are not Malayam speakers to engage with them"* (IV13); "*The most appropriate Indian language usually Hindi reaches most people and sometimes we need Tamil translation as well. We do translation in the main language. Language might be Hindi unless of course the speakers are not used to speak in Hindi and then you know most people get it… a secondary English perhaps … and sometimes we mix some languages sometimes my Hindi is not particularly good but sometimes I say one sentence in Hindi and the next one in English and words here and there*" (IV13)). Language differences did not only create misunderstandings and problems in data collection, but also led to suspicion on the part of the locals and to problems in creating rapport and collaboration. Some scientists and volunteers who were not local attempted to create relationships with locals by slowly building trust through getting to know them, wearing similar clothes, and visiting their homes ("*The first 2 months we are actually just talking to them, sort of going to their house, having a cup of tea, sometimes we invite them to our place … So this starts from the very beginning and in between if somebody leaves… the villagers they don't like it because they are so* *comfortable with that person*" (IS21)). However, many scientists ignored this issue and did not attempt to make any adjustments needed to overcome linguistic barriers; quite the contrary, they purposefully used uniform scientific taxa and not common names, ignoring local cultural sensitivities.

5.8.4 Bureaucracy

"*One thing in India, unless you are a part of the government or a government institute, it's very difficult to get access to all the existing data as well as to carry on your part because you need a lot of permission, and you need to have a backing*" (IV4)

Collaborative scientific projects were portrayed by many of the interviewees as a prime example of what an open and democratic society should strive for. In real life, though, the bureaucratic nature of Indian society placed many constraints on initiating and facilitating such projects, leading in many cases to frustration and de-motivation of the participants, and to a substantial attrition rate throughout the project. Some of the examples that were given were: lack of access to government documents that were essential in designing and implementing collaborative projects (the Indian Right of Information Act had to be used in order to get data from the government in most cases, as government officials were reluctant to share information that was supposed to be in the public domain); the hierarchical and complex structure of the Indian government – comprised of local officers (e.g. 'block developing officers'), local governments, state governments, and country (i.e. republic) government. Getting a project approved by all the necessary agencies could be a long and cumbersome process, that could take more than six months, at the very least, and sometimes much longer, causing difficulty in recruiting participants and retaining them throughout this time ("*Your application would be sent out to the ministry or department in Delhi and only when they cleared it the state department would, with the volunteer group that doesn't necessarily happen.*" (IV13)). This was attributed not only to the complexity of getting governmental licenses, but also to "*the government laxity and the government officials*" (IV15). The only exception to this was when the project was somehow associated with the government, or when the organizers of the project had some connection with government officials, which could be based on a previous personal relationship or institutional affiliation.

5.9 Technological barriers

"I don't think technology is a bad thing as long as I can control the technology... technology will never be biased. You can't just depend on technology, you should also know what's happening and then you use the technology to help you in saving your time or energy" (IV21)

Technology intertwined to a great extent with both practical implications and cultural ones. Many collaborative scientific projects that focus on ecology make use of technological tools for a variety of purposes: from stationary cameras trappings used to capture images of animals on the move and document abundance, the use of GPS for exact location depiction, to abundance maps overlaying on GIS data maps, to dedicated databases and checklists for identification. But when interviewees discussed technology they meant simpler things: the ability to use a computer, a camera, or a phone, and the ways that affected motivation.

Scientists saw themselves, and were seen by most volunteers, as being tech-savvy, advanced in their use of various technological tools, from basic internet search to complex database and statistical analysis. At the same time, many volunteers were not offered many opportunities to use advanced (or even common) technologies. The expectations of scientists for volunteers to have the same skills and familiarity with technology as they had, caused many volunteers to be hesitant and wary about what they were asked to do ("*We are not technically expert with that, it deals with softwares [sic] and techniques which we might not be trained in. You have to be technically very sound and have to have some kind of good training and practice after*" (IV12)). Interestingly, in many cases volunteers over estimated the tech-savviness of scientists, and saw them as highly versed in the practicalities of using various tools, where the case was more complex: many established (and older) scientists were not proficient users of advanced tools (such as databases and statistical analysis packages) and relied on antiquated technology ("*That whole thing [project] was done on two floppy.. three-sixty K floppy system and all the PCAD, not even three-eight*" (IS2)), leaving advanced tools to their (younger) students and urban volunteers. This became even more evident when scientists discussed their perception of rural volunteers: somewhat correctly, they saw rural volunteers as having very little exposure to technology, and therefore having almost no technological skills – leading many to see rural volunteers as less competent for their needs, and less valuable to the project as a whole, broadening even further the inherent gap between the groups participating in collaborative scientific projects.

A broader issue was that of the technological infrastructure available across India, and how it affected participation. Many urban areas in India are networked with broadband internet infrastructure. Rural areas, on the other hand, are remote and far less networked ("[*we*] *don't have email connectivity, sometimes even the phone don't work. Basically the Sikkim, south Sikkim, when we were doing this study cell also doesn't work, so we had a lot of problem with connectivity*" (IV21)). In urban areas participants tend to digitalize their observations during their outings (using smartphones or uploading notes online), while in rural areas participants emphasized the role of mobile phones, which are prevalent and that of texting (which is free of charge in most of India) as the prime mode of communication in collaborative projects. Projects that did not facilitate texting as an inherent mode of communication and relied on more advanced technology, lost many potential participants, and more than that – miss a lot of available data ("*60% don't have access to internet, and about as many people don't know what is computer actually… about 90% I guess, huge percentage. Leave the town and apart from town you don't have a cyber café. It's best to have a center with number of homes where people can sms so that they don't have to spend their money on the phone because now sms is absolutely free.*" (IV15). The flip side of that was that much of the available data was collected on paper, and in many cases was not digitalized (hence, it was not available beyond the immediate team members). One exemplifying case was an exchange between the interviewer and the interviewee regarding data storage:

Interviewee: We had to get sheets, we had to get exact location and the type of animal and then punch on the sign…evidence. It can identify the specific leopard, tiger, the difference.

Interviewer: so you kept all the data together in a database?

Interviewee: we kept them in a [sic] office.

Interviewer: you took the data down on papers..

Interviewee: yes, the datasheets and also the scat bag, and…

Interviewer: and them someone would transcribe it into the database?

Interviewee: no … we just put all the data in the subject tray and collect it [manually] (IV16)

This scenario repeated itself, and in many cases the data was left as hardcopies, waiting to be catalogued. For volunteers, the latter option made it difficult to see the value of their work and the data they contributed and caused some frustration, but since many of them were used to the slow and belabored processes of obtaining data from many Indian institutions, the lack of immediate gratification associated with online postings was not too prohibitive.

5.10 Summary

This chapter discussed the way motivation and culture affect ecology-related collaborative scientific projects in India. The two examples of the Bangalore birding group and the YETI conference highlighted different communities of participants in collaborative projects, comprised of scientists and volunteers, who may be students, individuals passionate about the subject matter, and locals. The range of motivations for each group is different. Initial motivation across groups came from a personal benefit or significance to the individual. Social mobility was also an important motivator, and was supported through initiating valuable relationships and creating reputation. For some locals, the range of motivation was slightly different and emphasized extrinsic rewards, such as payments, tangible assets, and funding. Initial motivation turned into continuous motivation where personal benefits advanced to include recognition within and outside the scientific community, and an inclusive learning process based on data-sharing, and, for some populations, extrinsic rewards. To attain continuous involvement, collective goals needed to be combined with personal benefits. Discussing continuous collective goals, volunteers emphasized the themes of awareness, education, and community empowerment. The chapter ended by discussing two ancillary issues: the role of culture in creating motivation; and, the role technology has in shaping collaborative scientific projects and sustaining motivation, specifically within the unique settings of India.

Culture, and specifically the way hierarchical social structures, language, local practices and trust facilitate (or hinder) motivation, had both an explicit role, in getting scientists and volunteers into the field, and an implicit role in enabling them to deeply interact with locals and obtain all the contextually relevant data from that area. Lacking a cultural understanding, or gatekeepers who would facilitate this access also affected the level of motivation participants in collaborative scientific projects had. Technology had an intricate relationship with both motivation and culture, sustaining existing power structures and affecting the ease of participation, therefore influencing motivation implicitly.

6 Case study - Costa Rica

Costa Rica is one of the smallest countries in the world (51,100 sq. km (State, 2012)) , with a relatively small population (just over 4 million people), but with one of the world's richest biodiversity areas (4% of the world's species inhabit Costa Rica), and one of the largest systems of protected areas in the world (more than a quarter of Costa Rica consists of various protected areas). Although the role of natural areas is a national asset that can be harnessed to sustain local communities has been noted since the 1950s, the land was overused until the 1980s. Through aggressive deforestation, the rain and cloud forests were uprooted in favor of coffee plantations and cattle grazing grounds. In the late 1970s, the intervention of local and international organizations in favor of conservation took an interesting turn; they did not only campaign for nature conservation for the greater good, but also showed the Costa Rican government how the local economy would benefit from conservation and eco-tourism. The government began subsidizing individual conservation efforts, leading to the creation of privately owned natural sanctuaries and reserves side by side with publicly held ones. That, in a addition to the dedication of funds reallocated from the defense budget and the growing governmental push toward ecologically sustainable practices, including support for collaborative scientific projects focusing on biodiversity, has made Costa Rica one of the world leaders in sustainability and biodiversity-based policies. It has also made Costa Rica a rich "testing ground" for various types of collaborative scientific projects that involve different populations in various roles. The variety of projects and participants gives rise to questions about what motivations encourage and support engagement in collaborative scientific projects, and especially long-term engagement. This chapter will discuss these issues.

6.1 Communities of participants in collaborative scientific projects

The heterogeneity of conservation efforts affects the way collaborative scientific projects take place in Costa Rica. In other countries, most collaborative scientific projects are led by academic scientists who seek volunteers as data collectors or field workers, and few projects are the result of individual initiatives led by lay people or NGOs, but here, the case is different. Since many reserves and natural areas belong to private people who have a vested interest (economic and other) in keeping them thriving, many collaborative scientific projects originate with individuals as the initiators and participants. Since many of these individuals lack formal scientific education, they rely on various NGOs, academic professionals, government agencies, and educational initiatives to actively support and facilitate collaborative projects. Indeed, many collaborative scientific projects taking place in Costa Rica devote a significant portion of their effort to educating locals and foreigners about issues ranging from biodiversity and conservation to the basics of scientific methods for data collection and analysis. The mix of organizers and participants is reflected in the interviewees whose characteristics and responses are discussed in this chapter.

6.2 Costa Rica interviews

In contrast to the interviews conducted in the United States and in India, in the Costa Rican interviews, it was difficult to distinguish interviewees according to their profession or their education level. Some organizers of collaborative scientific projects were indeed scientists; others were government or government-supported-NGO employees, others were commercial vendors (e.g., representatives of ecotourism hotels, travel outfitters), and the final group was composed of locals who had some connection to nature –

farmers, owners of natural reserves, or individuals who were interested in nature as a hobby. Participants in the projects ranged from school-age children, to college students, to tourists interested in a specific species or geographic area, to locals. Similarly, the projects ranged from scientific data collection missions, to educational programs, to active efforts to save a particular species. This led to a variety of collaborative scientific projects, especially considering the size of the population and the country. The most important difference with respect to Costa Rican interviewees was the lack of rigid barriers between scientists and volunteers, or participants (this will be discussed in section 6.3.5) Therefore, the interviewees for this chapter come from four groups: individuals who initiated collaborative scientific projects; participants in collaborative scientific projects, who may or may not hold a scientific degree; educators; and representatives of NGOs which support collaborative scientific projects. It should also be noted that some of the interviewees took part in several collaborative scientific projects simultaneously or consecutively, others in their capacity as organizers or principal investigators, and some in their capacity as volunteers, making the distinction even more difficult. Therefore, their opinions are described in the context of the specific project in which they were given, and not as representative of a "volunteer" or "scientist" opinion.

Nine interviews were conducted between September and November 2012. Two of the interviewees held formal scientific degrees (either in biology or in a related field), two were working towards a Ph.D. degree in ecology or biology, and the other five either did not hold an academic degree or had a bachelor's degree in an unrelated field. Among the nine, two worked for NGOs that led collaborative scientific projects, two worked for privately held reserves or eco-tourism businesses, and one was an enthusiast who built her own rescue program. The others were scientists and students at the advanced stages of their studies. Most interviewees were engaged, in one way or another, in educational efforts. Four of the interviewees were women and five were men. All interviews were conducted over the phone or via Skype. Most of the interviewees (6) spoke English; where an interviewee indicated that his/her spoken English was not fluent enough for an interview, the interview was conducted by a Spanish speaker versed in the Costa Rican dialect, who later translated the interview to English.

It should be noted that unlike the interviews in the United States and in India, the interviews in Costa Rica were not preceded by the analysis of quantitative data. A similar survey to that which was conducted in the United States and in India was deployed in Costa Rica, but the response rate was so low (29 participants) that it did not warrant statistical analysis. Therefore, this chapter is based solely on qualitative data.

6.3 Motivational factors

Costa Rican interviewees presented a very different motivational process than that presented by interviewees in the United States and India. Here, as with other countries, in order for a volunteer to join a collaborative scientific project, an initial motivation had to surface and dictate the individual's action; however, for the majority of Costa Rican interviewees, this initial motivation was not related to a personal benefit, but rather to an altruistic/collectivistic factor. Interviewees saw biodiversity conservation as something that all "ticos" (the local term for Costa Ricans) should strive to do as a collective goal. This view guided their initial interest in collaborative scientific projects in general, and specifically in those projects that had an effect on their local community or aligned with their personal interests. Other motivational factors, such as personal benefit, came into play concurrently or at a later stage, but were not what drove the interviewees to participate in collaborative scientific projects in the first place. It seemed that the impact of culture coupled with the role the educational system played in creating a robust, conservation-oriented community was significant. This section will discuss motivation in a slightly different order than that of previous chapters: first, the roles of culture and education will be discussed, and then the way various independent motivations affect the Costa Rican population, in the order in which they unfold throughout the participation cycle. That said, the collected data has shown that it is extremely hard to distinguish between the roles that culture and education have played in affecting Costa Ricans' attitudes towards participation in collaborative scientific projects, as the two were often tightly intertwined. This is not surprising, given that cultural support of educational efforts is necessary for the latter to bear fruit, and educational efforts are needed to change cultural perspectives. The separation between the two in this section is somewhat artificial but is needed in order to distinguish between actions (i.e. educational programs) and causes or effects (i.e. cultural perceptions).

6.3.1 Culture's role

"*We are all influenced by the green culture of Costa Rica*" (CR3)

Biodiversity conservation was emphasized by Costa Rican governments for more than 40 years. The official reason was fiscal: the country saw eco-tourism as a revenue resource that distinguished Costa Rica from its neighboring countries. However, beyond monetary benefits, conservation was touted as a way of extending local natural resources in a way that allows various populations (farmers, workers, lower and upper classes) to benefit almost equally from these resources. To do that, and instill the sense of ownership and need for careful stewardship of these resources, a major cultural emphasis was placed on bringing people closer to nature, not only as a resource to be used, but also as something to be proud – and careful – of. The cultural learning process that brought Costa Rica closer to nature was done in various ways, from formal teaching though the educational system (see Section 6.3.2) to informal ways in which the collective importance of protecting natural abundance is emphasized. One prominent example offered by the interviewees was the dedication of monetary bills to various species, so that they appear everywhere and are therefore inscribed into the collective memory as something that "is Costa Rica" (Figure 6-1). In a developing country, where money is highly valued, the psychological connection between money and biodiversity/conservation made the latter even more important.

Figure 6-1 Costa Rican bills showing local flora and fauna (right bill printed in the 1990s, and the left bill printed in 2011)

The Costa Rican government promotes the cultural aspects of the country's biodiversity in other ways as well. For example, farmers are encouraged to engage in conservation-related activities to benefit citizens. The growing number of privately owned refuges and conservation areas are supported through government subsidies, payments, and publicity as appealing tourism sites. The way these subsidies support the local economy and individual land owners has led to an unusual outcome: a substantial number of people were receptive to the idea of imposing a biodiversity-/ecology-related tax that would support such ventures, stemming from the collectivistic value of protecting natural resources ("*[A] journalist [was] asking people if they would be supportive of a tax to protect the country's rain forests. And the people responded that 'yes, they would be OK with that,' that it would be important and interesting. I often comment to my colleagues, 'We must be crazy in Costa Rica! Accepting a tax!'*" (CR6)). Government support was not always financial, however; despite the best intentions of government agencies, they often lacked an appropriate budget and could not support all the projects that were deemed valuable. Park rangers and volunteers described the local wildlife and fisheries agencies as under-budgeted, understaffed, and overtaxed. Their ability to support relevant programs was largely dependent on the locale of the project – where no economical benefits were recognized by the government (e.g., in areas that did not draw many tourists), support was slim at best. This difficulty created interesting partnerships between government officials who wanted to support conservation-related projects and individuals who were interested in volunteering. Some partnerships were ad hoc, while others became long-lasting; in some cases, the parties found support through the local media or privately owned outfitters such rescue shelters ("*A man found a baby sloth whose mother was stoned to death, he rescued the baby and tried to take care of it but realized he had no idea what to do and may harm it unintentionally. So, he started calling different zoos and rescue centers and was rejected time after time...he then called the MINAET* [Costa Rica ministry of the environment] *office of Heredia and told them: 'if you don't come pick up this baby I am calling in the local news.' Fortunately they had a* *car that was working that day, and had gasoline which is always a problem... they went to pick up the baby sloth, wrapping her in their shirts to keep her warm, because they don't have any other provisions to use, and drove her to the rescue ranch and left her in our care*" (CR7); *"The government has been working a lot with volunteers. The national park system has an association of volunteers that supports the efforts of the parks, but it is lacking a well-organized system, there is no long-term systematic approach to these organizations. Rather, they are of spontaneous nature and work in response to needs that arise quickly and cannot be met solely by the rangers and the state workers"* (CR8)). These difficulties, while substantial, did not negatively affect the perception of conservation; quite to the contrary, many times these ad hoc solutions grew into long-term partnerships that were supported by the local communities. Locals saw scientists and government officials as representing the same cultural values they upheld, identified with the fact that they were overworked and under budgeted, and were inclined to assist them ("*I never envisioned myself taking care of owls, but after I gained the trust of our Fish and Wildlife officers, whenever they would find any type of bird they would call me. so after hearing from several other sources... 'no we don't take baby owls, they just die...or, no we don't want an owl with only one wing' I decided to learn all I could about owls"* (CR7)).

This grassroots support turned into a growing pride in what Costa Rica has to offer to those who are interested in nature ("*When you have a Costa Rican outside of the country abroad, they would usually brag about the nature and the country, it is like we have 4% [of the world's biodiversity] and that figure is what many people use"* (CR2)). This national pride has turned Costa Ricans into ambassadors of nature conservation and biodiversity to outsiders as well ("*I think that in Costa Rica for better or worse, the people are really interested in the topics of environment. People … I think if you visit Costa Rica and you talk to a cop, driver, or maybe a bus driver or people that work in a restaurant, they will make you a conversation about the topics of environment and their importance, there's a true moral thing*" (CR1)). Building off the national pride, visitors to Costa Rica were exposed to the value of conservation and encouraged to take part in relevant projects ("*The rescue ranch is first and foremost a wildlife recovery center, and only subsequently, a tourist attraction. It opened to the public two years ago to help defray the high cost of food and medicine, but if we can get visitors interested in what we do, all the better*" (CR7); "*For visiting participants what we do is basically, they are here in the country for nine to twelve days… and they stay there for around four to five days working with research assistants … just looking for turtles or turtle nests… The data they collect it goes to a long term monitoring program not only for the conservation site we work on, but also for the whole Caribbean coast of Costa Rica.*" (CR3)).

6.3.2 Education

"Citizen science fits really well into environmental education. It's hands-on, it's such an engaging way to interact with your surroundings" (CR4)

Education was intertwined with culture throughout the interviews; it was seen as the actionable facet of culture and as the primary way of advancing cultural ideas into ongoing practice. This is evident from the fact that many interviewees emphasized the fact that conservation education was a life-long process that didn't focus solely on school-age children (although they always remained the optimal audience for educational projects), but rather on broader populations, including adults. Such populations may have an initial interest in nature that is the product of the cultural atmosphere, and a hands-on experience will bring them even closer to nature and will empower them as citizens. That said, most projects that were discussed focused on younger populations – school-age children, teens, and young adults. Getting children out of the traditional classroom, especially in urban areas, and engaging them in hands-on biodiversity projects helped many children who had trouble concentrating in class to overcome these issues and learn in different ways ("*Some of them they are more visual learners other than learning by hearing. Others, they learn by movement… so [we] offer the opportunity to go outside and go to the field, sometimes they become the leaders of their groups because they are more… more easy for them to find species, you know they will get you a frog, or they will get you a butterfly*" (CR1)). More than that, educational projects proved to have a broader cultural effect than just immediate learning; the children later brought their parents and families back to the natural reserves and educated them about conservation, thus helping adults and children alike relate to the Costa Rican cultural heritage, which is heavily intertwined with nature. Interviewees who discussed educational projects mentioned that these projects were positively received in most schools, which saw them both as part of the core curriculum and as an opportunity to expand learning experiences ("*Most definitely the schools are interested in working with projects that are related to environmental education or environmental conservation basically, so it's very easy for us. They are always interested in working on field trips to conservation [sic] or do environmental education*" (CR3)). They also found early learning experiences related to nature as a source of knowledge that will have a continuous effect throughout their lives ("*What we tried to do in our core education, our program basically gives them their* *basic knowledge on how the natural system works, so they can build a vision of how they can help sustainable [community]. It gives them skills in the sense of critical thinking skills, collaboration skills throughout our core educational program. Whether they will go to a completely different industry, like technology related industry, but they will have the knowledge, attitudes and skills to green the industry from the inside*" (CR3)).

On a different trajectory, education was perceived as an instrument to expand people's knowledge of the opportunities collaborative scientific projects offer and engage them further in them, and it also addressed personal goals – people wanted to be educated and sought opportunities to broaden their horizons through collaborative projects that offered them such education ("*I get the sense that a lot of people do recognize our motivation to do citizen science because of the educational aspect*" (CR4)).

