

Center for Behavior, Institutions and the Environment

CBIE Working Paper Series

#CBIE-2019-001

Tragedy of the Commons as Conventional Wisdom in Sustainability Education

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January 7, 2019

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Tragedy of the Commons as Conventional Wisdom in Sustainability Education

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Abstract:

More than 50 years ago biologist Garrett Hardin published his influential essay *The Tragedy of the Commons*. In this essay, Hardin argued that in situations where people share resources, external intervention via governmental regulations or privatization of the resource is needed to avoid resource overexploitation. While the article is considered by many resource governance scholars as misleading and incomplete, it is one of the most assigned articles in environmental education. Here we present findings from a survey of instructors who teach undergraduate courses on sustainability within the USA on how Hardin's essay is used and what the understanding is of the instructors about the essay. The survey demonstrates that there is mixed understanding of the current state of knowledge about commons governance. In particular, instructors trained in the natural sciences have more misconceptions about commons governance than instructors trained in other disciplines.

Keywords:

Tragedy of the Commons; Commons Governance; Misconception; Sustainability; Undergraduate Education.

“Tragedy of the Commons” as conventional wisdom in sustainability education

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Abstract: More than 50 years ago biologist Garrett Hardin published his influential essay “The Tragedy of the Commons”. In this essay, Hardin argued that in situations where people share resources, external intervention via governmental regulations or privatization of the resource is needed to avoid resource overexploitation. While the article is considered by many resource governance scholars as misleading and incomplete, it is one of the most assigned articles in environmental education. Here we present findings from a survey of instructors who teach undergraduate courses on sustainability within the USA on how Hardin’s essay is used and what the understanding is of the instructors about the essay. The survey demonstrates that there is mixed understanding of the current state of knowledge about commons governance. In particular, instructors trained in the natural sciences have more misconceptions about commons governance than instructors trained in other disciplines.

Keywords: Tragedy of the commons; commons governance; misconception; sustainability; undergraduate education.

Introduction

Biologist Garrett Hardin (1968) published the essay “The Tragedy of the Commons” (TotC) half a century ago, having a major impact on the way environmental governance is approached. In Hardin’s conceptualization, the “tragedy” refers to the inability of groups to manage common resources and the need for external intervention to avoid overharvesting. It provided a rationale for governmental regulation (specifically nationalization) and privatization as the only viable options to manage shared resources.

Hardin’s essay had a major impact on environmental education and policy, as can be witnessed from the following list. Hardin’s 1968 article:

- is one of the most-assigned texts in U.S. universities in the past decade (Open Syllabus Project, 2018);
- has been described by biologists as the most influential journal article in their careers (Barrett & Mabry, 2002);
- is one of *Science* magazine’s most requested articles (AAAS, 2003);
- has been described as a “philosophical root” of essential readings in wildlife management and conservation (Krausman & Leopold, 2013) and included in anthologies edited by science popularizers like Richard Dawkins (2008) and Bill McKibben (2008);
- has been one of the top-most cited articles in ecological economics (Costanza et al., 2004; Ma & Stern, 2005; Costanza et al., 2016);
- is the 31st-most-cited article in climate change literature (Marx et al., 2017).

Despite the popularity of the essay by Hardin, the argument was misleading and incomplete (Boyd et al., 2018). Self-governance of shared resources by resources users without external intervention often leads to the sustainable use of common resources. As many scholars of commons governance have pointed out (Cox, 1985; Bromley & Cernea, 1989; Berkes et al., 1989; Feeny et al., 1990; Burger & Gochfeld, 1998; Ostrom et al., 1999; Ostrom et al., 2002), Hardin’s article misses its mark because he fails to acknowledge that every enduring commons has rules to govern resource use. More pointedly, the type of commons at the center of the metaphor in “The Tragedy of the Commons,” communal pasture, has long been studied as an exemplar of sustainable institutions of commons governance. A commons is defined by its rules, not the absence of rules. An unmanaged resource without rules is best referred to as “open

access.”

Hardin authored several articles following the controversial success of “The Tragedy of the Commons,” some of which interpret the metaphor of pastoral commons and extend his moral argument for “lifeboat ethics” more clearly than his original article (e.g., Hardin, 1974) and deal more directly with his objective of zero population growth through ending international aid in food, agriculture, and medicine; immigration controls; and initiating compulsory sterilization of women (e.g., Hardin, 1970). None of these subsequent efforts has enjoyed the same popularity. Indeed, the article has remained popular even while Hardin’s ideas about population growth and commons governance have been refuted, and his opinions about race and public policy rejected by the mainstream public (see, e.g., Gardiner, 2001; Oakes, 2016; Patt, 2017).