The interviews have shown that education is more than just a goal for which volunteers and scientists strived, as was the case in other countries; rather, it is a collective goal deeply affected by national and cultural perceptions, while at the same time affecting these perceptions in return by creating more awareness and a closer attachment to Costa Rica's rich natural history.

6.3.3 Other collectivistic motivations

"*What we try to do is to harness all the knowledge and the potential that the institution has for the benefit of society*" (CR1)

In both the United States and India, personal motivations usually preceded the emergence of collectivistic motivations for participation in collaborative scientific projects; however, Costa Rican interviewees presented a different process. Throughout the interviews collectivistic motivations surfaced as the most compelling and effective appeal for recruiting volunteers to projects. Individual motivations surfaced later, in most cases, or simultaneously in a few other cases. The most indicative example of how collectivistic motivations were more pronounced than individualist ones was when participants were asked about the effect of monetary rewards on volunteers' participation in collaborative scientific projects. Their answers were overwhelmingly negative, as demonstrated by the following exchange:

Q: Do you believe that if volunteers were compensated with money it would be easier [to recruit them]?

A. No, no, well, at least not in Costa Rica. I don't know about other countries. In Costa Rica the context in which volunteers work…it's a context of idealism... (CR8)

This response repeated itself in various forms in almost every interview. Terms like "pride," "responsibility," and "values" were often mentioned when motivation was discussed. Collectivistic motivations were drawn from various contexts: a feeling of mutual social responsibility and attachment to the legacy of nature conservation as a cultural practice (*"[there is a sense of] social responsibility or environmental responsibility, I would say Costa Rica has been doing areas of positive effort. Sometimes these efforts come from individuals that sometimes are swimming against the tide*" (CR9)); a desire to protect Costa Rica's flora and fauna; or a formal position, a job, or a hobby that bring participants closer to nature and makes them understand the effects participation in collaborative projects has on their communities ("*People are idealists about nature conservation, and the people who volunteer do it because they want to. Maybe it's because it's part of their job, and their hobby, and they simply see it as one way to contribute*" (CR8)). They also understood the effect conservation-related collaborative projects had on them as life-long learners ("*Part of what we'll be working on for not just doing conservation in the short term but giving participants the skills and the knowledge they need to change their behavior, attitudes and skills for lifelong conservatio*n" (CR3)).

Social responsibility translated in some cases to empowerment of local communities. Due to the relatively small geographical size of Costa Rica, few communities were actually too remote or secluded to benefit from collaborative scientific projects; this enhanced the sense of community participants in collaborative scientific projects felt, and encouraged greater participation. The general concept of empowerment was broken down into various examples of advancing the communities socially and fiscally while preserving the natural resources the communities were surrounded by. This was especially important for Costa Rica as a developing country working to expand its urban infrastructure (e.g., highways, housing projects, shopping centers) affecting, and sometimes inadvertently harming natural resources. In several cases, the tension between conservation and development was mediated through collaborative scientific projects that either educated locals as to the dangers of over-development or helped them create alternative income resources that would not overtax the local natural resources ("*A good portion of the locals go to our program, so they see what they were eating and they realize that this is a dinosaur* [a specific type of tortoise descendent from dinosaurs] *And what they are doing is not only affecting the turtles, but also affecting the system. They rethink, they review their approach and act differently. So there's a local connection to it*" (CR3); "*Just from the participant or the volunteer point of view, if they see a result… not just seeing part of the picture but the whole picture, to see how systems are in place in natural order. So the* *data they collect for leatherback turtles will not only work for leatherback turtles but also for jellyfish population stats, or even how leatherback affect jellyfish, and how jellyfish affect commercial interests, fish population, and how that affects them. It's an important take away, something that's going to change the way that volunteers see… basically that everything is interconnected*" (CR3); "*Mushrooms, some of them are edible and that has the potential so people in rural communities or any people in general can focus on these specific species of mushrooms that can be grown in a laboratory conditions and sold for restaurants or to prepare dishes in supermarkets, so it can benefit, you can get a profit from it, but at the same time it will be a sustainable use*" (CR1)).

In order to truly achieve local empowerment, volunteers had another role as mediators between scientists and locals. Scientists were, for the most part, Costa Ricans who were well aware of the local culture, customs, and language. At the same time though, they were often removed from the local community, coming from urban backgrounds and living in the academic world. In order to bridge between the local community and the scientists, local volunteers acted as negotiators and facilitators of communication ("*Communication must be constant and clear. A scientist has to be well-prepared to speak the language of citizens in order to clearly transmit their project and to inspire interest in people*" (CR8)). In this capacity, the volunteers' role was not limited to data collection or analysis but was broader and aided in understanding the contextual effect of the collaborative scientific projects taking place within the specific community; it was also important in bringing the two populations – scientists and locals – together ("*One definite [obstacle] is the language. Access is not just technical, it's language and the process of data collecting… Again, it's a role that citizen scientists often take on, as an* *interpreter or translator, even more so than scientists*" (CR6)). Language, in this context, referred not only to taxonomic terms and scientific descriptions, but also to the broader principles of doing scientific work. Locals were not often versed in the principles of scientific data collection, including maintaining scientific rigor and data quality, using proper analysis methods, and disseminating results, and scientists were deemed aloof and too busy to take the role of educating local communities about the principles of the scientific method or their specific needs ("*I think scientists think that the most important thing for them is to publish and do their research and not as much, maybe sharing information with some audiences, yes. But the general public... I do not think that that is their priority so they do not find the time to really get into the platform or really answer the questions about their group, about their taxonomy group*" (CR2)). While some scientists did understand this chasm and its origin, they were not sure how to overcome it ("*In terms of the precision issue, we're still grappling with how do we ask people to take precise data when we're using a very North American approach: 'Here is a scientific name' so it's sort of subjugating the local culture and giving that less significance. And there were really no good answers*" (CR4)). At this point, it was the well-trained volunteers who bridged between local knowledge and scientific needs; because they spoke the "language" of both sides, they could interpret the principles of scientific data collection (and specifically create trust as to the quality of the collected data), and teach locals how to be effective volunteers, thus creating a stronger bond between local communities and scientists ("*I do see a role [for volunteers] not only in collecting data but also in diffusion and even in the use of data. For me there's a place where science reaches people, and people need interpreters. In the case of citizen scientists they fit that* *role perfectly, they understand the regularity of science, they understand the scientific method, etc. but they can also take the data to a more practical, popular place*" (CR6)).

6.3.4 Individual motivations

"*People are idealists about nature conservation, and the people who volunteer do it because they want to. Maybe it's because it's part of their job, and their hobby, and they simply see it as one way to contribute" (CR8)*

Individual motivations surfaced after, or at the earliest, simultaneously, with collective ones. Individual motivations emphasized personal benefits and prior interests, but were found to be less intricately defined than in The United States and India, which emphasized individualistic motivations over collective ones. As one interviewee elaborated: "*The motivation varies. You have two or three types of people that are interested [in projects]. The first are people that are working already as a tourist [guide] but they need their license, because sometime when you enter another conservation [sic] with a group of tourists then you have to present that kind of ID, so I think that the first motivation is [a] requirement. Then the other type of audiences are people that love nature. People that just have a natural sense to wonder. 'Are there spiders? Are there butterflies?' And they just want to know, is all, of that particular group. They are just fascinated, and they want to learn more and more for different reasons. They work in banks or they work as a pharmaceutical companies [sic], but they want to decamp these spaces where they can know more about their… it's kind of like their hobbies. So these kind of main audiences: people that are already working on [sic] the field, and of course they like the field, they like to work there, and you have people that just love nature and* *they just want to learn more and more, and then you have other people that are encouraged or motivated by other people*" (CR8).

Among the three types of individual motivations that this interviewee discussed, two were often repeated – personal benefit and personal interest in a specific species (or a related hobby). Those who sought personal benefit from participating in collaborative scientific projects usually saw them as a career building tool. Whether they were already involved in science or education, participation in ecology-related collaborative scientific projects gave them experience, credibility, and opportunities to interact with scientists ("*Having the opportunity to chat and speak, collaborate with the actual scientists that are naming species, the person that knows the most about fungi or butterflies, gets them really motivated*" (CR2)). A different type of personal benefit was closely tied with the emphasis Costa Rican culture placed on eco-tourism as an important source of income: many people sought jobs that require close interaction with nature – as official guides, caretakers of natural reserves, and park rangers. These positions were highly sought, especially for people who were not bound for academic degrees ("*The parents, they are … because people they are getting from high school, and they are not answering to a university. So instead of doing nothing, instead of being in their houses doing nothing, they want to have an opportunity for them to have something so they can start working*" (CR8)). Collaborative scientific projects offered them the opportunity to complete some of the needed requirements towards an official certification leading to future employment, or it gave them other practical tools they could later use ("*For a guide that's really passionate about birds that's a great way to record data. That's more of a motivation than maybe some other altruistic motivation*" (CR9); "*I would like something* *that would include maybe a practical component, something that meets a need or provides development, something that has a practical focus*" (CR6). While this was indeed a personal benefit that participants achieved, it was closely tied to the overall collectivistic and altruistic view of nature, and nature-related projects, in Costa Rica.

The other individualistic motivation that surfaced was also tied to nature itself as an outlet for personal benefit: a prior interest in a natural phenomenon, a species, or a way to engage in another hobby (e.g., photography, writing, drawing, travel). In this case, volunteers looked for specific projects that fulfilled their needs or allowed them opportunities to expand their horizons. This motivation largely depended on personal attributes of both volunteers (e.g., the free time they could spare for a project, the availability of necessary equipment, like cameras and GPS devices), and the appeal of the project both in general and specifically in terms of the studied area or species. (*"It actually depends on how charismatic species you will be working on. We have found that that is very important. We have had requests from students, from people, from six hours or seven hours drive to our conservation site. They are interested in going just because they were working with leatherbacks. So, our experience is it is not so much as distance rather than interests that motivates the participants*" (CR3). This was especially relevant where the collaborative project offered volunteers tasks that required more than just data collection – such as taking care of animals or protecting them from predators or human development – or offered them an opportunity to engage more closely with nature ("*It is always such a great feeling releasing an animal back to nature. A while ago someone left a [Spanish bird name, probably a hawk] in a plastic basket ... The poor guy was in a terrible condition and didn't eat at all. It took us time to nurse him back to eating, and* *then he started to fly a bit in his cage. So, we caught him up, walked down to the creek and he was on my gloved hand and he looked at me, then saw the trees and took flight … It was such a great feeling having him fly off my hand"* (CR7)).

Again, these motivations were not divorced from various personal benefits, but they were also closely tied to the overall sense that nature was part of Costa Rica's backbone, and volunteering in projects that were related to nature offered more than mere personal benefit, it enhanced the greater good.

6.3.5 Continuous participation

"*You would really want to conserve nature if you get to know it*" (CR2)

Continuous participation was viewed as a fundamental principle of most collaborative projects; a substantial number of them incorporated mechanisms that enabled prolonged participation into their protocols, either at the initial phase of project design or later, when volunteers' participation became instrumental to the project. This was inherently different from projects in other countries, in which sustaining participation was not set as an important goal for the project's organizers, and efforts to promote long-term participation were mostly incidental.

The case of Costa Rica was different on several levels. For example, plans to promote long-term participation were designed simultaneously with the other segments of the project's design. Also, Costa Rican collaborative projects were created on the basis of encouraging a strong partnership between scientists and volunteers and overcoming status-related barriers. This was done by establishing several principles: ensuring the existence of common goals between scientists and volunteers, and creating effective feedback and communication channels. Specifics are provided below.

Creating common goals

First and foremost, interviewees coming from various groups acknowledged the need to create a reciprocal exchange mechanism between scientists and volunteers. This exchange would enable the first group to obtain the data they need, and the latter to be acknowledged and credited for their work. By establishing such an exchange mechanism, both sides ensured that they were an important and valuable part of the project as a whole. In most cases, this translated into an ongoing conversation about the aims of the specific project and the effective feedback mechanism that was needed (which will be discussed in the following section).

Although scientists were seen by all as having the formal knowledge that allowed them to initiate and steer scientific projects, several scientists and educators explicitly mentioned the important role volunteers had in collaborative projects, and their high regard for volunteers' knowledge and competencies. Participants in collaborative projects in Costa Rica seemed more open to the idea that educated and interested volunteers could almost be equals to scientists in actualizing a project ("*A volunteer can participate at any level of research in my opinion. From a person who has no experience and needs to be trained to participate, to someone who has the same academic qualifications as the scientists and who just isn't being paid*" (CR9); "*I know several people who are citizen scientists who are truly dedicated to science, perhaps some have not had the formal education but they do have an interest in educating themselves and to learn more*" (CR6); "*In Costa Rica, in* *the case of the sciences, there has been an inclusion of citizens in these developments. An example is DJ [scientist's name], he … looks for individuals who have an interest in the themes [of his research] and are included in the research team that collects data. These people that stay with the project show a lot of dedication, others move on to other things like [being] a tour guides on private reserves"* (CR6)).

The theme of aligning scientists' needs and volunteers' interest surfaced another interesting phenomenon that was not present in other countries: volunteers were highly encouraged to start their own research projects within the broader scope of the overall collaborative project. This had several outcomes: first, volunteers steered toward projects they found interesting, and naturally those were the projects that scientists found valuable enough to pursue. They also tended to become attached to the project and maintain their participation for longer periods of time, as opposed to shorter term commitments to projects that didn't offer them this opportunity. Second, volunteers came out of the projects with both an interest in collaborative science and the ability to conduct similar projects, albeit on a smaller scale ("*Working on scientific processes or revising scientific processes so they can actually make a short term research project in which they can basically revisit the data and what they learned about the scientific process, and apply those skills that are learned to really understand the natural system or the natural ecosystem. They can actually build by themselves appreciation of how they can improve or what kind of actions they can do to improve the system*" (CR3)). These two processes allowed volunteers to take a bigger role in designing and determining the scope of collaborative scientific projects, which brought them closer to what Bonney et al. (2009) termed as "co-creation" of collaborative projects, and advanced volunteers' potential involvement in these projects. Examples of the "project within a project" format included re-use of existing data for analysis, sometimes adding volunteers' own data to the already analyzed corpus; stewardship projects such as planting trees and monitoring the development of fauna around them; participation in animal rescue programs while creating a small-scale database about the specific species; encouraging small local surveys and data documentation, especially in rural areas. Another important motivation was the ability of volunteers to have access to the data they contributed and the data others contributed. Data sharing held an important role in facilitating coordination, but more than that, it allowed volunteers to feel like an integral part of the project. Here again, Costa Rican projects diverged from their counterparts in the United States and India in that the concept of two-way data sharing was not only acceptable but encouraged ("*We have the data from throughout the years of working at those conservation sites for them to go through*" (CR2)). Part of this is related to the pattern of "project within a project" that was advocated by many ("*With the leatherback turtles we collect data, we have this data collected for twelve years for these conservation sites. And they can do their own research with that data, but we also do some small demonstrative data analysis for the short term research projects, and that's where the students can make some contributions or see some results out of their data collection*" (CR3)). But even if volunteers' interest in the data did not bloom into a full-scale research product, their wish to go back to the data they collected, see what it means, and realize how it fits with the rest of the data that was collected by others was seen as a valuable motivator ("*People value results, people want to see how the data they are collecting and the work they are volunteering are being used*" (CR8)). This led to quite a few projects that empowered volunteers to take control over their data and revisit it as they wished and needed ("*Now we have our own data, it is a community for naturalists that [they] can put their photographs and their observations and everything. So people would come, and at the end of their experience they would punch in their information*" (CR2)).

What almost every interviewee emphasized, whether coming from an educational background, a practical background (e.g., a park ranger), a scientific background, or experience in volunteering, was that the emphasis in many collaborative scientific projects was placed on achieving long-term participation in collaborative scientific projects, rather than on one-time involvement. This translated into careful planning of the process that volunteers go through, with the goal of creating affinity for collaborative scientific projects, rather than seeing immediate, actionable outcomes ("*We're trying to take the emphasis away from formally entering the data, we try to encourage at every turn that even if you can't enter data, even just writing down your own observations and having a record of that whether or not you submit it to a formal database, is still a valuable process. That doesn't necessarily address the precision issue directly – it's not accurate and you couldn't enter that data into eBird per se, but you're still engaging people in the process of monitoring and still keeping records"* (CR4)). Here, the need for coordination applied more to the scientists, who were often solely looking for the data they could derive from the project rather than the broader public participation. They were often asked to calibrate their expectations accordingly, in a way that would support long-term engagement rather than short-term goals.

Feedback and communication

Another way to facilitate this long-term partnership was through continuous feedback, as was done in other places. Such feedback could take form in many ways: from face-to-face training and mentoring sessions conducted by the scientists with small groups or individual volunteers ("*I don't know how to say it… in Spanish it is… basically a greater empowerment [comes] from feedback with the researcher or the research assistants. And that definitely helps with empowerment of the participants, where it helps with the collaboration part*" (CR3); "*Training for guides, naturalist guides, it's an opportunity for them to know more about, to become leaders in this area*" (CR1)), to large-scale meetings in which the volunteers' work was acknowledged and showcased ("*For some, at the end, at the congress where they present, they would mention "well, all this that we have presented is possible because we have been entertaining knowledge with X who is the expert on fungi, and so they put [an] address about the collaboration that they had with the scientists*" (CR2)).

However, unlike other places, the feedback that was provided in Costa Rica, did not seem to be an afterthought or something that was brought up unilaterally by volunteers. Quite to the contrary, it was a well thought-out process, as was exemplified by the fact that several collaborative scientific projects had a "communications director" or a spokesperson whose job was not only to be in touch with the media outlets or publish the project's achievements over social media, but also to keep volunteers' engagement and interest alive through constant communication and feedback ("*We have people… a partner that works as a communicator, and he's the one that sends sometimes communications about what we are doing. Perhaps maybe a new discovery on one new* *species for science or maybe a new exhibition, and so on*" (CR1); "*You just keep them involved in… just keep the active communication with them throughout … with Facebook, telling them about opportunities, workshops, scholarships, job opportunities, things like that. I guess the main take away is just to try to keep an open channel of communication with people interested in participating*" (CR3)).

Training was another form of communication: volunteers benefitted from training in data collection methods and data quality assurance at the onset of their project, and this training continued to be important over the life of the project for several reasons. Over the course of the project, training created a strong bond and facilitated trust between scientists and volunteers ("*As soon as we get all the cards on the table, is how much hours we are going to spend training... this is the protocol we are going to use which is the same that are used, and you spend more time with our instructors and the research assistants and they work together… you invest that time, it builds trust, it builds confidence… actually we spend the most [time] building relationships, and just human relationships*" (CR3)).

Various participants noted the need for this trust-building process, bound by communication and acknowledgement to be a continuous one, brought up deliberately by both scientists and volunteers, and closely mandated by shared goals ("*The biggest motivation for working with volunteers is that both sides of the research projects share a common goal. If the goals of the research personnel are not shared by the volunteers, I believe the project cannot be very motivating*" (CR8)). Once such a process was set in motion – and especially if it was initiated or expressly condoned by the scientists – volunteers felt it safer and more comfortable to express their minds to the scientists in a way that helped them overcome many status-related concerns and promoted long-term engagement.

6.3.6 Motivational problems

Despite the best intentions of scientists, educators, and coordinators of collaborative scientific projects, Costa Rica is not a utopian example of collaborative scientific projects. The following issues adversely impacted the motivational level of participants and persisted throughout the projects.

Coordinating the message

Collaborative scientific projects in Costa Rica aim to engage a broad audience of participants, from school children to older adults, from urbanites to residents of rural communities, and from highly educated participants to those who do not have formal education. This scheme is beneficial in terms of creating broad cultural involvement with biodiversity efforts and conservation efforts, but it also poses difficulties in terms of creating a unified message that will motivate different populations to become involved in the projects ("*You have to consider ages and it's not the same if you are working on citizen science program, focus it on children from a certain age or secondary… how do you personalize the message? The experience according to the audience?"* (CR1)). The difficulty in conveying the message may be quite literally linguistic. Just as there is a language gap between scientists and volunteers, similar gaps exist between volunteers from different walks of life ("*The expectation most adults have was being close to nature, having like a relaxing moment with nature, recreation. Children, they would say animals… I think it is more because what nature does to them then just because they* *really understand the importance and the value of nature on its own*" (CR2)). But the difficulty may also stem from the way the message is perceived by the intended audiences. Crafting the message in a way that is useful for both the project administrators and potential participants has proven to be harder than first expected.

Moving from intention to action

Several interviewees emphasized the difference between ideas and intentions and actual participation. Though all agreed that Costa Rica stands on a rich culture of natural history, it did not always (or even often) translate to actual participation in collaborative scientific projects ("*You have to be careful about the true moral thing. There is a lot of work still ahead in the areas of how to translate these initial cares about their environment to the actual actions that help us [in] the conservation of biodiversity*" (CR1)). This difference was a matter of concern to project initiators and educators alike. In some cases, identification of local leaders and gatekeepers helped scientists and educators gain access to the relevant community, and overcome the gap between wanting to contribute to the overall goal of conserving Costa Rica's biodiversity and actually taking steps to do so. Alternatively, approaching groups rather than individuals, and training those groups to engage others (in a pyramid-like structure) reached a substantial number of potential volunteers and compensated for both the difficulty of moving from principle to practice, and the natural attrition in participation ("*We are looking at citizen participation not as engaging individuals but rather organized groups. We've been looking for local groups and associations to help us and that will function as regional coordinators. In that sense we are using citizens who are in turn helping organize other citizens…it's working out pretty well*" (CR1)).

Technological gaps

While the use of technology promised to be a significant motivator for various populations (mostly school kids and students) Costa Rica is a developing country, and as such, there are substantial differences in the infrastructure available in different parts of the county, especially in rural areas. This has strongly affected participation and motivation. Some projects that were heavily dependent on technology could not be accomplished in designated areas, and some failed because they were not tailored to the actual technological conditions that the researchers found in place. For example, schools that promised to have an Internet connection actually had one computer that was locked in the principal's office and could not be used due to compatibility issues ("A *lot of the schools I worked with were like one-room schoolhouses, maybe they had a computer, but probably they didn't. They probably didn't have an Internet connection even if they had a computer, so that was a big challenge*" (CR4)). Smartphone were also rare, especially in rural areas. In these cases, scientists resorted to using "old school" tools like cameras, notepads, and at best, a GPS device.

Other issues were related to the perception of technology as disruptive by many educators who pushed back against its use in the classroom ("*Sometimes the mandatory directions are to turn off your cell phones or turn off your computers or leave that out of the class. So in this case, that we try to train the teacher and the students in this process is that 'turn on your cell phone, turn on your camera, we're going to learn biodiversity, you can use these technologies because these will allow you to have a strong contact with scientists*'" (CR1). All of these conditions resulted in a lower than expected use of technological tools for participation in collaborative scientific projects.

Attrition

Like other collaborative scientific projects, those located in Costa Rica also suffered from a significant attrition rate. The general assumption was that among the volunteers who actually started participating in such projects, only around 20% kept participating for a long period of time (what was considered to be a long period of time was subjective, and ranged from several months to several years and beyond). This attrition rate was not worse than in other countries, but it troubled the coordinators of collaborative scientific projects nonetheless ("*There's been mixed results where some communities really have come together to participate but many not so much so, some just want to participate for a little while and don't stick with it*" (CR6)). The reasons behind this attrition rate were several – from the requirement of a lengthy time commitment that many volunteers couldn't make, to a crucial decision point at the end of a task, a class, or a project that required volunteers to reassess their participation, to a subjective loss of interest. For many of the volunteers who left the projects, this was a limited time experience, and since most scientists and organizers of collaborative scientific projects could not find a way to raise the participation rate, they gave up on those individuals or communities.

6.4 Summary

Costa Rica presents another paradigm by which values and culture affect participation in collaborative scientific projects. Greatly motivated by the participatory culture and the view that natural resources are important and biodiversity should be conserved, the interviewees representing Costa Rica emphasized the collaborative aspect of participation and attributed the collectivistic viewpoint to the Costa Rican culture and educational system. Where individual motivation surfaced, it was mostly in conjunction with collaborative ones. It is also interesting to note that long-term participation was a well thought-out process by which scientists and volunteers became closer and built relationships and trust through intentional efforts to create rapport and engage volunteers in deeper ways than in other countries. That is not to say that Costa Rican collaborative projects were devoid of problems. Motivational barriers stemming from a “catch all” approach that didn’t specifically distinguish between volunteers, the need to move beyond a principlistic view of conservation toward actual engagement, as well as technological barriers, and the force of natural attrition all presented de-motivational factors with which scientists and volunteers had to contend.

7 Discussion of the findings

This chapter discusses the findings from the case studies presented in chapters 4-6, and synthesizes them into a thematic framework. This framework is then juxtaposed against the research questions that were outlined in chapter 1, and the current theories that were discussed in chapter 2. The chapter begins with a description of the cross-case analysis that was done and continues by addressing each research question separately. It concludes with a synthesis of all the findings and suggesting how they can assist in extending our understanding of the motivational basis for collaborative scientific projects.

7.1 Case study and cross-case analysis

This study is based on a close examination of three individual case studies. Each country was selected as a whole unit of observation, and was treated independently in the previous chapters. As the findings from the individual case studies were analyzed, it became apparent that each country is unique and offers a specific perspective of how motivation and culture are interconnected. While these findings are interesting enough by themselves, they are made even more compelling when compared.

As outlined in chapter 3, cross-case analysis allows for comparison not only within an individual case, but also across cases that share some similarities, but also surface differences (through what was termed by Perecman and Curran (2006) as ”within-case” and “across-case” analysis). Conducting the analysis through cross-case examination surfaces the implicit and explicit relationships among the findings garnered from each case, and highlights their association with existing theories and frameworks. The general themes that were distilled from the findings are:

- What brings volunteers to contribute to collaborative ecology projects
- The change in volunteers' motivation over time
- Motivating factors in different cultures

Country	Data	Main themes from the data	Major motivational factors	Major cultural aspects
The United States	142 survey responses; 13 interviews	Personal interest, personal benefits, social benefits, ease of participation, learning process, community involvement, advocacy, education	Initial – self-directed; Continuous – a combination of self-directed and collectivistic motivations	Locality, relationship between scientists and volunteers
India	156 survey responses; 22 interviews	Personal benefits, tangible rewards, personal value, learning process, ease of participation, community involvement, education, awareness, advocacy and policy change	Initial – self-directed; Continuous – mostly self-directed, with some collectivistic aspects	Cultural diversity, social stratification and hierarchy, trust issues, language barriers, bureaucracy
Costa Rica	9 interviews	National pride in conservation, social responsibility, education, empowerment, personal benefits, relationship with scientists	Initial and ongoing – mostly collectivistic with some self-directed aspects	Close-knit, highly collectivistic culture, cultural emphasis on ecology

7-1 Overview of the major findings from all three case studies, presented in chapters 4-6

Table 7-1 presents an overview of the major findings from the cases that were presented in chapters 4-6, and will be discussed in detail throughout the discussion.

This exploratory study started from examining the theme of motivation as a basis for participation in collaborative scientific projects. However, the cross-case analysis revealed the clear resonance of culture in shaping various motivational factors. It became apparent that the role cultural aspects play in determining participation practices could not be underestimated, as it frequently overcame the relative neutral motivating factors that were outlined by previous theories. The next sections discuss these emergent findings, and the way they relate to the original research questions outlined in chapter 1.

7.2 What brings volunteers to contribute to collaborative ecology projects

The first theme that was explored was the phase of initial participation. In other words, what draws volunteers into collaborative scientific projects and what prompts them to actively take part in them. Although previous studies have touched on these concepts in specific disciplines (Nov et al. 2007; 2011a; Raddick et al., 2007), there is no systematic work that examined this topic within ecology-related collaborative projects. Given the demand for mass numbers of participants in large scale ecology projects, the willingness of volunteers to fulfill the needed tasks warrants a closer look at their motivations. The general framework from which this exploration commenced was Batson et al. (2002) work, according to which many, if not most, social actions are guided by one of four principles: egoism, collectivism, altruism and principlism. As the data unfolded, it became apparent that participation is highly dependent on personal interest, and that the two concepts of interest and participation did not always correlate. This was demonstrated by interviewees who had a general favorable attitude toward the value that collaborative scientific projects hold for the greater good, yet they did not make the actual step of joining any project. While lacking an initial positive attitude toward collaborative scientific projects completely precluding any tendency to even consider joining such projects, those who had a positive inclination toward such projects needed some other prompt in order to take the extra step and actually initiate participation. That extra "something" could be an external or internal factor – but in either case it was closely related to a certain personal benefit. The range of personal benefits that surfaced from the data was broad: from the goals of the specific project, to the existing interests and hobbies of the potential volunteer, to the project design and the relationships with other participants (and specifically the professional scientists involved in the project), to the ease of joining a project and working within it. Several major personal benefits overshadowed all other motivational factors, and determined to a large extent if and how volunteers will even seek opportunities to join a collaborative project: these were the immediate personal benefit a volunteer will gain from his/her participation in a collaborative project, and how the project aligns with the volunteer's other interests.

Table 7-2 presents the breakdown of themes that were generated from the data pertaining to initial motivations (as described in chapters 4-6). In the table, the outlined themes are associated with related motivational factors, and with the specific concepts that were generated through the iterative coding process, highlighting the relevant groups of potential volunteers (based on the understanding of the way different motivations apply to various groups of participants), and noting the countries in which each theme surfaced.

As Table 7-2 shows, most motivational factors affecting initial participation in collaborative scientific projects are based on personal aspects and self-related advantages or interests, which can be related to egoism. The only exception to this was the collectivistic nature of participation in collaborative scientific projects that prevailed in Costa Rica, and could largely be associated with the national expectation for individuals' involvement in such projects as an expected social commitment.

Theme	Motivational factor	Related concepts	Potential participants	Countries
Personal interest	Egoism	Enjoyment, interest, ancillary hobbies, leisure, interest in nature	Individuals with ample time to spare or a very specific interest in nature; families, all ages	United States, India, Costa Rica
Self promotion	Egoism	Reputation building, social advancement, future employment	Individuals coming from lower classes wanting to advance themselves; young adults	India, Costa Rica
Self efficacy	Egoism	Affecting scientific work, belonging to the scientific community	Educated individuals; relatively older adults	US, Costa Rica
Social responsibility	Collectivism/altruism	Conservation, pride, national and local dependency	Individuals affected by the local culture and education system; relatively young adults	Costa Rica

Table 7-2 Breakdown of initial motivations according to the thematic concepts

7.2.1 Personal interests

Indeed, the motivations of volunteers varied widely, in specific countries and across them, as well as within and across different populations of potential volunteers (e.g. urban vs. rural, educated vs. non-educated). What brings them all together is the fact that every specific collaborative project had to respond to a personal need or an interest that would hook volunteers and make them cross the threshold from potential participants to actual ones.

The relatively simple case was that of a volunteer with an already-established personal interest in an ecology-related domain, process, or species. They already had an existing conceptual idea of the importance of ecology-related scientific projects, and needed an opportunity to become more engaged in such projects. Where collaborative projects offered opportunities to do so, volunteers were quite happy to combine their personal interests with a broader goal. Some volunteers (especially in the United States and to some extent in Costa Rica) were actively looking for opportunities to extend their knowledge through participation in collaborative scientific projects, and through interaction with professional scientists and the projects they headed. The ability to extend their hobby toward a semi-professional work flattered and encouraged them to look for opportunities to volunteer. Others stumbled upon such projects by chance, but where opportunities for participation surfaced they were happy to engage in them as long as they represented an extension of an existing interest. A slightly different case was that of an existing hobby which related – closely or loosely – to collaborative scientific like photography, art, travel, and sports. In these cases the main motivational factor was the ability to use the collaborative project as a platform to promote their hobbies. Similarly, some volunteers found collaborative scientific projects gave them an enjoyable opportunity to spend time with their friends and families, and enhance their relationships through joint activities.

In these cases the interest, hobby, or fascination with the subject matter preceded the collaborative project, and the project itself was mainly a tool, or a platform, to facilitate leisurely activities. Alternatively, the fascination of volunteers with nature-related phenomena, such as finding or following different species, identifying them, observing their behavior, and recording it, was also a strong motivator. As such, collaborative scientific projects had to be fun, engaging, and directly speak to the interests and skill sets of potential volunteers, in order to maximize the number of volunteers who move beyond mere interest into actual participation.

7.2.2 Self promotion

Several alternative themes of personal benefits also surfaced from the data. These motivations were inherently different from the ones outlined earlier in that they specifically addressed self-promotion and social advancement of the volunteer, and not an extra-curricular personal interest. Self-promotion, or personal advancement, could be broken down to several different aspects: personal benefits, social advancement, and career goals. The goal of all those was to advance the volunteer and him to use the skill-set and the connections that were created through participation in collaborative scientific projects to present himself in a different light to future employees, collaborators, or within different social circles. In a country divided thoroughly by different social strata such as India, this was a crucial benefit that collaborative scientific projects offered to lower-class volunteers, who otherwise may not have had the opportunity to push through the rigid social structure. This motivation was less salient in other countries (specifically in the United States), and where it surfaced it was only a secondary motivation that applied to a relatively small portion of the potential volunteers, those coming from lower class or less educated populations, who sought opportunities for social advancement.

Another form of personal benefit that was salient in these cases was monetary (or equivalent) rewards. While in all the countries that were studied some projects offered some types of compensation, ranging from paying travel fares to providing volunteers with tools needed to perform their tasks (cameras, GPS devices), the most noticeable use of monetary rewards was seen in India, where many volunteers would not consider joining a collaborative project unless they were compensated or rewarded for their participation. This begs the question of whether a population that demands monetary rewards in exchange for participation could even be considered "volunteers" and should their motivation be examined along the lines of other groups of volunteers. "Volunteers" may be a misnomer here, since this group's impetus for their participation in collaborative scientific projects was not "voluntary" in the sense that was described by Dekker and Halman (2003): people who give an asset to others – their time, their resources, their attention – without the expectation of monetary or other rewards. In a sense these individuals can be viewed more as low-paid field workers than volunteers. However, volunteers and scientists alike mentioned these individuals as an inherent part of the volunteer population; this may be due to cultural differences that conceptualize what may, or may not, transpire as volunteerism in different populations. That said, following Dekker & Halman, the remainder of this thesis will not consider those involved in collaborative projects solely for the sake of remuneration as volunteers (notwithstanding this, individuals who were compensated for travel or given the necessary tools to perform their tasks are considered volunteers for purposes of this analysis).

7.2.3 Self efficacy

The depth and level of involvement offered to volunteers within each collaborative scientific project also became a strong motivator, speaking to volunteers' sense of self efficacy, and feeling of equality and control over the scientific process. This was best exemplified by the Costa Rican data sharing practices described as "projects-within-a-project" which offered volunteers the opportunity to create their own small-scale research project using the data and the tools of the original collaborative project. In this case, volunteers were empowered to become members (albeit not equal partners) of the research team and were encouraged to gain control over some aspect of the larger research project. This led to volunteers' increased sense of competency and self-efficacy. Even if opportunities for in-depth participation were not become apparent immediately at the onset of the projects, as soon as they became public many people who were interested in various aspects of ecology research were drawn to projects that offered them this form of empowerment. Projects that were purposefully designed to enable this type of participation were more successful in recruiting (and retaining) participants than others.

7.2.4 Social responsibility

Interestingly, collectivistic motivations as antecedents to participation surfaced at the initial stage of collaborative scientific projects only in one case – that of Costa Rica. Neither in the United States nor in India was participation in such projects was driven by collectivism, altruism, or principlism. In Costa Rica, however, the collectivistic culture, supported by education and practice, and its emphasize on principles of social responsibility toward natural resources, drew many people to explore the opportunities collaborative scientific projects offered, with the intention of joining these projects in order to advance the greater good of society. The role of the education system in establishing these principles, and the way they were supported by the local institutions cannot be underestimated; but even more than that, the collectivistic motives were the product of grassroots understandings of the role nature has in maintaining and supporting the community, and in the reliance of the local citizens on natural resources, leading them to be proud and protective of these resources. This introduces an alternative view of initial motivation to participate, one not directly related to the person volunteering but also associated with local and broader communities to which he or she belongs. In this case, the broader aims of collaborative scientific projects that pertain to conservation and direct actionable tasks speak to the way volunteers want to see their community advance. Compared to volunteers in other countries that were studied, the collectivistic motivations that guided the initial tendency to engage in collaborative scientific projects in Costa Rica overshadowed self-directed motivations although for some Costa Rican volunteers these motivations were also present.

7.2.5 Egoism and collectivism as initial motivations

Bearing in mind the importance of egoism as a motivating factor prompting initial participation, as could be observed from the qualitative data (and the themes of personal interest, self-promotion, and self-efficacy described in the preceding subsections that were detailed earlier), it was interesting to go back and look at the results of the surveys that were disseminated in the United States and India. The survey data placed egoism relatively low in comparison with other motivational factors, for the Indian population, and as a highly valued motivational factor for United States respondents. Among Indian respondents the most valued motivational factor by far was collectivism (see Figure 5-3), and when asked specifically about the primary motivation that dictated their inclination toward participation in collaborative scientific projects, Indian respondents almost completely ignored the option of status improvement (only a handful naturalists chose this option among the eight options they were offered), completely negating the themes that came up from the qualitative data. This meaningful difference can be explained in several ways – from a mismatch between the phrasing used for the survey and the interviews that potentially led to misunderstanding of the survey questions (although every effort was made to maintain control and coherence of the language and the terms that were used), to the problem of social desirability issue, leading respondents to supply the answers they thought were expected of them, which was brought up often in the Indian interviews as a constant concern affecting responses and data collection in India. From this perspective it is difficult to say if and how social desirability affected the gap between the survey responses and those obtained through the interviews; however, given the depth of the interviews and the fact that many of the interview protocol questions addressed the same concepts from different angles, it is plausible that the more accurate responses were elicited from the qualitative data. Thus, the themes outlined in Table 7-1 are those representing the actual motivations that facilitate initial participation in collaborative scientific projects – namely, a variety of self-focused motivations that are set to attain personal goals of advancement and enjoyment.

This is even clearer in regards to United States participants, who valued egoism-related motivations across the board, both in the survey – where egoism was significantly more valued among volunteers – and in the interviews, correlating with the themes of personal interest and self efficacy that were inferred from the interviews.

7.2.6 Applying the theoretical framework to the initial motivations

Several studies examined the nature of initial motivations affecting participation in collaborative scientific projects. Raddick et al. (2010) found that personal interest was the most salient motivational factor. Nov and colleagues (2011a, 2011b) suggested that intrinsic enjoyment of the tasks offered by the project was the most important factor affecting motivation, while the nature of the project and its goals were of importance, but significantly less than any intrinsic motivation. Although these were solely quantitative assessments, it is not surprising they are supported by the findings discussed in this section, and particularly the themes that surfaced from the qualitative data. As the concepts and themes were salient across all three cases, they present a compelling argument in favor of seeing initial motivation as stemming from some form of personal benefit – be it enjoyment, curiosity or interest, leisurely activity or a hobby, a step toward reputation building and social advancement, or an intended increase in self-efficacy – all fit within the context of personal gain that was outlined earlier, and seem to be the basic step for engaging potential volunteers across all types (and most locales) of collaborative scientific projects. From this standpoint it is interesting to go back to Batson et al. theory of social motivations and specifically examine how egoism is interpreted by them. According to Batson et al. (2002) egoism is simply an act that is done in order to advance one's own welfare. And while each theme (other than social responsibility) can be seen as egoistic in and of itself, the variance of self-based themes that stretch from pure self-enjoyment to growing self efficacy suggest not only that egoism is a more powerful motivating factor than its three other counterparts but also that it should be looked at more closely in order to tease out its different manifestations.

7.2.7 RQ1 - What brings volunteers to contribute to collaborative ecology projects?

The first research question aimed to capture the motivations that prompt the initial stage of participation. One interesting finding which was not completely expected was the obvious gap between an interest in participation in general, or in a specific collaborative project, and the move toward actualizing participation by joining a project. Although it would have seemed that the motivations affecting the two decisions would be different, as each pertains to a different stage in the participation lifecycle, it seemed that both were based on the same factors that highlighted personal benefits. With the only exception of social responsibility demonstrated in Costa Rica, the two other cases exemplified that the overall motivation for initializing participation in collaborative scientific projects can be summarized as being self-directed.

7.3 Changes in volunteer motivation over time

This theme explored a different stage of participation. Whereas the previous section detailed the first step toward participation, i.e. the move from a favorable view of collaborative scientific projects to actual participation, here the focus is on continuous participation for extended periods of time. Such participation can take several forms: from participation in the same collaborative project over long periods of time (as the repeated engagement in the annual Christmas bird count exemplifies), through participation in the same project but in different capacities (from data contributor to analyst, and from an individual working alone to leader of a group of volunteers), to moving between projects. The flip side of continuous participation is attrition. Not all volunteers remain involved in collaborative scientific projects over long periods of time; the truth is actually the opposite – most beginning volunteers do not reach the phase of continued participation and drop out at various stages of the project's lifecycle. This begs the question of what motivates those who remain committed to collaborative scientific projects, and if and how these motivations are salient at different temporal points.

Unlike initial motivations which focused mainly on one's self, and related to the benefits one expected as a result of such participation, continuous participation was motivated through a range of relationships. These relationships were negotiated between individual volunteers and their counterparts – the scientists who initiated and guided the scientific projects, the volunteers' communities, the broader scientific community, and their nation. Generally speaking, we can discern two types of meaningful relationships that affected continuous participation: within the project and external to it. Within project relationships were those initiated and cultivated between participants of the collaborative projects – predominantly volunteers and scientists (and in a few cases administrators, educators, and paid workers); external relationships were those created between volunteers and others who didn't take part in the collaborative effort, such as their communities, friends and families.

Table 7-3 describes the various motivational factors affecting continuous participation, according to the themes that were synthesized from the data. The themes distinguish between internal factors that pertain to the relationship between participants in the specific collaborative project, and external relationships that reach beyond the specific project to include broader populations. Based on this table, the following sections will detail the various relationships and the way they affect long-term participation.

Theme	Motivational factor	Related concepts	Potential participants	Countries
Within project relationships				
Trust	Egoism	Data quality, skills, value, time, leadership roles	Experienced volunteers looking for close relationship w. scientists	US, Costa Rica
Common goals	Collectivism	Communication, updates, structured protocols	Volunteers looking to deepen their relationship with scientists	Costa Rica
Acknowledgement	Egoism	Recognition, attribution, value	All volunteers	US, India, Costa Rica
Mentorship	Egoism	Training, closeness, empowerment	Volunteers who wanted to become deeply involved in the project	US, India
External relationships				
Education and outreach	Collectivism/altruism/ principlism	Mediation, empowerment, local populations, knowledge	Long standing volunteers who interact with locals	US, India, Costa Rica
Policy and activism	Collectivism/altruism/ Principlism	Accountability, government, institutions, community	Long standing volunteers who interact with locals	US, Costa Rica

Table 7-3 Breakdown of motivational factors affecting continuous participation, and their presence in each case study

7.3.1 Within project relationships

Collaborative scientific projects bring together very different populations. On one hand there are scientists bound by rigid processes and pre-defined expected outcomes, and who see these projects first and foremost as an opportunity to overcome budgetary and manpower obstacles to support the research that will advance their careers. On the other hand are the volunteers who sought opportunities to engage in scientific work mostly for various personal reasons. Creating a lasting and productive partnership between the two groups often proved to be difficult. Several related issues were brought up by the interviewees:

Trust between volunteers and scientists

The main obstacle for collaboration, and hence to maintaining long-lasting participation, was the lack of trust between scientists and volunteers. Scientists often saw volunteers as well-intentioned individuals who have a limited ability to fulfill substantial scientific tasks. While they acknowledged the need for volunteers' help in their work, they were hesitant to trust them with tasks that were more complex than simple data collection (very few collaborative scientific projects allowed volunteers to go beyond observations and data collection), for fear of "data contamination", low quality or complete lack of quality control, and potential deviance that would hinder their work. Volunteers, on the other hand, were shy of scientists, often seeing them as aloof and intimidating, speaking a particular jargon that was foreign to them, and in quite a few cases they did not even meet with the scientists throughout the project. Under these conditions, creating trust among them seems almost impossible. However, some projects succeeded, this success often related to the governance structure of the project – the more centralized and pyramid-like the project was (where the leading scientists were removed from the volunteers), the less it resulted in trust between the groups, while relatively flat projects that enabled interaction between scientists and volunteers more often led to a slow build-up of personal relationships that facilitated trust. Trust was also closely related to the tasks volunteers were allowed to fulfill and to their sense of self-efficacy. As mentioned earlier, projects that offered volunteers opportunities to engage in more than mere data collection (e.g. quality control, data analysis, leadership roles, project design) were very few (and took place mostly in Costa Rica and to a lesser extent in the United States). But when such opportunities arose, volunteers saw them as an affirmation of their capabilities and the level of confidence that was vested in them. In such cases, volunteers' inclination to continue and participate in the projects became higher. One particular example of the negotiated trust pertains to data use: in many of the collaborative projects volunteers were seen merely as a broad base of data collectors assisting the scientists. Once they provided the necessary data, and it was entered into the scientists' records, volunteers had little or no access to the data, and could not reflect on it or use it for any purpose. In quite a few cases they were not even offered a copy of the records they contributed. On the opposite end of the scale stood a handful of projects that supported open-access records and availed the data to anyone who was involved in the project. Where such option existed, volunteers felt valued and trusted, leading to a stronger sense of self-efficacy and of attachment to the specific project. All this translated into a stronger motivation to continue and contribute to the collaborative project for longer periods of time; where projects that kept strict distinction between data contribution and data sharing a relatively high attrition rate was reported.