As commons scholars ourselves, we (the authors) are not principally concerned with whether Hardin’s argument about overpopulation has merit, but rather how the context in which students read the article might affect their understanding of real commons dilemmas. In the rest of this section, we elaborate on this context of pedagogy. In particular, we discuss how this intrinsically interdisciplinary issue of governance of commons has been approached through varied disciplinary lenses, and how this is likely to influence how the material on the commons is presented to the students. In the next section we discuss our empirical strategy to test this thesis.

To begin with, let us consider the disciplinary training and scholarship of the two leading scholars in this field: Garret Hardin and Elinor Ostrom. Hardin was trained in zoology and microbiology, wrote his dissertation on unicellular organisms, and studied algae before turning to teach human ecology full-time at the University of California, Santa Barbara from 1946 to 1978 (Locher, 2013; for a contextualization of Hardin’s arguments in the teaching of ecology see also Hagen, 2008). Ostrom was trained in public administration and political science and published her dissertation on ground water basin governance (an example of common-pool resources) in 1965. When Hardin’s essay was published, she found Hardin’s statements in contrast with her observations. Although the resource users of the groundwater basin had to overcome major challenges in order to have effective governance, they were not trapped. The contrast between her observations and Hardin’s metaphor led Ostrom to a long journey studying the collective action of shared resources (Ostrom, 2010). Elinor Ostrom, was awarded the Nobel Prize in Economic sciences in 2009 because she “challenged the conventional wisdom by demonstrating how local property can be successfully managed communally without any regulation by central

authorities or privatization” (Nobelprize.org, 2009).

As a parable or polemic about the human-nature interface, Hardin’s tragedy of the commons is a natural scientist’s view of society¹. Though contemporaries to a degree, Hardin’s contributions to environmental discourse primarily coincided with the first major wave of proliferation in environmental education programs in U.S. colleges and universities, beginning in 1965 and peaking in 1970, while Ostrom’s contributions coincided with the second major wave, beginning in the mid 1980s when Ostrom and a concerted group of scholars started to do comparative empirical research on resource governance (Romero & Silveri, 2006). Commons research in general also rose with this second wave (van Laerhoven & Ostrom, 2007).

In 2005, Romero and Silveri found that natural science curricula dominated environmental science, environmental studies, and the less-numerous environmental programs in engineering, biology/ecology/conservation and policy/analysis/planning -- accounting for 35% of program curricula among the 1,059 programs they surveyed. While many programs included different disciplinary approach, less than 4% of the environmental education programs were fully interdisciplinary, i.e., incorporating social science and humanities in addition to natural sciences. The inclusion of the humanities in undergraduate interdisciplinary training is relevant because it likely determines whether Hardin’s essay is understood in the context of ethical argumentation as opposed to a natural law or principle of social dynamics. Using a more exclusive definition, Vincent and Focht (2010) identified 840 “broadly interdisciplinary” graduate and undergraduate environmental programs in the United States, the vast majority of these labeled either environmental science or environmental studies. Based on a representative survey of those programs, they claim there is a consensus that curricula for environmental education should be based on sustainability as a normative principle and a professional competency. On environmental sustainability, however, Sherren (2007) suggests curricula designers may believe that natural sciences should take precedence at the core of the program while studies in human society are ideally optional electives that “can be easily picked up.” Thus, in refuting the conventional wisdom of commons tragedies, Ostrom occupies what appears to be a less-valued interdisciplinary space, examining natural resource outcomes from a social science perspective. The notion that sustainability research in economics, humanities, and the social sciences is less-emphasized and less-valued in the academy than sustainability research originating in and

¹ Hardin [1998] later described it as “an ecologist's view of the human overpopulation problem.”

referencing the natural sciences is also borne out by academic journal publication statistics (Schoolman et al., 2012). From publication statistics for the years 1996-2009, Schoolman et al. (2012) found that sustainability research was dominated by natural science journals citing work from other natural science journals, and not including much social, economic and humanity scholarship.