Setting common goals

Another form of establishing positive relationships among the various participants of collaborative scientific projects was setting and repeatedly updating the goals of the project. Setting the goals at first was used to create a common baseline of expectations among the various participants and particularly between scientists and volunteers. Potentially contentious issues, such as roles, responsibilities, expected outcomes, and standards, were easier to overcome when they were openly discussed among participants, or at least set in a formal manner by the project's leaders. Periodic discussion of these goals, which included volunteers as partners (or at the very least alerted them to the existence of such goals) helped in facilitating a positive rapport that maintained their sense of competency. To enable this, a clear and open channel of communication needed to be established. The goals had to be communicated in a manner that would be understandable to lay-people who were not versed in scientific jargon, and include tailored messages that would address the different populations that can take part in collaborative scientific projects (kids, adults, with various degrees of education and interest). Beyond opening a channel of communication between participants, the periodic streamlining of the project's goals also helped reaffirm the value volunteers had – through this two-way process they became collaborators and not just resources to be used for the scientists' purposes. Such communications also served another purpose, which is especially relevant in longitudinal projects that typify ecology – routine messages about the project's status, goals, and procedures helped remind volunteers of upcoming events or the continuity of the project, which was useful to those who were not deeply involved in it, and encourage their participation for longer periods of time.

Acknowledgement of contributions

A crucial motivational factor that highly influenced continuous participation was the level of acknowledgement volunteers received from the scientists. While acknowledgement could take various forms, and the view of what constituted sufficient acknowledgment varied greatly, a minimal level of recognition was essential for facilitating long-lasting participation. The value of acknowledgement as a motivating factor contributing to continuous participation was distinctly a recurrent theme across all cases, and its importance cannot be underestimated. The data revealed several aspects of acknowledgement that were either independent or interrelated, depending on the specific project and its settings. For example, some projects offered structured modes of acknowledgement that were open to all participants (periodic meeting in which volunteers' work was showcased, or single out individual volunteers for their contributions). Other projects offered lab-meetings or meetings in the field, in which active volunteers and scientists interacted. In both cases these were pre-planned events that were meant to bring volunteers closer to the leaders of the projects and highlight the work that they do. Most volunteers were not particular about the form acknowledgement took, as long as some was made, and it was made public. However the more "scientifically valid" the acknowledgement that was made, the more it was appreciated. In other cases, acknowledgement was provisory and impromptu, and came up though chance meetings among project participants. In these cases acknowledgement was not contribution-specific or structured, but was based on a general "thank you" message for the effort that was done. Two conditions were necessary for that to happen – a meeting between project participants, and the scientists' awareness of the need to acknowledge volunteers. Unfortunately, in many cases the two didn't coalesce; scientists were often removed from the field, and unaware of volunteers' need for recognition.

A variation on this theme was volunteers' need for attribution. They felt a protective sense of ownership toward the data they contributed to the project, although for the most part they recognized the fact that the data were collected for a specific scientific purpose. Even under these known conditions, their attachment to the data inspired them to seek some type of attribution from the scientists. As with acknowledgement, attribution could be had in many ways – from a general acknowledgement that the data was obtained through collaboration with volunteers (without specifically naming volunteers or volunteer groups), to individual credit given to specific contributors. This was especially important where the data was used for outside publications (e.g. journal and conference papers, books, and online publications). Although many volunteers were not notified of such external publications, especially in projects that posed rigid barriers between scientists and volunteers, where they did find out about them in retrospect, they were disappointed and frustrated not to find attribution. This was observed across all types of projects, and in all three cases. However, projects in the United States and Costa Rica tended to offer slightly more credit and attribution to volunteers than projects based in India.

Mentorship

This theme was less prevalent than the others described in this section. As with the other themes discussing within-project relationships, mentorship was based on several separate but interrelated concepts: training, closeness, and empowerment. Many of the volunteers who joined collaborative scientific projects in order to advance their scientific understanding and sense of self-efficacy (as was described in section 7.2.3) actively sought an ongoing relationship with scientists that would contextualize their knowledge. To do that, they needed to move beyond amateur positions toward more specific roles and deeper involvement in various tasks related to the collaborative project. They could not do this alone – they needed the guidance and encouragement of the senior staff of the projects to accomplish this. Advancement could sometimes be achieved through continuous practical work, but more than that it necessitates some formal manner of instruction and guidance. Various forms of mentorship could offer this guidance – from initiating close contact between scientists and volunteers to address questions and provide detailed research protocols and instruction as to the proper way of conducting scientific inquiries, to establishing close personal relationships between scientists and volunteers. Many volunteers appreciated every opportunity they were given to meet with scientists and were willing to give up time and resources (e.g. pay for travel) to accomplish that. However, not many senior scientists were interested in providing mentorship for various reasons that can be summed in terms of time and priorities. That said, junior scientists saw great value in mentorship activities (perhaps because they were close enough to the apprenticeship process required of beginning scientists). Similarly, NGOs that were involved in ecology education placed a substantial emphasis on facilitating structured mentorship programs within their collaborative scientific projects. Mentorship took another form that was slightly removed from the direct relationship between scientists and volunteers – through providing volunteers with various training programs. Some projects offered or required initial or repeated training in order for volunteers to actively participate. Training varied according to the specific project needs, and could be short (a few hours) or long (several days); it could be free or require payment; and it could be done online (birdsong recognition audio tracks) or in the field (scat and track identification outings). In all cases, volunteers were appreciative of the opportunity given to them to extend their knowledge and competencies, and some even expressed a view according to which the more rigorous and demanding the training was, the more they were motivated to participate in the project. Although training of volunteers could offer scientists numerous advantages, including a higher level of data quality, and deeper commitment among volunteers. Not many embraced this opportunity and included training in their research protocol or when designing a collaborative project.

7.3.2 External relationships

The effect of participation in collaborative scientific projects goes beyond the immediate relationship among project participants. Issues related to the ongoing negotiation and interaction with people and groups outside the project boundaries transpired into motivational factors affecting continuous participation. Interestingly, bar for the theme of social responsibility that affected the initial motivation of volunteers in Costa Rica, the role of external relationships surfaced only as a secondary (or continuous) motivation and didn't affect volunteers' initial inclination to participate in collaborative scientific projects. In addition, where initial motivations, and the internal relationships among the projects' participants speak to what Batson et al. (2002) identified as "egoistic" motivation, external relationships were based on the other three motivational factors Batson et al. identified, namely collectivism, altruism, and principlism.

Education and outreach

Most volunteers did not become engaged in collaborative scientific projects in order to create change but due to personal interests. However, through their participation they became exposed to the effects collaborative scientific projects can have on their immediate environment and beyond it, and for some volunteers this became a major cause which they pursued. In turn, this cause motivated them to extend their participation even more. The move from self-related motivation to collectivistic or altruistic one was not trivial – by definition volunteers have fewer avenues to extend their knowledge to others, and their status is not as highly regarded as that of professional scientists. Yet, in many cases they saw their role as mediators between local communities and scientists. As they were standing in the middle - not professionals, yet knowledgeable enough to offer an insightful perspective – they facilitated knowledge transfer to the local community (in a few cases the exchange was mutual and indigenous knowledge was reported back to the scientists, but these cases were relatively rare). Throughout this process, volunteers became aware of issues of education and outreach that pertained to the local communities, and sought to improve the well-being of the relevant community and its members. Educational efforts took place in formal settings (i.e. schools) but also in informal ones (i.e. in the field), and were aimed mostly at school-children, but with the hope of reaching their parents through them. Education as a motivational factor was especially salient where volunteers encountered remote communities or populations that were not regularly offered structured educational opportunities (India and Costa Rica), or whose exposure to conservation-related education was lacking (United States). Beyond awareness, education was seen as a tool to empower the local population and enable it to combine ecologically-minded and sustainable practices with its economic and social needs. For example, excessive fishing or pollution of water bodies was directly related to the ability of the community to support itself financially, yet in many cases these practices were rooted in long standing traditions that were not questioned. Through public education some of these practices were slowly modified, leading to a stronger and more sustainable economy. In other cases education was used to offer locals alternative financial resources (e.g. eco-tourism) that would compensate them for the fiscal loss they would suffer if they did not overuse natural resources. The informal rapport that led to public education enhanced the sense of purpose volunteers had, and acted as a strong motivator for their continuous participation. Where actionable results became apparent – whether these were changes in the hunting or eating habits of the local population, or a move toward sustainable practices that protected the local environment, volunteers felt that the purpose of their participation was greater than just data collection or assisting scientists, and they were more inclined to continue and participate over extended periods of time.

Policy and activism

Some volunteers saw their involvement in collaborative scientific projects as a tool for advancing political awareness and activism. Policy and activism were meant to complement education as an actionable process that would allow locals to protect their needs while understanding the ecological implications these needs and actions have, and were directed at the local population, but had an effect that went beyond geographical proximity. Empowering locals to understand the broader aspects of environmental actions and policies was intended to give them tools that will allow them to be independent and active in maintaining their needs, and promoting them toward statutory and governing institutions. Volunteers envisioned a process in which awareness leads to an understanding of how development works, what are the effects it may have on the local community and on the local natural resources, and how the community can come together to reach its goals. They did not actively push toward action, but saw their role as facilitators of awareness toward civic action. Again, the more they saw actual results, or at least a move toward them, the more they were motivated to continue and engage in collaborative scientific projects.

7.3.3 De-motivating factors

Participation does not happen in a void. As described in the previous sections, in order to actualize participation favorable inclination toward collaborative scientific projects has to be complemented by various motivational factors that will drive volunteers to act. At the same time, de-motivating factors also affect participation, and particularly continuous participation. The tension between these forces directs in many cases the depth of commitment toward the collaborative project, and the level of attrition throughout the project's lifecycle. Attrition rates among volunteers in collaborative scientific projects were discussed across all cases, and were estimated to range between 80 to 95 percent. This could be due to several issues: the lack of positive motivational factors, their slow disappearance with time, or alternatively, the existence of de-motivating factors. Unlike motivating factors that reflected the relationship between volunteers and other participants or volunteers and the broader communities, demotivating factors spoke to internal negotiations between the demands of the "project" as an entity, and the volunteers.

The recurrent themes that addressed the latter option (presented in Table 7-4 Themes related to de-motivating factors affecting continuous participation, spoke of time and technology as the most prominent independent de-motivating factors.

Theme	Related concepts	Potential participants	Countries
Time	Intensity, demands, commitment, breakdown of tasks	Professionals, hobbyists	US, India, Costa Rica
Technology	Accessibility, infrastructure (lack of), project design	Field workers, project leaders, seasoned volunteers	India, Costa Ricaa

Table 7-4 Themes related to de-motivating factors affecting continuous participation

Time –

Volunteers who were enthusiastic at the prospect of participating in collaborative scientific projects became disenchanted with the project if the demands placed on their free time were too high. Interest, enjoyment, and challenge were not enough to overcome excessive time demands. Some volunteers complained that scientists had no appreciation of their time, and demanded they engage in overly complex and time-intensive tasks protocol. While some volunteers appreciated intensive projects that made them feel more committed to the scientific goals, most volunteers balked at the thought of spending too much time (a subjective term that could stretch from a morning every week to continuous immersion in the field) on a given project. Projects that placed such demands on the volunteers often suffered from greater attrition rates than others that broke down tasks into manageable building blocks. Similarly, projects that required extensive travel to remote areas (especially in India) were seen as less favorable than local projects that could be interlaced with volunteers' routine. Limited scale projects that were focused on the volunteer's immediate environment (e.g. in the back yard, in a local park, within the state) and required an incremental time commitment (e.g. observations for blocks of 10 minutes each, weekly or even daily) were agreed to be manageable and even fun, but taxing volunteers with a more intensive time commitment had an opposite motivational effect, leading to a decline in participation.

Technology –

Projects that were (or could potentially be) made easy through the use of technology, but failed to deliver on that aspect, frustrated volunteers and discouraged them. This problem was apparent in the cases of India and Costa Rica where the technological infrastructure (and especially mobile and web connectivity) is extremely poor in some rural areas, and is somewhat limited even in urban areas. When volunteers were asked to go into the field in order to record observations, but were armed only with pen and paper, the tasks they were assigned became difficult and frustrating – especially when they expected some use of technology to enable their work. In some cases volunteers were surprised by the lack of technological resources as they arrived at the research site. In other cases some data was lost in the move between paper notes and electronic databases. These occurrences frustrated and left many volunteers.

De-motivating factors can be summed up as "ease of participation". The projects that addressed this issue and built into their design mechanisms to allow volunteers to take upon themselves scaffolded tasks that fit their abilities and spare time, or enabled them to make use of technological tools that would make their tasks easier, were the ones that managed to engage volunteers for extended periods of time.

7.3.4 Applying the theoretical framework to continuous motivations

To examine the change in volunteers' motivation over time, the inquiry commenced from Batson et al. (2002) four motivations of social identity. The initial stage of participation was overwhelmingly dependent on a self-directed motivation, which could be aligned with Batson et al. *egoism.* Based on the growing complexity of participants, events, processes, and activities that typify the ongoing stages of collaborative scientific projects, I was expecting to find a similarly complex system of various motivations that guided continuous participation. Therefore, it was initially surprising to find that even in the case of continuous participation motivational factors could roughly be divided into two groups – egoistic and collectivistic – with the latter absorbing the two other motivations that look beyond the individual (i.e. altruism and principlism). This was due to several issues: first, the relative ambiguous breakdown of Batson et al.'s definition of collectivistic motivations, which are based on the intended audience of the action. For example, altruism is understood as doing something for someone else's greater good. But isn't an altruistic action already based on some prior principal that dictated the altruistic behavior? And, shouldn't it always be the product of some principle? Or, when a volunteer acts within his local community, but his activity is expected to affect other communities – would basing the exact definition on the intended audience attribute his motivation to collective or altruistic principals? When volunteers were asked directly about their motivations in the context of their activities and experiences through the lens of Batson et al.'s theoretical framework, they often stumbled and found the distinction between them difficult to tease out. As one interviewee said in a moment of frustration "I don't just do it for myself, and for me it is enough". In the same manner, when trying to tease related concepts and themes that speak to Batson et al. framework it was almost impossible to do so in the context of collaborative scientific projects. The boundaries between acts coming from collectivism, altruism, and principlism (Batson's fuzziest concept) were extremely difficult to chart. Ultimately, it seemed that there are two large "silos" of motivation that can chart the theoretical framework addressing social motivations (see Figure 7-1): one was all types of motivations directed at "the self" (including personal interest, self efficacy, learning, trust, acknowledgement, and mentoring) and the other compiled of motivations directed at others in general (e.g. education, empowerment, activism, policy changes, and social responsibility), which can be grouped under the term "collective motivations".

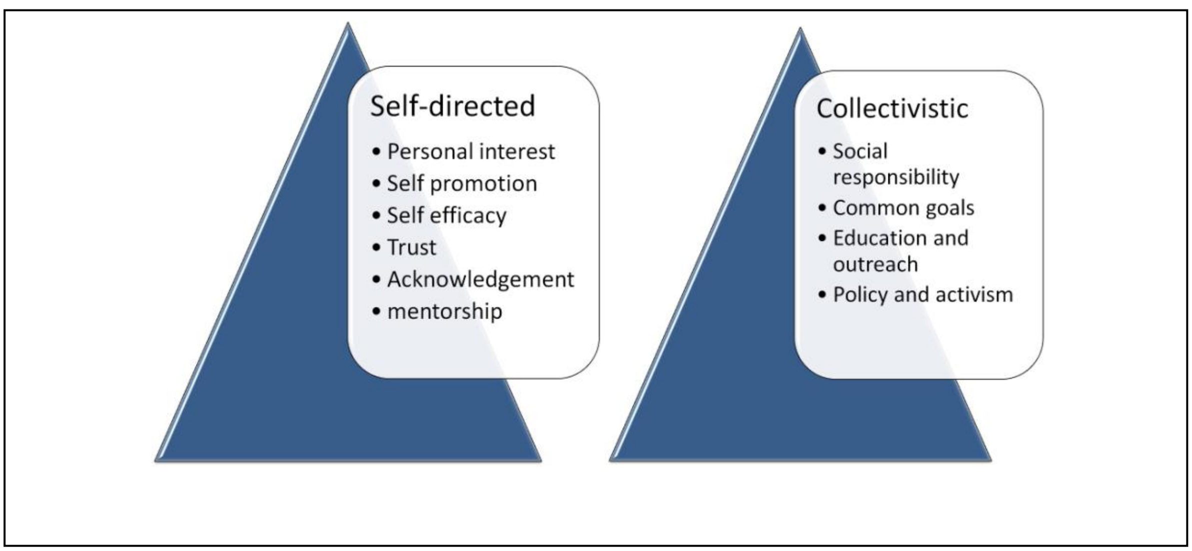


Figure 7-1 The two silos of motivation - self-directed and collectivistic replacing Batson's framework of four social motivations

While the theory of Baston et al. originally seemed apt for examining the motivational aspects of collaborative scientific projects, in this specific context the theory is imperfect. Collapsing Batson et al.'s three collective motivations (collectivism, altruism, and principlism) allows for separation between self-directed motivations and those that pertain to the "other" – a population, a community, a group, a locale, or even a county, whether they are related to the individual volunteer or not.

7.3.5 RQ2: do volunteers' motivations change over time?

RQ2 set out to address the issue of continuous participation and examine how different motivations affect it. The analysis showed that long term participation is affected by myriad aspects, ranging from those reflecting self-directed motivations, within the context of project-specific relationships, to external relationships that extend beyond the project, and affect individuals and communities outside it. At the same time, demotivating factors affect participation negatively and may cause attrition throughout the project lifecycle. Continued participation reflects a complex relationship coming from both self-directed and collectivistic aspects.

7.4 Motivating factors in different cultures

Culture is an important background against which motivation is evaluated. Therefore, a close examination of the way different cultures approach motivation as well as collaboration practices is warranted in order to provide a holistic picture of their interdependence. This exploratory study started from the assumption that each national culture is inherently unique. Culture was divided into three main types – national culture, collaborative culture, and scientific culture. The combination of all was expected to provide a unique approach to collaborative scientific projects in each country. As with many exploratory studies, the results were quite surprising. The following section will discuss the role culture has on collaborative scientific projects, and how different cultures shape motivational aspects.

7.4.1 The cultural foundations

Culture is a complex and ambiguous term. Defining what constitutes a culture is a matter for on-going debate in various domains (Geertz, 1973; Kluchhon, 1951; Malinowski, 1939), and is beyond the scope of this study. Here, I address the three types of culture that pertain to the way collaborative scientific projects are shaped, and the effect they have on volunteers' motivation – namely, national, collaborative, and scientific culture.

These sub-cultures are described in detail in chapter 2, but in general *national culture* is defined as the structures, values, and relationships among members of one group which is situated in a specific geographic area during a certain period; *scientific culture* reflects the knowledge of science by people and their attitudes toward science and technology; and, *collaborative culture* encourages individuals to contribute toward the common good. The following discussion will focus on the themes related to culture that came up from the data that was specifically collected in this study. The four major themes are presented in Table 7-5. These themes reflect the way culture was addressed in the interviews, and how it relates both to the three different cultural aspects, as well as to the cultural scales offered by Hofstede (1980).

Theme	Related concepts	Cultural effect	Representation on Hofstede's scales	Country
Ethos	Pride, story-telling, symbols, values, diversity, communication	National culture, collaborative culture	Individualism vs. collectivism, masculinity vs. femininity, long vs. short term	Costa Rica, India
Education	Learning, formal education, informal education, fiscal support	National culture, scientific culture	Uncertainty avoidance, long vs. short term	Costa Rica, US, India
Language	Interpretation, mediation, communication, distance, cultural bridges, social stratification	National culture, scientific culture	Power distance, individualism vs. collectivism	India, Costa Rica
Institutions	Hierarchy, bureaucracy, fiscal support, government agencies, partnerships	National culture, collaborative culture	Uncertainty avoidance, power distance	India, Costa Rica, US

Table 7-5 Cultural themes and their application to the three cases

7.4.2 Ethos

Cultural ethos speaks to the broad framework of the way culture transpires within a specific nation. Although both scientific and collaborative cultures can be widely affected by the national ethos, it is first and foremost a determining factor shaping the overall national culture. When speaking of ethos the concepts of values, symbols, practices, and how they are communicated among members of the specific culture come to mind. In all three cases, these concepts were often discussed, as well as the way they shape the- and are reflected in- collaborative scientific projects. The importance of the national ethos cannot be underestimated – it was the driving force behind the existence of collaborative scientific projects and their success in each case. The discussion of national ethos was often implied or underlined in participants' descriptions, as they used different terms that characterize it, such as "pride", "support", and "values", and thick descriptions of the emotional negotiations among members of their country. These terms often turned into telling experiences by which the cultural ethos was shared and passed along among members of the specific culture – some examples included external and public symbols (monetary bills in Costa Rica) or heritage-related story telling (the ritualistic role monkeys have in India). The cultural learning process that passed these values and symbols throughout the different societies was highly dependent on support of the cultural ethos, but was not always supported by local institutions (i.e. the government or the formal education system). That did not stop the national ethos from being created and passed on within and across communities. National ethos was apparently easier to create in small and relatively homogenous countries like Costa Rica, especially as it was institutionally supported and funded (in the case of ecology). It was much harder to follow the national ethos in a country that is huge and diverse like India. The fragmentation of India into dozens of states and the rich and diverse social backgrounds gave rise to alternative local ethos that changed along with geographical placement and heritage. Therefore, this study cannot speak to the dimensions of an "Indian ethos", but point out the conceptual similarities that were found in the descriptions offered by Indian participants, and emphasize that the more diverse the country, the more difficult it was to identify one particular ethos that could bring together participants from all over the country. Given this, the need for clear communication was even more crucial in the case of India than in the other two cases. Creating understandable and ongoing communication routes between the various populations that will address and honor their cultural backgrounds, yet facilitate a common ground that will support the overall national ethos was, apparently, extremely difficult. This affected the way both scientific and collaborative cultures were shaped – the distance and fragmentation of the various communities that make India led to disparate views of the scientific and the collaborative cultures. Interestingly, the two were at odds: in remote places, where local communities were tight-knit and people were highly dependent on each other, collaboration was an inherent practice; in the same places the scientific culture was less familiar, and often replaced with indigenous knowledge. Where scientists came to these communities in order to advance research projects they were often regarded with suspicion, and had to overcome social and practical barriers in order to gain acceptance into the community, or have its support. On the other hand, in urban areas, where more professional and educated population gathered, individualistic tendencies led participants to appreciate less the collaborative culture and prefer structured scientific culture over it. This was not found in the cases of the United States and Costa Rica.

7.4.3 Education

Education was often seen as an extension of the national values, and as a practical way of implementing them. As such it was both affected by culture and affecting it. In all three cases, participants referred both to formal and informal education as an important and effective tool. In India and Costa Rica a stronger emphasis was placed on formal education as a representative of the overall national culture, where in the United States education carried less intensive cultural meanings. Formal education was highly valued in both rural and urban areas (in both Costa Rica and India), but in many cases, due to lack of resources and institutional support it was the informal education that took precedence through incidental activities and meetings. Informal education was seen by volunteers as a potential bridge between local populations and the understanding of the scientific culture. In many cases, local communities were unexposed to the concepts of the scientific method through formal learning, and the volunteers sought to change that; yet, despite the fact that formal knowledge was highly regarded (and in some cases even considered trusted truth), moving from conceptualization and appreciation of such knowledge to the practical understanding of it and following this conceptualization into actionable activities almost always failed, due to the distance between the local cultural practices and the formal and rigid scientific culture.

Here, again, in the smaller and more homogenous country (Costa Rica) or the where the education system supported structured learning processes (the United States), it was easier to bridge between formal and informal learning practices.

7.4.4 Language

The theme of language in this context is multi-faceted: on one hand it refers to the basic concept of language as a tool for practical communication among people; on the other hand, participants referred to language as a mechanism for facilitating an intricate interaction between different social groups, within and beyond collaborative scientific projects.

Language as a tool –

Common and scientific languages differ in the terms they use and how they use them. While scientists tended to use formal taxa, other participants such as volunteers would often use the local names they are familiar with. Both scientists and volunteers needed to learn the linguistic associations and the way they were used by the other population in order to facilitate collaboration. But in many cases it was hard to overcome inherent beliefs about how language should be used, and what are the "correct" terms that describe a species or a phenomena. English was seen as the primary scientific language and was often used to convey scientific findings and instructions. This was effective in countries or areas in which English is widely spoken (the United States, most of Costa Rica, and the urban parts of India), yet was extremely problematic in rural areas where mostly local dialects were used. Indigenous terms were often disregarded in favor of scientific terms (in some cases due to practical requirements of common databases and scientific tools, in other cases due to scientific arrogance), creating misunderstandings and mutual hesitation.

Social stratification created by language –

The use of different terms by different communities surfaced another linguistic issue that had implicit cultural meanings within collaborative scientific projects. As a hint of social stratification, the terms that were used by scientists to describe the volunteers and imply their roles varied greatly by case. From "volunteers" and "citizen scientists" in the United States, to "amateurs", "enthusiasts" and "naturalists" in India, and "urban scientists" in Costa Rica. The emphasis on using the proper terms was so great, that it took several iterations of the terms used in the survey that was to be disseminated in India to become acceptable to our Indian colleagues. The importance of using proper terms was based not only on a correct description, but also on social implications. The language was used to convey cultural meanings of distance or closeness between participants: by naming them "amateurs" or "enthusiasts" they are distanced from professional scientists and their value was relatively diminished. Using terms like "citizen scientists" or "urban scientists" brings them closer to the scientific world and implies to their rank as knowledgeable individuals who can positively contribute to collaborative projects. This is mostly the outcome of power distance relationships that are embedded in the local culture: while India is a highly rigid culture that places an emphasis on social stratification, the United States is a more liberal and open society that does not always place an emphasize on formal credentials but rather on experience, and Costa Rica is a small and tight-knit society in which power distance in not prevalent.

Language as a mediated object –

While language was used in some cases to create social stratification, quite a few volunteers saw language as an instrument to shape the interaction between the local culture and the scientific culture. By placing themselves in the role of mediators, clarifying meanings and practices that are constructed through language, they aimed to facilitate a stronger bond between scientists and locals. Scientists often did not have time for this, nor did they see this mediation as part of their responsibilities, and in many cases this was left to volunteers who bridged between the two communities. Here, language was an asset that allowed volunteers to act within and between the two worlds, understand both communities, and import crucial cultural and practical aspects across the division between the different populations. This mediation was especially significant in the interaction that happened with remote communities (especially in Costa Rica, and to some extent in India), but also – on a smaller scale – with different communities that were less exposed to scientific principles, like school kids and interested adults (mostly in the United States and Costa Rica). This practice was highly impacted by the effects of both the local scientific and collaborative cultures: in cultures that placed an emphasis on science and collaboration (the United States and Costa Rica) this role was accepted and deemed important. By contrast, in India, in which the collaborative culture was less pronounced volunteers did not often engage in such mediation.

7.4.5 Institutions

Just as education is both a manifestation of culture and shapes the culture, so do the various formal and informal institutions a country has. The variety of institutional structures that were discussed in each case exemplifies how unique each culture was, and how deep the effect of those institutions have on collaborative scientific projects:

- The United States – Many collaborative scientific projects are supported and funded by governmental agencies either directly (e.g. NPS, NOAA) or though supported institutions (e.g. NSF support for academic research projects). In addition many country-wide and local NGOs and other organizations are engaged in smaller scale projects. The formal requirements for initiating and implementing a project are highly structured but relatively non-complex.
- India – India is an extremely bureaucratic country, mandated by local, state, and country governments. In order to initiate a collaborative scientific project, administrators need to get an approval from all relevant agencies and

governments. This process may take several months to more than a year. Financial support from the government is rarely available, but some support is available through NGOs and charities.

- Costa Rica – Bureaucracy exists but is rarely effective. There is a deep engagement of the government in ecology related projects, and a strong commitment to support them. Many collaborative scientific projects are the outcome of partnerships between various government agencies and academic institutions or local and foreign NGOs. Other projects are the outcome of individual initiatives that are not always backed by formal institutions.

These three models are inherently different and speak not only to the value each country places on collaborative scientific projects, but more than that to the national culture. Strongly hierarchical cultures like India, which exemplifies the power distance between individuals and institutions, are not automatically supportive of projects that are external to the system, while cultures that are less hierarchical or accept the role of individuals in creating societal initiatives provide them support, according to the culturally determined values, and place fewer restrictions on implementing them.

7.5 The relationship between national, scientific, and collaborative cultures

Three separate sub-cultures make up the overall cultural framework that affects collaborative scientific projects: national culture, collaborative culture, and scientific culture. Within each case in this study, every sub-culture took a different place and had a different effect on the local practices and norms. That said, the analysis showed that the three sub-cultures are tightly connected and affect each other in various ways.

First and foremost, national culture overshadows the other two subcultures. Based on ethos and foundational principles the national culture determines to a large extent how both the collaborative and scientific sub-cultures will be shaped and enacted. For example, an individualistic culture which prefers personal development over joint social acts will tend to offer less institutional support to collaborative projects. Similarly, cultures that value local rituals and learning may be opposed to the external practices of a structured scientific culture. At the same time, influences of collaborative and scientific cultures may filter into the national culture and slowly shape it. The primacy of the national culture was evident in all the cases that were studied, and determined how the other two cultures were viewed.

It was interesting to note that across all cases, the scientific culture was second only to the national culture, and greatly affected how collaborative projects were understood and accepted.

This was especially noticeable where participants who were not scientists were involved in such projects – jargon, structure, and actions were totally mandated by scientific principles, and volunteers followed the principles of the scientific culture faithfully. Yet, despite the seeming importance of the scientific sub-culture in shaping activities and views, it often remained ambiguous and remote. Additionally, when tensions arose between the national culture and the scientific one (as with the case of local customs that negated scientific practices, like sea-turtle hunting which put the species in danger but was considered an honored tradition) usually the national culture prevailed.

Collaborative culture was evident in the overall cultural structure, but its role and importance was slightly less pronounced than that of the scientific culture, and significantly less than that of the national culture, though it was strongly tied with the national culture and shaped by it.

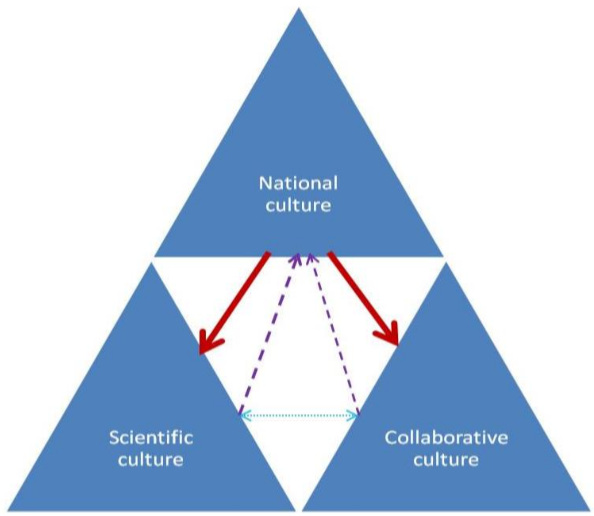


Figure 7-2 The relationship between three sub-cultures: national, collaborative, and scientific, representing the effect each subculture has on the others

Figure 7-2 represents the relationships among the three subcultures: the national culture has primacy over the other two sub-cultures. It highly affects how they are shaped, and how they affect individuals and groups. While both the scientific and the collaborative sub-cultures have some mutual effect on the national culture, their effect is less pronounced, and where it shapes the national culture it is a long and slow process. Finally, collaborative and scientific sub-cultures have a mutual effect on each other, but it is relatively minute, and was not observed in all cases.

These complex relationships are shaped somewhat differently in the three cases. This reflects back to Hofstede (1980) theory of social dimensions which located the three countries along different points on the various cultural dimensions. Although Hofstede specifically discussed the composition of a national culture, and did not address other sub-cultures, the institutions, practices, and activities he based his work on are relevant to the two other subcultures as well.

According to Hofstede, the United States represents the most individualistic and masculine culture, followed closely by India with Costa Rica being a far more collectivistic and feminine culture. At the same time, power distance relationships place India as the most rigidly structured culture, with the United States and Costa Rica close to each other and far behind it. Completing this analysis, Costa Rica leads in security seeking and uncertainty avoidance (translated into emotional attachment) while the United States and India are ranked closely as less emotional and more structured.

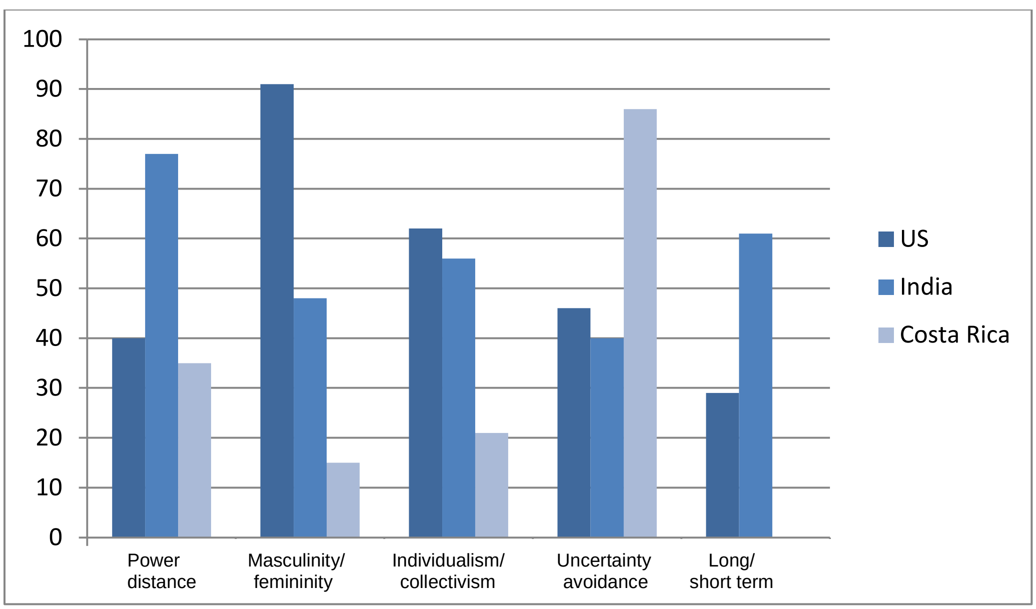


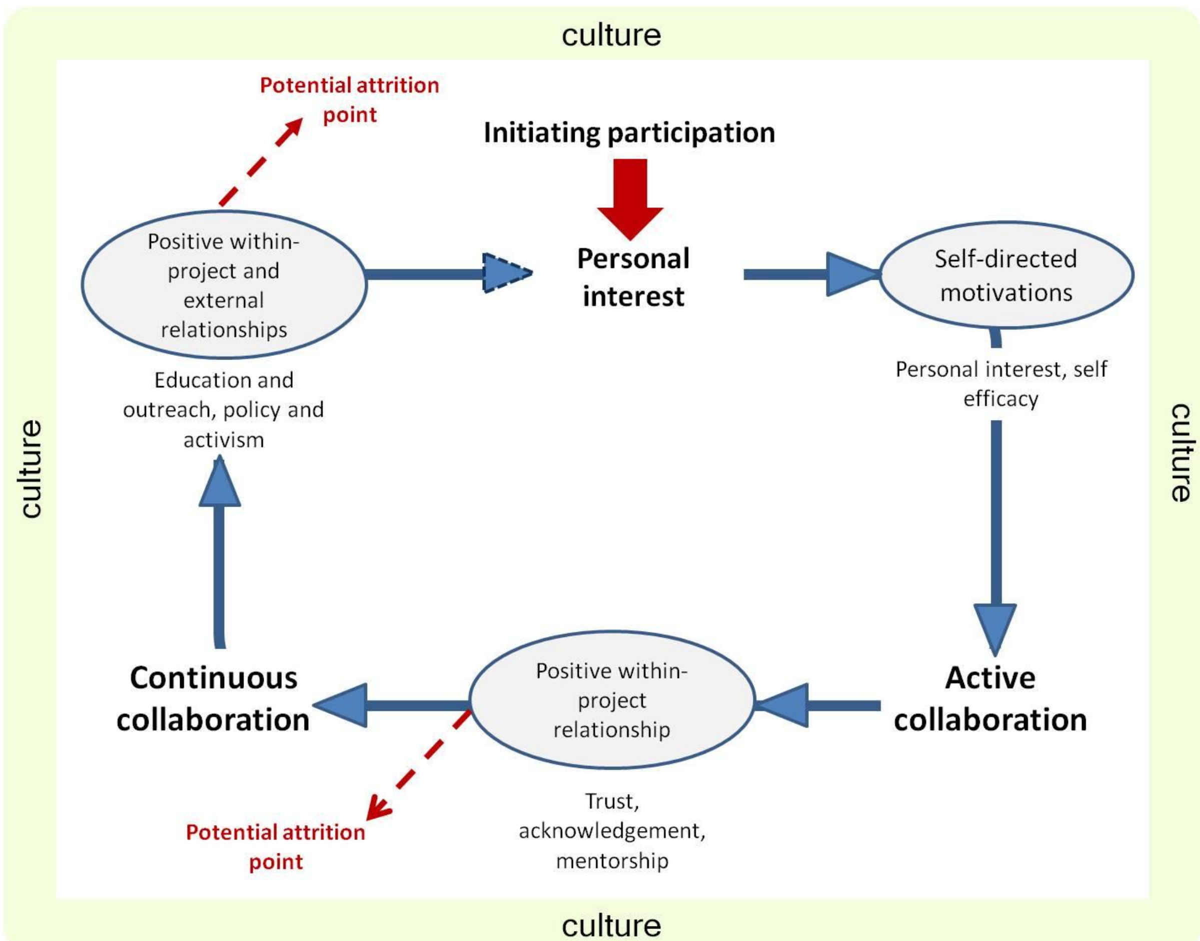
Figure 3-1 A comparison of Hofstede's dimensions across the three countries in the study (reprinted from chapter 3)

Looking at the placement of each case on the cultural dimensions scales, it is not surprising that the three sub-cultures are shaped differently in each country. Highly individualistic cultures like the United States and India will likely favor individual initiatives and actions over collaborative ones, and are expected to place a substantial emphasis on formal knowledge and professionalism. Comparatively, collectivism is highly regarded and supported in Costa Rica, both according to Hofstede's theory and to this study's findings, leading to broader support of collaborative initiatives that involve various populations. It is interesting to see the value and recognition that collaborative culture received in the United States, which negates its individualistic and masculine placement on Hofstede's scale. This may be due to the specifics of collaborative scientific projects as benefitting both the society and individuals, to the fact that individuals who are involved in collaborative scientific projects do not represent the overall population because they are predisposed to engage in collectivistic efforts, or to changing cultural tendencies, but this study cannot answer this question. It should also be noted that Hofstede referred to countries as monolithic entities, comprised of the same population across their geographic borders, with the population sharing the same values and practices. Later studies (McSweeny, 2002; Myers & Tan, 2002) critiqued his works for this view; this critique also applies in this study – as was previously described, even within one country or geographical area there is a great variety of practices, norms, values, and communities. This heterogeneity is hard to capture solely by comparing a whole nation against singular dimensions. Therefore, while Hofstede's theory is helpful in generally distinguishing between the various cases, it cannot fully explain the particular findings that describe the various properties of each sub-culture, and their inter-relationships.

7.6 RQ3 - Cultural effects on motivation and participation

Because motivation is highly dependent on the context and circumstances in which it is created, the role of specific cultures in its creation should not be underestimated. However, the relationship between culture and motivation is implicit at times, and hard to tease out. When looking at the way motivational factors play out in the three cases there are very few noticeable differences at first. Most volunteers commence their participation in collaborative scientific projects because of self-related motivations. These motivations dictate not only the initial process of selecting and joining a project, but continue throughout the project, and determine to a large extent the inclination of volunteers to continue and participate for extended periods of time. However, at later stages of the project motivations that pertain not only to the self surface. In most cases, collectivistic motivations have a substantial influence on continuous participation in collaborative scientific projects for extended periods of time. These motivational factors were observed across all the three cases that were studied. That said, a closer look at how motivation is shaped, and especially at the way each motivational factor weaves through the project lifecycle, shows the difference between the cases, and how the unique cultures affect motivation. Based on the analysis of initial and continuous motivation that was presented in Sections 7.2 and 7.3 the following figures present the cycle of participation in each of the three cases that were examined.