Considering the likelihood that sustainability education in U.S. universities shares the bias toward natural science approaches evident in other nominally interdisciplinary academic enterprises, we think the particular popularity of Hardin's "The Tragedy of the Commons" should interest educators and sustainability advocates at large. Interdisciplinary environmental programs and sustainability curricula are still relatively nascent developments, with frameworks and assumptions drawn from training in earlier, adjacent fields. Given the current emphasis (for example, at our own university) on problem-based learning, we are especially concerned that a biased perspective on managing common resources could impact the way people look for governance solutions. In what follows, we investigate through survey research how instructors who teach "The Tragedy of the Commons" see it in the context of their pedagogy, and whether there are patterns in instructors' perspectives based on their training or current field of practice.

Data and Methods

The aim of the survey was to derive information from instructors who use "The Tragedy of the Commons" in their curricula, or teach the "tragedy of the commons" concept, on how and why they introduce the concept in their classes. We asked their opinion on ten statements related to motivations behind teaching the tragedy of the commons. The statements were constructed to address a range of perspectives significant in the governance of the commons, some of which we believe are misunderstandings of (or interpretations stemming from) Hardin's essay. For example, we ask whether the tragedy of the commons demonstrates the need for external intervention in managing the commons, and whether it represents the foremost thinking on the commons. Further, we asked how the concept of the tragedy of the commons was included in their course curriculum -- for example, as a stand alone concept, as historical context, or as a social science perspective on natural resource management. We also asked about the disciplinary context of the programs in which the material was taught and the graduate training of the instructor. For those who received the survey but were not currently teaching the concept, we

provided a space for them to share their reasons for not teaching it. Several of the questions regarding teaching of the TotC were in the form of a 5-point Likert scale, for use by respondents to rate the degree in which they agree or disagree with a statement (with 1 representing strongly agree and 5 representing strongly disagree). The complete survey can be found in the Appendix.

We sent the survey to two partially overlapping sample populations, namely a sample of instructors who currently teach introductory sustainability related courses at universities in the U.S.A, and educators affiliated with the Association for Environmental Studies and Sciences (AESS).

In order to derive a sample of relevant instructors we built a database of 549 instructors from universities affiliated within the Association for the Advancement of Sustainability in Higher Education (AASHE). The creation of the database was restricted by availability of public information on instructors teaching an introductory course related to sustainability topics as part of the undergraduate curriculum in the academic year 2017/2018. Up to five instructors from a university were selected, and we selected universities by going through the list of about 700 universities and colleges in the U.S. alphabetically and selecting every third university. A reminder was sent after two weeks to those who had not responded. The second sample was derived by posting to the general discussion list of AESS.

The survey was sent out in March 2018. We received 177 responses (32% response rate) from the targeted survey of instructors within organizations affiliated with the AASHE, and 98 responses (5% response rate) from the distribution list of the AESS. In all, 235 of the responses had complete information on the statements provided. All data used for our analysis is available at <https://osf.io/hg43b/>.

Results

Twenty five respondents indicated that they are not teaching the tragedy of the commons, and seven of them explained why they don't teach it: one found the article unpersuasive, one said it was outdated, one hadn't heard of the article, one said the concept didn't fit in their current course, two indicated that the concept was taught in a companion course to the one they themselves were teaching, and one thought the concept of market failure sufficiently covered the topic.

Descriptive statistics

250 respondents indicated they taught courses in which the tragedy of the commons concept was featured. In the remaining discussion of the results we focus on these, the vast majority of respondents. We also collapse both samples together -- unless explicitly stated otherwise -- since both samples have similar patterns (see Appendix). According to 56% of the respondents TotC is required in the course curriculum they are responsible for teaching. 42% of the respondents agree that TotC demonstrates that external intervention is needed to avoid a tragedy of the commons, while a large majority (74%) agree that the TotC illustrates the fundamental dilemma that occurs when people share resources. More than a third (35%) of the respondents agree that the TotC represents the foremost thinking about commons governance and the concept that student should learn if they learn one thing about commons governance, while 10% agree that they are not aware of alternative theories. One-third (33%) of the respondents agree that the TotC provides a useful counterpoint to empirical case studies, but more respondents (46%) agree that it establishes the utility of property rights².

Those results confirm that there is a wide spectrum of understanding of the concept and context of the tragedy of the commons, and the broader literature on commons governance. When we evaluate correlations between the responses to the statement, we find a high correlation (>0.2) between many of the statements.