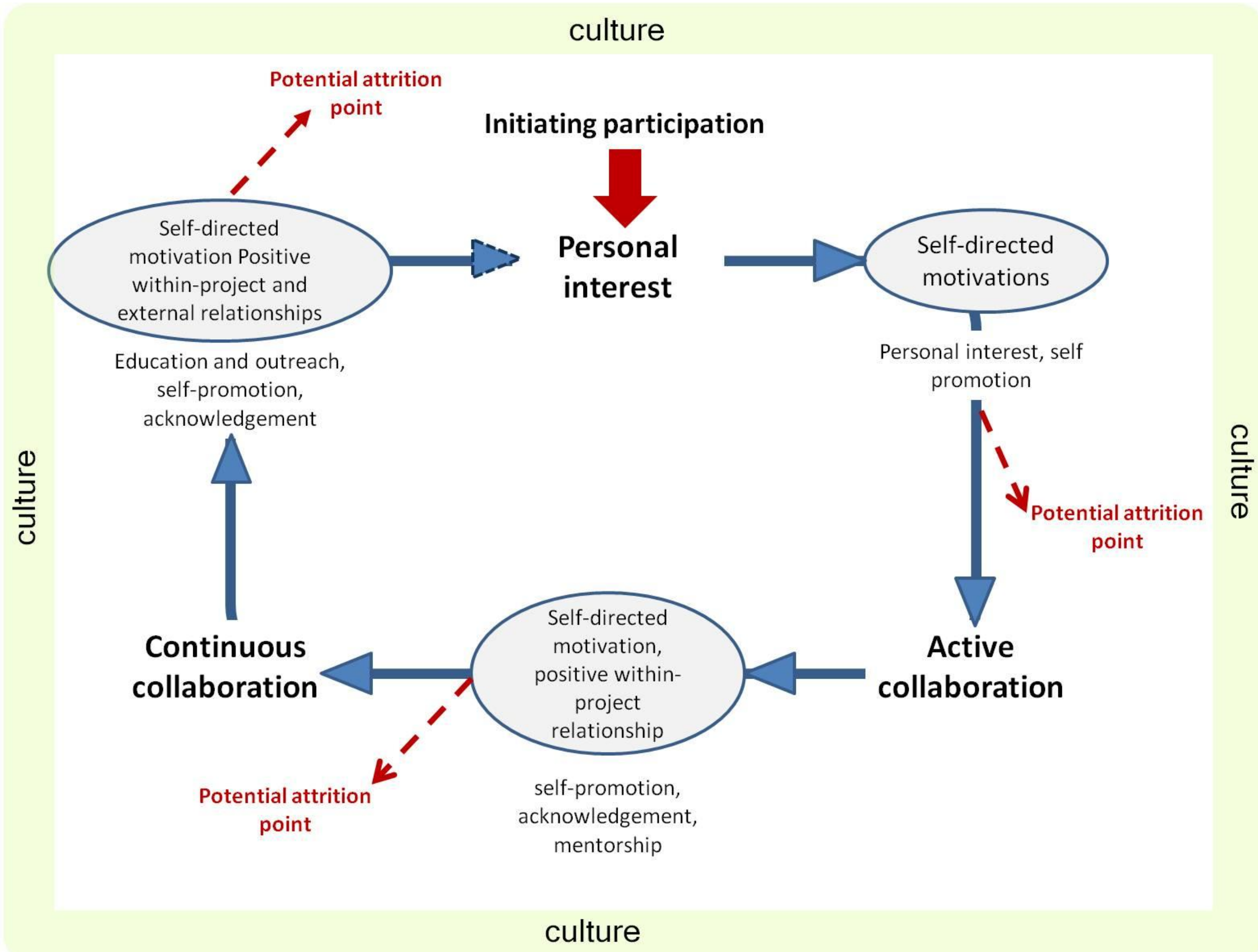
Figure 7-3 demonstrates volunteers' participation throughout a project's lifecycle in the United States. In this case, the antecedent to actualizing participation is an initial interest in the subject-matter of the project or in its purpose (e.g. a specific species or activity). Following that, potential volunteers seek opportunities that match their interests, but also supply them with openings for self-promotion and a sense of self-efficacy as they contribute to scientific work. At this point, as participation becomes an actuality, positive within-project reinforcements, which are directed at the individual volunteer (e.g. acknowledgement, trust building, and mentorship), support continuous involvement. Where these are missing, some volunteers will become frustrated and leave the project.



7-3 The participation cycle of volunteers in the United States, highlighting the relationship between motivations and culture

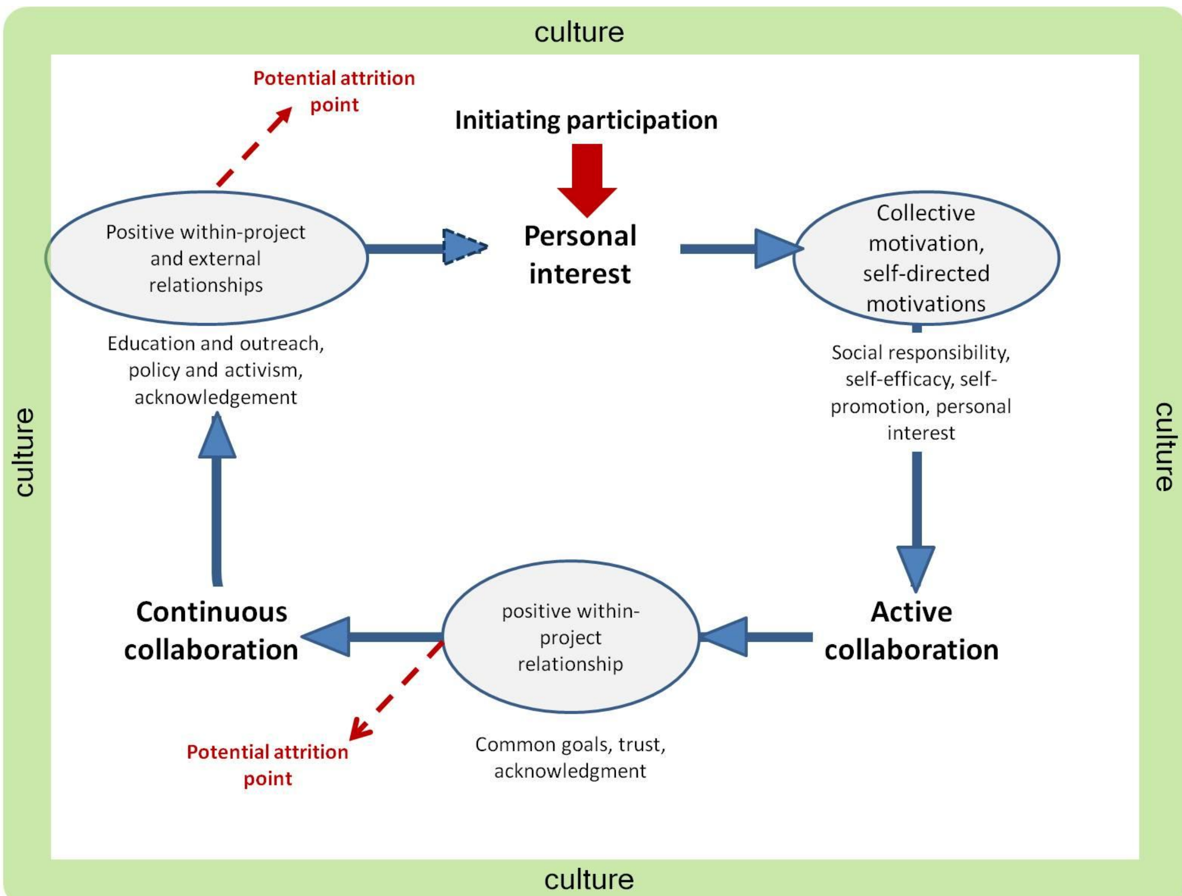
For those who remain active yet another type of motivation becomes effective - the effect contributions to collaborative scientific projects have on an audience beyond the project participant. Education, outreach, policy changes and activism, and their actionable results become as important as self-directed motivations. This is another potentially fragile point in the participation lifecycle. As the collective motivations become important projects that do not address these issues may suffer from higher attrition rates. At the same time, self-directed motivations are continuously woven throughout the participation cycle, and where they are missing or if they disappear, volunteers may also leave the project. This analysis demonstrates how dominant self-directed motivational factors are in determining participation practices, but also accentuates the role collectivistic motivational factors have in supporting continuous participation.

In comparison, a similar model depicting participation practices in India (Figure 7-4) shows a slightly different scenario. Here, as well, participation commences from personal interest. Yet, the self-directed motivational factors are more pronounced throughout the project lifecycle, as self-promotion and acknowledgement become important motivators both for initial participation and continuous participation. While collaborative motivations do appear to influence continuous participation, their role is secondary to self-directed motivations, and lacking substantial reinforcement of self-directed motivations, collaborative motivations will not be sufficient to maintain continuous participation. In addition there are more fragile points in which attrition happens, mostly because of volunteers' continuous need to reaffirm the self-directed value that they gain from participating in the project – where these do not meet their needs, volunteers tend to discontinue their participation, even if the project still holds a collective value.



7-4 The participation cycle of volunteers in India, highlighting the relationship between motivations and culture

An inherently different picture is shown through the participation cycle in Costa Rica (7-5). Although here, like in the United States and India, participation commences from a personal interest its actualization is highly dependent on collective motivational factors side by side with self-directed motivations. The active collaboration stems from a sense of social responsibility, complemented by a range of self-directed motivations (first and foremost personal interest). But these self-directed motivations are secondary, or at best, equally important as the collectivistic motivation. Later, self-directed motivations that represent within-project relationships become apparent and affective in determining the depth of continuous participation yet, continuous collaboration remains highly dependent on collaborative motivations that take precedence over self-directed motivations. While points of attrition exist here as well, they resemble those described in the US, and not the ones in India.



7-5 The participation cycle of volunteers in Costa Rica, highlighting the relationship between motivations and the green culture

The motivational factors represented by the themes that came up from the data were repeated (albeit slightly differently) in the different cases, but the way they shaped and affected participation, the role they had in each case, their temporal nature, and their significance was extremely different in each case. This variance followed the cultural aspects that characterized each case: in a highly individualistic country like India, self-related motivational factors dictated to a large part the types of motivational factors that affected participation, and shaped participation such that when these self-directed motivations were missing participation declined drastically. In comparison, a collectivistic culture like that in Costa Rica emphasized social responsibility and other collectivistic motivations as a basis for participation. The United States was a middle case in which both self-directed and collectivistic motivational factors largely determined participation practices. The variance in how motivational factors are viewed by each culture, and in how they shape the participation process, suggests that although there is significant similarity in the general type of motivational factors that are related to ecology-based collaborative scientific projects, the way they affect participation and motivation is tightly related to cultural aspects. This relationship is nuanced, and may be not noticeable at first, as the participation cycles (Figures 7-3, 7-4, 7-5) seem quite similar, but a closer look at the initial impetus for participation, as well as the pivotal points in which motivation affects retention and attrition, shows that the difference among the three cases is instrumental and greater than originally perceived. This is critically important when thinking about the design of collaborative scientific projects, given that the great cultural variety affects motivation in a profound way. In this scenario there cannot be a uniform protocol of design solution that would fit the extremely varied nature of motivation. Rather a "tailored" approach that acknowledges the particular characteristics of each culture and how they affect motivation through time should lead any attempt at creating and implementing collaborative scientific projects, even when all other attributes of the projects are similar.

7.7 Summary

This exploratory study set to examine the over arching question of how can we motivate volunteers to continuously collaborate with scientists toward large scale biodiversity projects, in different cultures. To do this, three different sub-questions were examined: what brings volunteers to contribute to collaborative ecology projects scientists? Do volunteers' motivations change over time? And, are the motivating factors similar across different cultures?

The cross-case analysis offered a unique view of three inherently different cultures in which collaborative scientific projects happen regularly. Although the data suggests that motivations are almost similar across cases, their manifestation – over time and within locales – is extremely different.

The process of participation is highly dependent on motivation. As the initial motivation for participation stems from self-related motivations, volunteers are initially attracted to projects that are seemingly interesting, but an interest is not enough to warrant participation. Elements of self-advancement and enjoyment are crucial in order to actualize participation. For continuous participation, the motivational process becomes more complex and includes both self-related motivations and collaborative motivations. In addition within-project relationships and external relationships determine, to a large extent; volunteers' inclination to maintain their participation in the project. This part of the study answers the second research question, and offers new understandings as to the motivational process that affects continuous participation. The third research question addressed various aspects of culture and their effect on motivation. To do that, the three cases, representing three distinct cultures, were compared, and the basic cultural principals that were teased out of the data, were superimposed on the motivational factors that were identified earlier. From this, it became apparent that cultural aspects that speak to the unique aspects of each national, collaborative, and scientific culture have a substantial effect on the way motivation is shaped and how and when it is effective. While this effect is nuanced, it cannot be underestimated, and should be carefully evaluated before embarking on new projects.

8 Conclusions, Limitations and Future Work

This chapter begins by briefly summarizing the findings from this study and contextualizing them against the research questions. It then discusses the limitations of the study, and suggests opportunities for future research. The chapter concludes by highlighting the contributions of the study.

8.1 Summary and Conclusions

Collaborative scientific projects that are highly dependent on volunteer participation have become extremely popular in the last decade. Cutting across disciplines, geographic places, and participation practices, they now involve hundreds of thousands of people all over the world, and are used to facilitate tasks that scientists cannot accomplish alone. Previous studies have looked at participation practices and motivational aspects mainly from the scientists' point of view, and have examined to a lesser extent initial participation; ongoing participation has rarely been studied. Given that many collaborative scientific projects are often grounded in a specific culture or locale, there was surprisingly little attention given to the cultural factors affecting participation and as to how motivation is shaped by culture. This study provides a first look into the relationship of motivation and culture in the context of ecology-based collaborative scientific projects.

This exploratory study set out to examine the over-arching question of how can we motivate volunteers to continuously collaborate with scientists towards large scale ecology projects, in various cultures. To do this, three case studies were independently researched, each focusing on a country representing different characteristics: the United

States, India, and Costa Rica. The inquiry into two of the cases involved both quantitative surveys and qualitative interviews, and the third case was based on qualitative interviews alone. The cases were then compared to surface similarities and differences in the way motivation is shaped, and in order to examine how culture affects the various motivational factors. To do that, three related sub-questions were examined: what brings volunteers to contribute to ecology-related collaborative scientific projects? Do volunteers' motivations change over time? And, are the motivating factors similar across different cultures?

By looking at the findings pertaining to the first two research questions we can chart a process of participation that is highly dependent on motivation. As the initial motivation for participation stems from self-related motivations, volunteers are inclined to participate in projects that offer them interest, self-advancement and enjoyment. This correlates well with the existing literature that discusses initial motivation in this context. At a later stage, the motivational process becomes more complex and includes both self-related motivations and collaborative motivations that dictate volunteers' long-term participation. In addition within-project relationships and external relationships determine, to a large extent, volunteers' inclination to maintain their participation in the project – a project has to show some value outside the actual tasks volunteers take upon them in order to be deemed important enough to warrant continuous participation. The last research question addressed various aspects of culture and their effect on motivation. To do that, the three cases, representing three distinct cultures, were compared, and the basic cultural principals that were observed were superimposed on the motivational factors that were identified earlier. From this, it became apparent that cultural aspects that speak to the national, collaborative, and scientific culture, have a substantial effect on the way motivation is shaped and how and when it is effective. Although the data suggests that motivations are almost similar across cases, their manifestation – over time and within locales – is extremely different. While this effect is nuanced, it cannot be underestimated, and should be carefully evaluated before embarking on new projects. Volunteers' cultural expectations and motivations should be specifically met in order to facilitate successful, long-lasting, collaborative projects, and prevent high attrition rates.

This study also placed the novel findings within existing theories that pertain to motivation and culture. While one of the leading theories of motivation presented by Batson et al. (2000) was an excellent basis for this exploration, the study showed that the categorization of motivational factors suggested by Batson et al. is too ambiguous at times, and doesn't capture the complete range of motivations – both when these are self-directed,and when they are directed at others - and how the various motivations relate to each other. Instead, I've suggested an alternative motivational framework, which largely distinguishes between self-related motivation and collective motivations, collapsing the three collective linked motivational (collectivism, altruism, and principlism) factors into one general collective motivation, thus aggregating all motivations pertaining to others on one hand, and all motivations pertaining to oneself on the other.

8.2 Limitations of the study

Several limitations affect this study. The limitations come both from the research questions and from the methods that were chosen. The overall research question which guided the study aimed to look at the differences in the way motivation plays out in various cultures. The focus on culture immediately conjures the image of a researcher set in the field, for extended periods of time, in the tradition of classic anthropological studies. As with other studies that focus on aspects of human-computer interaction, this study pulled from ethnographic methods, but in a compressed way that befits the subject matter. While this is an accepted practice, it should be noted and its limitations should be considered. While every effort was made to perform an in-depth analysis that would highlight experiences and meanings, the length of the study and the relative limited access to the fields were obstacles that affected the way the study was conducted; in order to try and overcome that, the interviews that were conducted, were intentionally long, and the qualitative data was complemented by quantitative data (in two of the three cases). This raises another methodological limitation: unlike the United States and India, in which a quantitative survey preceded the qualitative interviews, and helped in shaping the interview protocol, the Costa Rica study did not have a survey-based starting point. Although numerous attempts to recruit participants for the survey were made, participation was slim and did not warrant statistical analysis. This places the Costa Rica study on a different level than that of the United States or India, and requires future work to overcome the potential lack of a holistic picture of how motivation is shaped and manifested in Costa Rica. That said the interviews provided a rich depiction of collaborative scientific projects in Costa Rica, and that could be – at the very least – a convincing starting point for future analysis.

In addition, as with every study that is inherently qualitative there is always an a-priori choice between depth and breadth. Here, I chose depth over breadth, through focusing on a relatively small group of volunteers in each country (13 in the United States, 22 in India, and 9 in Costa Rica) and deeply looking into their experiences within the specific scope of ecological collaborative scientific projects. This is a one perspective that has been rarely studied, but it is just one among the many people and groups taking part in such projects. A broader study that would include a larger number of individuals in these and other roles, such as administrators, educators, or scientists, would have undoubtedly enriched the findings, but could not have been accomplished within the scope of this work. This is a typical characteristic of qualitative studies, which affects the generalizability and transferability of the findings. The goal of this study was not to present a representative sample of collaborative scientific projects around the world, or test various hypotheses related to different motivational factors. Rather, this is an exploratory study aiming to produce an initial theoretical framework that will be a basis for later studies. Narrowing the scope of the study to collaborative projects that focus on ecology/biodiversity, and providing an interpretive analysis leading to comparable theoretical frameworks which cut across cultures, ensures that this study is a sound basis for future explorations that will seek to confirm or refute the motivational processes that were outlined in here. Given the thick descriptions provided, and the details of the interpretive process that contextualized the data, future studies will be able to use the findings and the emergent theoretical framework that was presented in this work, in order to look at the way motivation transpires in collaborative scientific projects in different domains and in different countries. However, this is by no means a replicable or generalizable study.

One of the most critical limitations that should be noted in studies that look into cultural perspectives is the ingrained perspective of the researcher. No researcher comes into the field culturally neutral, and where a researcher visits other cultures this is all the more apparent. My individual characteristics (white, middle class, western, female) affected the way I perceive collaborative scientific projects, the way I understand the relationships created within and outside these projects, and even more than that – my grasp of the cultural differences between the three cases. Coming from Israel, and Living in the Unites States for almost a decade, my perspective was most similar to the United States interviewees, and contextualizing their reports was the easiest. I was most removed from the Indian participants, and needed both practical and conceptual translations in order to attain a better grasp of how things are done in India, and why. Costa Rica was more familiar to me, as I've travelled there several times in the past, yet my perspective was still that of a foreigner. This was especially evident where matters of culture (e.g. family relationships, social expectations, etc.) were discussed. This difficulty was not unnoticed. Throughout the research project I took care to note and reflect on my understandings of the cases – and particularly the cultural implications that were embedded in the data – and tried to make sure that my cultural values, assumptions and biases, as well as basic attributes did not affect the data collection or the interpretive process. To do that I kept reflexive notes in which I documented culture-related questions and observations, and consulted with colleagues from India and Costa Rica where needed.

8.3 Future work

This study is by no means a conclusive representation of the state of ecology-based collaborative scientific projects. The study highlights new perspectives that pertain to motivation and the way it is interwoven into cultural practices. Since collaborative scientific projects are growing rapidly, affecting more and more volunteers, scientists, and domains, future studies are needed to further explore additional perspectives that relate to engagement and participation. Deepening the study in Costa Rica, and extending the study to include other countries – some who share similarities with the current cases, and others which present different characteristics – will enrich the picture that was portrayed here. Future studies should also include closer partnership with locals, in order to overcome some of the cultural obstacles and present a more locally grounded understanding of this issue. In addition, it would be useful to render the qualitative findings into quantitative survey tools that will enable large scale comparative studies. Along the same lines, future work is needed to establish potential guidelines for the design of collaborative scientific projects according to specific cultural aspects, and testing these guidelines within viable projects in each country.

A different, but no less important trajectory would be to focus on the role technology has in affecting motivation, and specifically overcoming motivational barriers that are associated with limited infrastructure and technological imbalance. Where volunteers are hindered by the lack of access or tools, or have to accomplish complex tasks using nothing but pen and paper, motivation can only go so far.

Although from the outside collaborative scientific projects may seem uniform, bridging the gap between motivation and practicality necessitates a deeper look into how technology presents in different cultures, and how it is affected by the specific culture, so that any design scheme will be tailored to the needs and abilities of the unique culture.

8.4 Contributions of the study

The contributions of this work are both to the existing literature, and an improvement to the existing theoretical frameworks that discuss motivation. Through the comparative analysis of three different cases this study highlighted imperative aspects of collaborative scientific projects that coalesce motivation and culture. Providing both theoretical and practical implications, this study can support our understanding of existing collaborative scientific projects and affect the design and implementation of future projects.

Appendix A – Interview protocol

Interviews will be semi-structured, the following high-level questions and probes will be used to elicit responses from participants but other topics will be explored as well, based on the participants' responses.
Three areas will be discussed – collaboration of scientists and volunteers, motivation to contribute, and design.

<u>Collaboration between scientists and volunteers</u>

1. Please tell me a little bit about yourself and your experiences working with scientists/citizen scientists?

   Maybe a probe: What did you find most challenging?

2. Where do you think volunteers can be most helpful for the scientific process?

   Maybe a probe: Can you name a few processes or missions that volunteers can do that will help you in your work (this can be changed into "missions").

   Maybe a probe: If you had 200 committed citizens to help you collect data in the field, what would you have them do? What work would they need to perform? If it won't help you, personally – do you see any way they can help your extended professional community? Other scientists?

   Maybe a probe: Do you see any role for citizen scientists in the analysis process or only in the data collection phase?

3. Where do you see potential problems in getting help from volunteers (enthusiasts/citizen scientists)?

<u>Culture</u>

Do you find that there's support for collaborative scientific projects where you live? How?

Is it difficult to participate or conduct collaborative scientific projects?

Probe: Where do you see the major difficulties? What do you think is the best ways to overcome them?

<u>Motivation</u>

1. What would be the most important factor affecting your decision whether to collaborate with volunteers?

probe: if not discussing motivation directly – What motivates you to collaborate with Scientists/citizen scientist; What would make you unwilling to collaborate with volunteers

2. Do you think that there is one specific reason (or motivation) that mostly effects your participation in scientific projects? Please describe it.

3. Is there a difference between the initial motivation to participate in the project and the ones that cause you to take upon yourself continuous tasks or engage in following projects [*i.e. do other motivations come into play; does the initial motivation loses its power]*?

4. Are there any actions, process or tools that you find especially important in maintaining your interest in a scientific project?

5. Say there are 4 types of motivation – (1) doing something for your own good (interest, education); (2) doing something for your immediate community; (3) doing something for the greater good of society; (4) doing something because you believe in the principle behind it. Which one would be the most compelling to initiate your participation in scientific projects, and which (if at all) will be relevant at later stages? *[multiple answers are OK]*

6. Do you see your involvement in collaborative scientific projects affecting your local community? Other communities?

7. What are your thoughts about involvement in collaborative scientific projects in regards to educational efforts? Do you see them related? What kind of effect they have on each other?

<u>Design</u>

1. Tell us how you envision the best tool for collaboration between scientists and volunteers / what would be your "dream tool" for those purposes?

End by asking if there is anything that was not asked, anything that needs clarification, anything the interviewee wants to add, and get permission to contact the interviewee in the future.

Appendix B – Survey

Motivation for scientific collaboration - India

Thank you for participating in the survey.

The survey is conducted by researchers from the Smithsonian Institute, The Encyclopedia of Life, the University of Maryland, and The Western Ghats Portal. The study was approved by the University of Maryland Institutional Review Board (IRB protocol #10-0352).

The insights that you will provide are intended to inform the design of a platform for collaboration between citizens, naturalists, and scientists.

The survey should take no more than 10 minutes to complete.

Your input will be confidential and anonymous.

Motivation for scientific collaboration - India

Questions marked by * are mandatory.

1. Age

- ◯ Under 18
- ◯ 18-25
- ◯ 26-35
- ◯ 36-45
- ◯ 46-55
- ◯ 56-65
- ◯ Over 65

2. Gender

- ◯ Male
- ◯ Female

3. Years of experience in biodiversity and conservation

- ◯ Less than 1
- ◯ 1-3
- ◯ 4-5
- ◯ 5-10
- ◯ Over 10 years

*4. Involvement in biodiversity and conservation

- ☐ As a researcher in biodiversity and conservation science
- ☐ As a student in biological sciences
- ☐ As a naturalist interested in biodiversity and conservation

5. Institutional affiliation (if any)

6. Geographic location

Motivation for scientific collaboration - India

This section explores participation and collaborations between citizens, naturalists and scientists on biodiversity and conservation focused portals.
In the next questions you will be asked about your experiences:

7. Have you ever participated in an on-line collaborative project?

- [ ] No
- [ ] No - but would like to
- [ ] Yes - contributed to Wikipedia
- [ ] Yes - active on mailing lists
- [ ] Yes - other (please describe briefly the type of collaboration)

***8. The following questions will ask you about your opinion regarding collaboration on scientific projects. Please select the response that describes your reaction to each question.**

Collaboration between scientists and naturalists...

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
... is beneficial for producing better research	○	○	○	○	○
... is beneficial for the naturalist community	○	○	○	○	○
... makes me feel that I contribute to society	○	○	○	○	○
... is beneficial for scientists	○	○	○	○	○
... helps me in my work	○	○	○	○	○
... changes science	○	○	○	○	○
... improves the public's access to scientific findings	○	○	○	○	○
... improves naturalists access to scientific findings	○	○	○	○	○
... is fun	○	○	○	○	○
... produces data that help scientists	○	○	○	○	○
... provides insights that help scientists	○	○	○	○	○

Motivation for scientific collaboration - India

*** 9. Collaborative projects...**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
... help educate naturalists about scientific methods	○	○	○	○	○
... help me learn about scientific methods	○	○	○	○	○
... open my horizons to new ideas and knowledge	○	○	○	○	○
... are useless for my research goals	○	○	○	○	○
... are useless for the scientific community	○	○	○	○	○
... make scientific knowledge accessible to everyone	○	○	○	○	○
... help counter unsubstantiated and biased beliefs	○	○	○	○	○
... can damage the integrity of scientific work	○	○	○	○	○

*** 10. My involvement in collaborative projects...**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
.... promotes my status among my peers	○	○	○	○	○
.... promotes my status outside my community of peers	○	○	○	○	○
.... helps me learn more about science	○	○	○	○	○

*** 11. The most important motivation for my participation in biodiversity projects is:**

○ I enjoy this activity as a pastime

○ I learn a lot by participating in this activity

○ It helps me improve my status

○ I believe it is important for my community

○ I enjoy sharing my experiences of nature with the community

○ I believe it helps the greater good of society

○ It helps others, such as scientists and educators

○ I believe everyone should take part in something that benefits society

Other (please specify)

Motivation for scientific collaboration - India

12. Given below is a list of the different types of biodiversity data. We'd like to know what kind of data you would like to see and/ or contribute on a biodiversity portal. Please address each option independent of the others.

	View	Contribute
Photographs	☐	☐
Observations	☐	☐
Descriptions	☐	☐
Maps	☐	☐
Species identification	☐	☐
Raw data	☐	☐
Processed or analysed data	☐	☐

13. How frequently would you like to contribute data to collaborative biodiversity projects?

- ○ Every day
- ○ Several times a week
- ○ Every week
- ○ Every month
- ○ Once in several months
- ○ Yearly
- ○ Never

14. What form of communication will be most helpful for you?

- ○ Webpage with individual participation record and contact details
- ○ Periodic email digest
- ○ Direct email communication with other participants
- ○ Email upon request for specific content
- ○ Other (please specify)

15. Should all data on the portal be public?

- ○ Yes
- ○ No

Reason (please specify)

Motivation for scientific collaboration - India

16. Would you like to generate reports from the data on the portal?

- ◯ Yes
- ◯ No

Please specify what kinds of reports

17. Would you like to create your own collections of information on the portal?

- ◯ Yes
- ◯ No

18. Would you like to share your collections with others?

- ◯ Yes
- ◯ No

Motivation for scientific collaboration - India

19. Thank you for participating in the survey. Please provide us with your email address so we can contact you in the future to participate in an interview or share the study results. We will not share your email with anyone outside the research team.

Appendix C - Codebook

GENERAL REQUIREMENTS

Each individual interview is coded separately, not based on other interviews (even if interviewees participate in the same project, share the same interest, or are related in any way). Interviews will be coded first to separate between professional scientists and volunteers, and then coded separately, based on the role the interviewee plays in collaborative scientific projects.

The seven general codes that will be applied at first are: personal, collaboration between scientists and volunteers, motivation, culture, project, technological tools, learning process. These codes will be broken down to concepts that will be used to code the interviews, as described in the following sections.

Each interview will be coded for personal, collaboration, motivational and cultural codes, including relevant concepts. If the interview does not discuss these codes, it should be noted. If the interview surfaces the other three codes (project, technological tools and learning process) the interview will be coded for those as well, but it is not required.

PERSONAL

Includes all types of information pertaining to the person who is interviewed. Some of the concepts that belong in this category are:

- *Demographics*

Gender, age, origin, status (=caste), level of education, current *occupation*/position.

- *Location*

Is the interviewee working with his/her local community, or has he/she participating in a project that requires relocation and working in a remote location? In a foreign community? Has the interviewee relocated for educational or professional reasons (and are these reasons relevant to participation in collaborative scientific projects?)

- *Personal opinion of collaborative scientific projects*

What is the interviewee's position on collaborative scientific projects – does the interviewee sees them as beneficial in general? Under some (specific) conditions? In specific domains/disciplines? Does the interviewee considers them to be a waste of time and resources, and if so – why?

- *Personal involvement in collaborative scientific projects*

What role has the interviewee taken in collaborative scientific projects? Has that role changed (and why?) over time. Description of the interviewee's role, including status in the project.

Length of participation (if different projects – in each project separately.

Familiarity with the specific scientific discipline in which the project(s) take place.

- Attitude towards using technology to support collaborative scientific projects

Positive/negative (plus examples, if relevant).

COLLABORATION BETWEEN SCIENTISTS AND VOLUNTEERS

Includes all type of information pertaining to the process of scientific collaboration and to the relationship between scientists and volunteers. This code will not be applied to the details of specific projects in which the interviewee participated (the code “project” will be used for that).

- *Need for collaborative projects*

Interviewee’s view on the general need for collaborative projects (in specific cases and domains).

- *Design of collaborative projects*

How collaborative projects should be designed, what are the specific properties that should be included in such projects. Some examples include: data sharing practices, uses of different platforms, communication practices, the role of volunteers in designing the scientific project. The effects of study design on volunteer participation.

- *Interaction between scientists and volunteers*

The benefits, opportunities, and challenges of the interaction between scientists and volunteers. Creating trust and positive communication routes between scientists and volunteers. Power structures that affect this interaction. Characterization of scientists who see this interaction as positive or negative.

- *The role of volunteers in scientific collaborations*

Level of volunteer involvement - data collection, data analysis, writing, reporting and dissemination of results, or any type of participation in collaborative scientific projects (opinions and experiences).

Doubts regarding the involvement of volunteers in the scientific process.

- *Trends in scientific collaborations*

Active domains, projects, specific locals, tools or study designs that are currently prominent, and those that have become obsolete. Reasons for this change, including failed and successful project, and response to the projects from the scientific and general community.

MOTIVATION

The concepts details under this code will also be coded based on the distinction between initial motivation and ongoing motivation. For each motivational concept, the stage in which it surfaced or impacted the interviewee's involvement should be noted.

Initial motivation – is the nascent reason(s) for the interviewee's joining a collaborative scientific project. This is the original cause that motivated the interviewee to seek opportunities to collaborate.

Ongoing motivation – affects the interviewee throughout his/her participation in the project, and causes him/her to stay involved in the project, return to it, or seek other projects to be involved in. It may be similar or identical to the initial motivation or different from it.

Motivational concepts:

- *Batson's motivational factors*

Egoism, collectivism, altruism, principalism – based on Batson et al. theory of social motivations.

- *Other motivational factors*

Only if mentioned explicitly – intrinsic and extrinsic rewards.

- *Personal vs. community motivations*

Where motivations are related to personal activity or reward, or to the affect action has on a group of people (joined by locale, culture, socio-economic status, etc.). These motivational concepts can be: personal or community rewards (monetary or other), education, civic engagement, building status and reputation.

- *Facilitating a pro-motivational process*

Acknowledgments, recognition, means to build reputation, feedback, training, rewards (monetary, support, covering expenses, equipment).

- *Creating motivation for different groups*

Scientists, students, volunteers, local communities.

- *Failure of specific motivational prompts and processes, and demotivating actions*

CULTURE

This concept details the way various cultural aspects affect and are being affected by scientific collaborative projects. To do that it address various cultural aspects.

- *Locales*

Places of origin of the scientists, volunteers, or the place of study.

Aspects of the local community, including geographic and socio-economic factors: income level, main income sources, other community resources, general level of education, power structures within the community, geographic remoteness, type of community (rural vs. urban).

- *The experience of working with local population*

Challenges, opportunities, benefits. Success and failure stories – and the reasons for success or failure.

- *Cultural barriers for collaboration*

Language, norms, power structures that prohibit collaboration, and ways of overcoming these barriers.

PROJECT

This code details the experiences of the specific project(s) in which the interviewee engaged. This code includes the following concepts.

- *Project details*

Study design specifics - purpose, discipline, location, activities, data collected, recruitment, composition (scientists vs. volunteers), length, products.

- *Level of volunteers' involvement*

Study design, data collection, analysis, writing, disseminating products.

- *Relationship between scientists and volunteers*

In the specific project, including the heterogeneity or homogeneity of the participants in the project.

TECHNOLOGICAL TOOLS

This code details the interviewee's attitude towards the use of various technological tools in collaborative scientific project. The concepts detailed below will address both the interviewee's general attitude and particular experiences he/she had while engaged in collaborative scientific projects.

- *Use of technology in collaborative scientific projects*

General attitude towards supporting collaborative scientific project through technological tools. The value of using various technologies to support and enable collaborative scientific projects; including details of specific tools that have been used in projects that the interviewee has been involved in, and the success or failure of these technologies.

- *Problems in using technological tools to support collaborative scientific projects*

Challenges and failures of technology use, including fear and reluctance to use specific types of technology (and the reasons behind them). Practical problems in adopting and using specific

LEARNING PROCESS

This code refers to the apprenticeship-like that a volunteer goes through in order to participate in scientific inquiry, and to the skills he/she has to learn in order to have a meaningful contribution to the collaborative scientific process. The learning process can (but does not have to be) related to motivation.

- *Initial and ongoing learning process*

A distinction between the initial interest in scientific collaborative projects and the personal learning that they promote and the ongoing learning that a volunteers experiences throughout the project, including the steps taken to learn, the facilitation of learning by scientists, and the institutional support for learning (where such exists).

- *The relationship between learning and motivation*

Learning as a motivational factors. Engagement as a facilitator of learning. And the relationship between the two.

- *Specific examples of learning processes in collaborative scientific projects.*

References

Abelson, R. P., Aronson, E., McGuire, W. J., Newcomb, T. M., Rosenberg, M. J. , & Tannenbaum, P. H. (1968). *Theories of cognitive consistency: A sourcebook*. Chicago, IL: Rand McNally.

Agarwal, D.A. , Sachs, W.E., & Johnston, W.E. (1998). The reality of collaboratories *Computer Physics Communications, 110*(1-3), 134-141.

Andrews, D., Nonnecke, B., & Preece, J. (2003). Electronic survey methodology: A case study in reaching hard to involve Internet Users. *International Journal of Human-Computer Interaction. , 16*(2), 185-201.

Babbie, Earl R. (1990). *Survey Research Methods* (2nd ed.). Belmont, CA: Wadsworth Publishing.

Babbie, Earl R. (2010). *The Practice of Social Research* (12th ed.). Belmont, CA: Cengage Learning.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(191-215).

The World Bank. (2012). India Facts. Retrieved October 20, 2012, from http://data.worldbank.org/country/india

Barker, E., Phillips, R. , Kusek, K., & Thomas, B. (2011). Earthwatch and HSBC: embedding sustainability into the DNA of HSBC's business. *People Strat, 34*, 25-32.

Batson, C.D. (1997). Self-other merging and the empathy-altruism hypothesis: Reply to Neuberg et al. *Journal of personality and social psychology, 73*(3), 512-522.

Batson, C.D., Ahmad, N., & Tsang, J.A. (2002). Four motives for community involvement. *Journal of Social Issues, 58*(3), 429-445.

Batteau, A. (2010). *Technology and Culture*. Long Grove, IL: Waveland.

Bederson, B. & Quinn, A. (2011). *Human Computation: A Survey and Taxonomy of a Growing Field.* Paper presented at CHI '11, Vancouver, Canada. ACM Press, NY, New Yoak, pp. 1403-1412.

Benkler, Y. (2002). Coase's Penguin, or, Linux and" The Nature of the Firm". *The Yale Law Journal, 112*(3), 369-446.

Biernacki, P, & Waldorf, D. (1981). Snowball sampling. *Sociological methods and research, 10*(2), 141-163.

Birch, D., Atkinson, J. W., & Bongort, K. (1975). Cognitive control of action. In B. Weiner (Ed.), *Cognitive views of Human Motivation* (pp. 252-264). NY, NY: Academic Press.

Birnholtz, J.P., & Bietz, M.J. (2003). *Data at work: supporting sharing in science and engineering*. SIGGROUP (pp. 339-348). New York, NY: ACM Press

Blanchard, A. & Markus, M.L. (2002). *Sense of Virtual Community - Maintaining the Experience of Belonging.* Paper presented at the 35th Hawaii International Conference on System Sciences - HICSS, Hawaii. Vol. 8. IEEE Computer Society, Washington, DC, USA.

Boland, R.J., & Tenkasi, R.V. (1995). Perspective Making and Perspective Taking in Communities of Knowledge. *Organization Science, 6*, 4350-4372.

Bond, M.H. , & Hofstede, G. (1988). The Confucius Connection: From Cultural Roots to Economic Growth *Organizational Dynamics, 16*(4), 4-21.

Bonney, R., Ballard, H., Jordan, R., McCallie, E., Phillips, T., Shirk, J., & Wilderman, C. C. (2009). Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education - a CAISE Inquiry Group Report. (pp. 1-59). Washington, DC: Center for Advancement of Informal Science Education.

Borgman, C.L. (2007). *Scholarship in the digital age: Information, infrastructure, and the Internet*: The MIT Press.

Bos, N., Zimmerman, A., Olson, J., Yew, J., Yerkie, J., Dahl, E., & Olson, G. (2007). From shared databases to communities of practice: A taxonomy of collaboratories. *Journal of Computer Mediated Communication, 12*(2), 652-672.

Bowker, G. (2005). *Memory Practices in the Sciences*. Cambridge, MA: MIT Press.

Bozeman, B., & Corley, E. (2004). Scientists' collaboration strategies: implications for scientific and technical human capital. *Research Policy, 33*(4), 599-616.

Cameron, J., Banko, K.M., & Pierce, W.D. (2001). Pervasive negative effects of rewards on intrinsic motivation: The myth continues. *The Behavior Analyst, 24*, 1-44.

Carini, R. M., Hayek, J. C., Kuh, G. D., Kennedy, J. M., & Ouimet, J. A. (2003). College student responses to Web and paper surveys: Does mode matter? *Research in Higher Education, 44*(1), 1-19.

Carroll, J.M. , Rosson, M.B. & Zhou, J. (2005). *Collective Efficacy as a Measure of Community*. Proceedings of the SIGCHI conference on Human factors in computing systems, Portland, Oregon

Chavis, D.M., & Pretty, G. . (1999). Sense of community: Advances in measurement and application. *Journal of Community Psychology, 27*(6), 635-642.

Clarck, T. (1990). International Marketing and National Character: A Review and Proposal for an Integrative Theory. *Journal of marketing 54*(4), 66-74.

Clary, E. Gil, & Snyder, Mark. (1999). The Motivations to Volunteer: Theoretical and Practical Considerations. *Current Directions in Psychological Science, 8*(5), 156-159.

Cohn, J.P. (2008). Citizen science: Can volunteers do real research? *BioScience, 58*(3), 192-197.

Constant, D., Kiesler, S., & Sproull, L. (1996). The kindness of strangers: On the usefulness of weak ties for technical advice. *Organization Science, 7*, 119-135.

Cooper, C.B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K.V., Shirk, J. & Bonney, R. (2009). Citizen Science: A Developing Tool for Expanding Science Knowledge and Scientific Literacy. *BioScience, 59*(11), 977-984.

Cooper, C.B., Dickinson, J., Phillips, T., & Bonney, R. (2007). Citizen Science as a Tool for Conservation in Residential Ecosystems. *Ecology and Society, 12*(2), .

Corbin, J. & Strauss, A.C. (2007). *Basics of Qualitative Research:Techniques and Procedures for Developing Grounded Theory*. (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Cosley, D., Frankowski, D., Kiesler, S., Terveen, L., & Riedl, J. (2005). *How oversight improves member-maintained communities*. Paper presented at CHI'05. ACM, New York, NY, USA, 11-20.

Couper, M. (2000). Web surveys: a review of issues and approaches. *Public Opinion Quarterly, 64*(4), 464-494.

Couper, M., Traugott, M.W., & Lamias, M.J. (2001). Web survey design and administration. *Public opinion quarterly, 65*(2), 230-253.
Crane, D. (1969). Social structure in a group of scientists: A test of the" invisible college" hypothesis. *American Sociological Review, 34*(3), 335-352.
Cranshaw, J. & Kittur, A. (2011). *The polymath project: lessons from a successful online collaboration in mathematics*. Paper presented CHI'11. ACM, New York, NY. pp. 1865-1874.
Creswell, J.D., Plano-Clarck, V.L., Guttman, M.L., & Hanson, W.E. (2003). Advanced Mixed Methods Research Design. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of Mixed Methods in Social & Behavioral Research* (pp. 209-240). Thousand Oaks, CA: Sage Inc.
Crowston, K. & Howison, J. (2005). The Social Structure of Free and Open-source Software Development. *First Monday, 10*(2).
Csikszentmihalyi, M. , & Rathunde, K. (1993). Developmental perspectives on motivation. *Nebraska Symposium on Motivation, 40*, 57-97.
Curtis, J.E. , Grabb, E.G. , & Baer, D.E. . (1992). Voluntary Association Membership in Fifteen Countries: A Comparative Analysis. *American Sociological Review, 57*(2), 139-152.
David, R.W. (1992). The Quetzal and the Macaw: the story of Costa Rica's national parks San Francisco, CA: Sierra Book Club.
Davies, C. (2008). *Reflexive Ethnography: A Guide to Researching Selves and Others*. New York, NY: Routledge.
deCharms, R. (1968). *Personal Causation*. NY, NY: Academic Press.
Deci, E. L. . (1975). *Intrinsic motivation*. NY, NY: Plenum Press.
Dekker, P., & Halman, L. (2003). Volunteering and the Values. In P. Dekker & L. Halman (Eds.), *The Values of Volunteering: Cross Cultural Perspectives* (pp. 1-18). New York, NY: Plenum Publishers.
Denzin, N.(1978). *The research act: A theoretical introduction to sociological methods*. NY, NY: McGrow Hill.
Dickinson, J. & Bonney, R. (2012). *Citizen Science: Public Collaboration in Environmental Research*. Ithaca, NY: Cornell University Press.
Droge, S. (2007). *Just because you paid them does not mean their data are better.* Paper presented at the Citizen Science Toolkit Conference.
Duguid, P. (2006). Limits of Self-Organization: Peer Production and "Laws of Quality". *First Monday, 11*(10).
Durant, J.R. , Evans, G.A. , & Thomas, G.P. (1989). Public Understanding of Science. *Nature, 340*, 11-14.
Eckstein, S. (2001). Community as Gift-Giving: Collectivistic Roots of Volunteerism. *American Sociological Review, 66*(6).
Eisenhardt, K.M. (1989). Building Theories from Case Study Research. *The Academy of Management Review, 14*(4), 532-550.
Ellis, R., & Waterton, C. (2004). Environmental citizenship in the making: the participation of volunteer naturalists in UK biological recording and biodiversity policy. *Science and public policy, 31*(2), 95-105.
Emerson, R.M., Fretz, R.I. , & Shaw, L.L. (1995). *Writing Ethnographic Fieldnotes* Chicago, IL: University of Chicago Press.

Evans, J.R., & Mathur, A. (2005). The Value of Online Surveys. *Internet Research, 15*(2), 195-219.

Evans, S. (1999). *The Green Republic: A Conservation History of Costa Rica*. Austin, TX: University of Texas Press.

Fan, W. & Yan, Z. (2010). Factors affecting response rates of the web survey: A systematic review. *Computers in Human Behavior 26 (2010) 132–139, 26*, 132-139.

Farooq, U., Ganoe, C., Carroll, J., & Giles, C. (2007). *Supporting distributed scientitific collaboration: Implications for designing the CiteSeer collaboratory*. Paper presented at HICSS 2007. Hawaii, HI.

Feagin, J. R., Orum, A. M., & Sjoberg, G. (Eds.). (1991). *A case for the case study*. Chapel Hill, NC: The University of North Carolina

Feller, J. , Finnegan, P. , Fitzgerald, B. , & Hayes, J. (2008). From Peer Production to Productization: A Study of Socially Enabled Business Exchanges in Open Source Service Networks. *Information Systems Research 19*(4), 475-493.

Finholt, T.A. (2002). Collaboratories. *Annual review of information science and technology, 36*(1), 73-107.

Finholt, T.A., & Olson, G. (1997). From Laboratories to Collaboratories: New Organizational Form for Scientific Collaborations. *Psychological Science, 8*(1), 28-36.

Finkelstein, M. (2009). Intrinsic v. Extrinsic Motivational Orientations and the Volunteer Process. *Personality and Individual Differences, 46*, 653-658.

Finkelstein, M., Penner, L. & Brannick, M. (2005). Motive, Role Identity, and Prosocial Personality as Predictors of Volunteer Activity. *Social Behavior and Personality, 33*(4).

Forte, A., & Bruckman, A. (2005). Why do people write for wikipedia? Incentives to contribute to open. *content publishing. In Proc. of GROUP, 5*, 6-9.

Gadgil, M. (2006). Science and the Right to Information. *Economic and Political Weekly, 41*(19), 1895-1902.

Geertz, C. (1973). *The interpretation of cultures*: Basic Books.

Gilbert, G.N., & Mulkay, M. (1984). *Opening Pandora's Box: A Sociological Analysis of Scientists' Discourse* (of Scien ed.). Cambridge, UK: Cambridge University Press.

Godin, B. & Gingrass, Y. (2000). What is scientific and technological culture and how is it measured? A multidimensional model. *Public Understanding of Science, 9*, 43-58.

Gosling, S. D., Vazire, S., Srivastava, S., & John, O. P. (2004). Should we trust Web-based studies? *American Psychologist, 59*(2), 93-104.

Graneheim, U.H. & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today 24*, 105-112.

Greene, D. (2007). *Mixed Methods in Social Inquiry*. San Francisco, CA: John Weily and Sons.

Guba, E.G. (1981). Annual review paper: criteria for assessing the trustworthiness of naturalistic inquiries. *A Journal of Theory, Research and Development 29*(2), 75-91.

Hall, E.T. (1976). *Beyond Culture*. New York, NY: Anchor Books.

Hancock, J.T., Gee, K., Ciaccio, K. & Lin, J. (2008). *I'm Sad You're Sad: Emotional Contagion in CMC.* Paper presented at CSCW '08. ACM, New York, NY. pp. 295-298.

Hand, E. (2010). Citizen Science: People Power. *Nature, 466*(7307), 685-687.

Hara, N., Solomon, P., Kim, S.L., & Sonnenwald, D.H. (2003). An emerging view of scientific collaboration: Scientists' perspectives on collaboration and factors that impact collaboration. *Journal of the American Society for Information Science and Technology, 54*(10), 952-965.

Harding, S. (2005). Science and Democracy: Replayed or Redsigned? *Social Epistemology, 19*(1), 5-18.

Harvey, F. (1997). National Cultural Differences in Theory and Practice: Evaluating Hofstede's National Cultural Framework. *Information Technology and People, 10*(2), 132-146.

Haythornthwaite, C. (2009a). *Crowds and Communities: Light and Heavyweight Models of Peer Production* Paper presented at the Proceedings of HICSS'42. Hawai, HI.

Haythornthwaite, C. (2009b). Participatory Transformations. In E. Cope & M. Kalantzis (Eds.), *Ubiquitous Learning* (4th ed.). Champaign, IL: University of Illinois Press.

Hey, T.& Trefethen, A.E. (2005). Cyberinfrastructure for e-Science. *Science, 308*(5723), 817-821.

Higgins, E. & Kruglanski, A.E. (2000). *Motivational Science: Social and Personality Perspectives*. Philadelphia, PA: Taylor and Francis.

Hofstede, G. (2001). *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations* (2nd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-Related Values*. Thousand Oaks, CA: Sage Publications.

Hofstede, G. & Bond, M. H. (1988). The Confucius connection: From cultural roots to economic growth. *Organizational Dynamics 16*(4), 5-21.

Hofstede, G., Hofstede, G.J. & Minkov, M. (2010). *Cultures and Organizations: Software of the Mind* (3rd ed.). Nerk, NY: McGraw-Hill.

Hogg, M.A., & Terry, D.J. (2000). Social Identity and Self-categorization Processes in Organizational Contexts. *Academy of Management Review 25*(1), 121-140.

Hopkins, A. (1918). Periodical events and natural law as guides to agricultural research and practice. *Monthly Weather Review, 9*, 1-42.

Howe, J. (2006). *Crowdsourcing: Why the power of the crowd is driving the future of business*. Marbel Hill, GA: Crown Business.

Hull, C. L. (1943). *Principles of Behavior: An Introduction to Behavior Theory*. NY, NY: Appleton Century Crofts.

Jenkins, H. . (2006). *Convergence Culture: Where Old and New Media Collide*. New York, NY: New York University Press.

Kannan, K. P. (1990). Secularism and People's Science Movement in India. *Economic and Political Weekly, 25*(6), 311-313.

Kim, S., Robson, C., Zimmerman, T., Pierce, J. & Haber, E.M. (2011). *Creek watch: pairing usefulness and usability for successful citizen science*. Paper presented at CHI'11. ACM, New York, NY. pp. 2125-2134.

Kittur, A., & Kraut, R.E. (2010). *Beyond Wikipedia: Coordination and Conflict in Online Production Groups.* Paper presented at CSCW'10. NY, New York: ACM Press. pp. 215-224.

Kluchhon, C. (1951). The Study of Culture. In D. Lerner & H. D. Lasswell (Eds.), *The Policy Science* (pp. 74-93). Stanford, CA: Stanford University Press.

Klukhohn, C. (1962). *Culture and Behavior* (R. Klukhohn Ed.). Glencoe, IL: The Free Press of Glecoe.

Knorr-Cetina, K.D. (1981). *The Manfecture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science*. Oxford, UK: Pergamo.

Kollock, P. (1999). The economies of online cooperation: gifts and public goods in cyberspace. In P. Kollock & M. Smith (Eds.), *Communities in Cyberspace* (pp. 220-242). London ; New York: Routledge.

Kouzes, R.T., Myers, J.D., & Wulf, W.A. (1996). Collaboratories: doing science on the Internet *Computer 29*(8), 40-46.

Kozinets, R.V. (2002). The Field Behind the Screen: Using Netnography for Marketing Research in Online Communities. *Journal of Marketing Research, 39* (1), 61-72.

Kriplean, T., Beschastnikh, I. & McDonald, D.W. (2008). *Articulations of wikiwork: uncovering valued work in wikipedia through barnstars*. Paper presented at CSCW'08. ACM, New York, NY.

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology*: Sage Publications, Inc.

Kvale, S. (1996). *Interviews: An Introduction to Qualitative Research Interviewing*. Thousand Oaks, CA: Sage Inc.

Kvale, S. & Brinkmann, S. (2009). *InterViews: Learning the Craft of Qualitative Research Interviewing* Thousand Oaks: Sage Inc. .

Lakhani, K.R., & Wolf, R. (2005). Why Hackers Do What They Do: Understanding Motivation and Effort in Free/Open Source Software Projects. In J. Feller, B. Fitzgerald, S. Hissam & K. R. Lakhani (Eds.), *Perspectives on Free and Open Source Software*. Cambridge, MA: MIT Press.

Lakhani, K.R. & von Hippel, E.(2003). How open source software works: "free" user-to-user assistance. *Research policy., 32*(6), 923.

Langholtz, J., Lassoie, J. & Schelhas, J. (2000). Incentives for biological conservation: Costa Rica’s private wildlife refuge program. *Conservation Biology, 14*(6), 1735-1743.

Latour, B. & Woolgar, S. (1979). *Laboratory life: The construction of scientific facts*: Princeton Univ Pr.

Lazar, J., Feng , J. H. & Hochheiser, H. (2010). *Research Methods in Human-Computer Interaction*. New York, NY: John Weily and Sons.

LeCompte, M.D., & Goetz, J.P. (1982). Problems of reliability and validity in ethnographic research. *Review of educational research, 52*(1), 31.

Lee, C.P., Dourish, P. & Mark, G. (2006). *The human infrastructure of cyberinfrastructure*. Paper presented at CSCW'06. ACM, New York, NY, USA, 483-492.

Lepper, M., Greene, D., & Nisbett, R. (1973). Undermining C'06. hildren’s Interest with Extrinsic Rewards: A Test of the ‘Overjustification Hypothesis'. *Journal of Personality and Social Psychology, 28*(129-137).

Lewenstein, B. (2004). *What does citizen science accomplish?* Paper presented at the CNRS colloquium, Paris, France.
Lincoln, Y. S., & Guba, E.G. (1985). *Naturalistic Inquiry*. London: Sage Publications, Inc.
Lindenberg, S. (2001). Intrinsic Motivation in a New Light. *Kyklos, 54*(2-3), 317-342.
Ling, K., Beenen, G., Ludford, P., Wang, X., Chang, K., Li, X., . . . Kraut, R. (2005). Using social psychology to motivate contributions to online communities. *Journal of Computer-Mediated Communication, 10*(4).
MacCormack, A., Rusnak, J. & Baldwin, C.Y. Exploring the Structure of Complex Software Designs: An Empirical Study of Open Source and Proprietary Code. *Management Science, 52*(7), 1015-1030.
Malinowski, B. (1939). The Group and the Individual in Functional Analysis. *The American Journal of Sociology, 44*(6), 938.
Malone, T., Laubachar, R. & Dellarocas, C.N. (2009). Harnessing Crowds: Mapping the Genome of Collective Intelligence *MIT Research Report* (pp. 4732-4709). Cambride, MA: MIT.
Malone, T. & Crowston, K. (2001). The Interdisciplinary Study of Coordination. In G. Olson, T. Malone & J. Smith (Eds.), *Coordination Theory and Collaboration Technology* Mahwah, NJ: Lawrence Erlbaum Assoc.
Marshall, A. & Batten, S. (2003). Ethical Issues in Cross-Cultural Research. *Connections, 3*, 139-151.
McKenna, K.Y. A. , Green, A.S., & Gleason, M.E. (2002). Relationship Formation on the Internet: What's the Big Attraction? *Journal of Social Issues, 58*(1), 1-39.
McMillan, D.W. & Chavis, D.M. (1986). Sense of community: A definition and theory. *Journal of Community Psychology, 14*(1), 6-23.
McSweeny, B. (2002). Hofstede's Model of National Cultural Differences and their Consequences: A Triumph of Faith - A Failure of Analysis. *Human Relations, 55*(1), 89-118.
Michael, M. (1992). Lay discourses of science: science-in-general, science-in-particular, and self. *Science, Technology and Human Values, 17*(313-333).
Michinov, N., Michinov, E. & Toczek-Capelle, M.C. (2004). Social identity, group processes and performance in synchronous computer-mediated communication *Group Dynamics: Theory, Research, and Practice, 8*(1), 27-39.
Miller-Rushing, A., Primack, R. & Bonney, R. (2012). The history of public participation in ecological research. *Front Ecol Environ 10*(6), 285-290.
Morgan, D. (1998). Practical Strategies for Combining Qualitative and Quantitative Data Methods: Application to Health Research. *Qualitative Health Research, 8*(362-376).
Morse, J.M. (1991). Strategies for Sampling. In J. M. Morse (Ed.), *Qualitative Nursing Research: A Contemporary Dialogue* (pp. 126-145). London Sage Publications, Inc.
Myers, M.D. , & Tan, F.B. (2002). Beyond Models of National Culture In Information Systems Research. *Journal of Global Information Management, 10*(1), 24-32.
Nov, O. (2007). What motivates wikipedians? *Communications of the ACM, 50*(11), 60-64.

Nov, O., Arazy, O. & Anderson, D.P. (2011a). *Dusting for Science: Motivation and Participation of Digital Citizen Science Volunteers* Paper presented at the iConference 2011. Toronto, Canada.

Nov, O., Arazy, O. & Anderson, D.P. (2011b). *Technology Mediated Citizen Science Participation: A Motivational Model.* Paper presented at the AAAI International Conference on Weblogs and Social Media (ICWSM), Barcelona, Spain.

Nov, O., Anderson, D.P. & Arazy, O. (2010). *Volunteer computing: a model of the factors determining contribution to community-based scientific research*. Paper presented at the Proceedings of the 19th international conference on World wide web, Raleigh, North Carolina, USA.

NSF. (2012a). Science and Engineering Indicators 2012. Retrieved Septmber 20, 2012, from http://www.nsf.gov/statistics/seind12/

NSF. (2012b). *Two "Firsts" Give Citizen Science New Prominence in Addressing Societal problems*. Retrieved from http://www.nsf.gov/news/news_summ.jsp?cntn_id=124991.

O'Hara, K. (2008). *Understanding geocaching practices and motivations*. Paper presented at CHI'08. ACM, New York, NY. pp. 1177-1186.

Olson, G. M., & Olson, J. S. (2000). Distance Matters. *Human Computer Interaction, 15*, 139-179.

Olson, G.M., Malone, T., & Smith, J.B. (Eds.). (2001). *Coordination Theory and Collaboration Technology*. Psychology Press.

Ostrom, E. (2003). Toward a Behavioral Theory Linking Trust, Reciprocity and Reputation. In J. Walker (Ed.), *Trust and Reciprocity: Interdisciplinary Lessons From Experimental Research*. New York: Russell Sage Foundation.

Ostrom, T. M. . (1984). The Sovereignty of Social Cognition. In R. S. Wyer & T. K. Srull (Eds.), *Handbook of Social Cognition* (Vol. 1, pp. 1-38). Hillsdale, NJ: Lawrence Erlbaum.

Patton, M.Q. (2002). *Qualitative Research and Evaluation Methods.* Thousand Oaks: Sage Publications Inc.

Penner, L. (2004). Volunteerism and Social Issues: Making Things Better or Worse? *Journal of Social Issues, 60*(3), 645-666.

Perecman, E., & Curran, S.R. (2006). *A Handbook for Social Sciences Field Research*. Thousand Oaks, CA: Sage Publications Inc.

Pew (2012). Internet and American Life Project July 2012. Washington, DC: Pew Research Center.

Postmes, T., Spears, R. & Lea, M. (2000). The Formation of Group Norms in Computer Mediated Communication. *Human Communication Research, 26*(341-371).

Preece, J. (1999). Empathic communities: Balancing emotional and factual communication. *Interacting with Computers, The Interdisciplinary Journal of Human-Computer Interaction, 12*(1), 63-77.

Preece, Jennifer , & Shneiderman, Ben (2009). The Reader-to-Leader Framework: Motivating Technology-Mediated Social Participation. *AIS Transactions on Human-Computer Interaction, 1*(1), 13-32.

Press, Associated. (2011). Rare nine-spotted ladybugs, thought extinct after citizen science experiment, found on farm. *NY Daily news*. Retrieved from NY Daily News website:

Putnam, R.D. (2001). *Bowling Alone: The Collapse and Revival of American Community*. New York, NY: Touchstone Books.

Qin, J., Lancaster, F.W., & Allen, B. 1997). Types and levels of collaboration in interdisciplinary research in the sciences. *Journal of the American Society for Information Science and Technology, 48*(10), 893-916.

Raddick, M.J., Lintott, C. J., Schawinski, K., Thomas, D., Nichol, R. C., Andreescu, D., …. Vandenberg, J. (2007). Galaxy zoo: an experiment in public science participation. *Bulletin of the American Astronomical Society, 39*, 892.

Raddick, M.J., Bracey, G., Gay, P.L., Lintott, C.J., Murray, P., Schawinski, K., . . . Vandenberg, J. (2010). Galaxy zoo: Exploring the motivations of citizen science volunteers. *Astronomy Education Review, 9*, 010103.

Ross, A. (2007). The Challenge of Science. In S. During (Ed.), *The Cultural Studies Reader*. Milton Park, UK: Routledge.

Rotman, D., Preece, J., Hammock, J., Procita, K., Hansen, D.L. , Parr, C., Jacobs, D. (2012). *Dynamic Changes in Motivation in Collaborative Citizen-Science Projects.* Paper presented at CSCW'12. ACM, New York, NY. pp. 217-226.

Rotman, D., Procita, K., Hansen, D., Parr, C. & Preece, J. (2012). Supporting Content Curation Communities: The Case of the Encyclopedia of Life. *American Society for Information Science and Technology, 63*(3).

Rubin, H. J. & Rubin, I. (2005). *Qualitative interviewing: the art of hearing data*. Thousand Oaks, CA: Sage Inc.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(68-78).

Sansone, C., & Harackiewicz, J. M. (Eds.). (2000). *Intrinsic and extrinsic Motivation: The search for optimal motivation and performance*. New York, NY: Academic Press.

Sassenberg, K., & Postmes, T. (2002). Cognitive and strategic processes in small groups: Effects of anonymity of the self and anonymity of the group on social influence. *British Journal of Social Psychology, 41*, 463-480.

Schmeller, D.S., Henry, P.Y., Julliard, R., Gruber, B., Clobert J., Dziock, F. . . . Henle, K. (2008). Advantages of Volunteer-Based Biodiversity monitoring in Europe. *Conservation Biology, 23*(2), 307-316.

Shamir, B. (1991). Meaning, self and motivation in organizations. *Organization Studies, 12*(3), 405-424.

Sharp, H, Rogers, Y, & Preece, J. (2007). *Interaction design: beyond human-computer interaction*: Wiley Hoboken, NJ.

Slater, M., Sadagic, A. Usoh, M. & Schroeder, R. (2000). Small-Group Behavior in a Virtual and Real Environment: A Comparative Study. *Presence: Teleoper. Virtual Environ., 9*(1), 37-51.

Snider, A. G., Pattanayak, S. K., Sills, E. O., & Schuler, J. L. (2003). Policy Innovations for Private Forest Management and Conservation in Costa Rica. *Journal of Forestry, 101*(5), 18-23.

Sonnenwald, D.H. . (2007). Scientific collaboration. *ARIST 41*(1), 643-681.

Sproull, L., & Kiesler, S. (1991). *Connections: New Ways of Working in the Networked Organization*. Cambridge, MA: MIT Press.

Star, S.L., & Bowker, G. (2001). Social Theoretical Issues in the Design of Collaboratories: Customized Software for Community Support Versus Large-Scale Infrastructure In G. Olson, T. Malone & J. Smith (Eds.), *Coordination Theory and Collaboration Technology*. Boca Raton, FL: Psychology Press.

Strauss, A., & Corbin, J.M. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*: Sage Publications, Inc.

Sullivan, B.L., Wood, C.L., Iliff, M.J., Bonney, R.E., Fink, D., & Kelling, S. (2009). eBird: A citizen-based bird observation network in the biological sciences. *Biological Conservation, 142*(10), 2282-2292.

Sun, H. (2012). *Cross Cultural Technology Design*. Oxford, UK: Oxford University Press.

Tapscott, D. & Williams, A. D. (2006). *Wikinomics: How Mass Collaboration Changes Everything* New York, NY: Portfolio Hardcover.

Tashakkori, A. & Teddlie, C. (1998). *Mixed Methodology: Combining Qualitative and Quantitative Approaches* Thousand Oaks, CA: Sage Inc.

The Independent Sector. (2010). Retrieved September 18, 2012, from http://www.volunteeringinamerica.gov/

Thomson, A.M., Perry, J.M., & Miller, T.J. (2007). Conceptualizing and Measuring Collaboration *Journal of Public Administration and Theory, 19*(1), 23-56.

Trane, D. (1972). *Invisible Colleges: Diffusion of Knowledge in Scientific Communities*. Chicago, IL: Chicago University Press.

US Department of State. (2012). *Backgrond note: Costa Rica*. Internet: Retrieved from http://www.state.gov/r/pa/ei/bgn/2019.htm

Van House, N.A. (2002a). Digital libraries and practices of trust: networked biodiversity information. *Social Epistemology, 16*(1), 99-114.

Van House, N.A. (2002b). *Trust and epistemic communities in biodiversity data sharing*.

Wasko, M., & Faraj, S. (2000). "It is What One Does": why people participate and help others in electronic communities of practice. *Journal of Strategic Information Systems, 9*, 155-173.

Weisinger, J. Y. & Trauth, E.M. . (2003). The Importance of Situating Culture in Cross-Cultural IT Management. *IEEE Transactions on Engineering Management, 50*(1), 26-30.

Weiss, Robert S. . (1994). *Learning from Strangers: the Art and Method of Qualitative Interview Studies* NY, NY: Simon & Schuster.

Wenger, E., McDermott, R.A., & Snyder, W. (2002). *Cultivating communities of practice: a guide to managing knowledge*. Boston, Mass. Harvard Business School Press.

Wiggins, A. & Crowston, K. (2011). *Conservation to Crowdsourcing: A Typology of Citizen Science* Paper presented at HICSS'41, Hawaii, HI.

Wilderman, C. C. (2007). *Models of community science: design lessons from the field*. Paper presented at the Citizen Science Toolkit Conference, Ithaca, NY.

Williams, R. (1983). *Culture and Society 1780-1950* (2nd ed.). New York, NY: Columbia University Press.

Wulf, W.A. (1993). The Collaboratory Opportunity. *Science 261*(1993), 854-855.

Yin, R.K. (2008). *Case study research: Design and methods* (4th ed.). Thousand Oaks, CA: Sage Publications, Inc.

Ziman, J. (1991). Public Understanding of Science. *Science, Technology & Human Values, 16*(1), 99-105.

Zimmerman, A. (2007). Not by metadata alone: the use of diverse forms of knowledge to locate data for reuse. *International Journal on Digital Libraries, 7*(1), 5-16.