The main context in which the TotC is taught is as a social science perspective on how to cope with shared resources (34%), while 25% use the TotC as a background for the literature on the common pool resource governance. As discussed in the introduction, scholarship on the commons demonstrate that external interventions are not always needed for successful governance of the commons, and that Hardin's argument is limited to open access situations. As such those who agree with statements Q4 ("It demonstrates that external intervention is needed to avoid a 'tragedy of the commons.'"), and Q6 ("It represents the foremost thinking on the commons; if students learn one thing about commons governance it should be this concept.") indicate a misunderstanding of the current state of knowledge in this field. When courses taught were in natural science programs we find instructors have greater misunderstanding of empirical commons governance than in other programs (Figure 1). We selected Q4, Q6, and Q7 ("I am not

² The question asked did not specify a type of property rights -- e.g., common or private -- so respondents may have made assumptions based on their own insights

familiar with alternative theories on managing common resources”) since they have high correlations with various other statements.

When instructors have graduate training in humanities or natural sciences they have a greater misunderstanding of the commons concepts compared to other disciplines (Figure 2). Those with more recent graduate training do agree less with the statement that TotC is the foremost thinking about commons governance and have a slightly lower agreement with the need for external intervention to avoid the TotC (Figure 3). This may suggest that the newer generations of instructors are better informed about the context of the TotC.

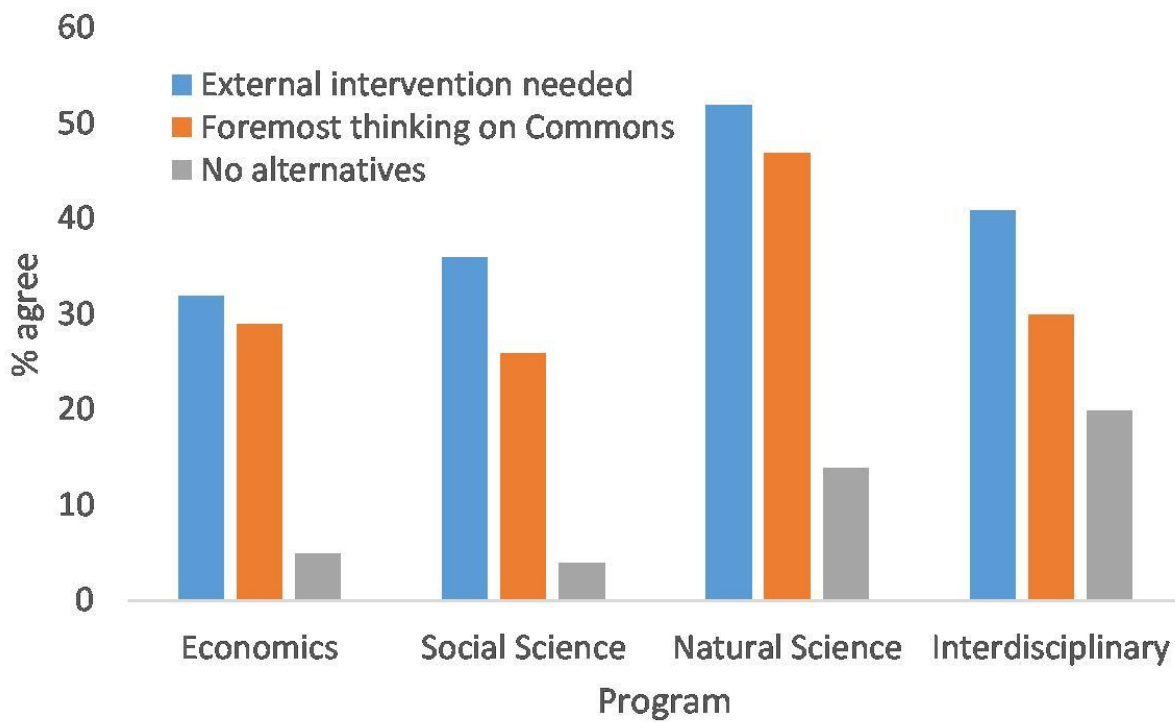


Figure 1. Percentage of respondents who teach courses in a program identified as economics, social science, natural science or interdisciplinary, who agree with statements Q4, Q6 and Q7 (see Appendix).

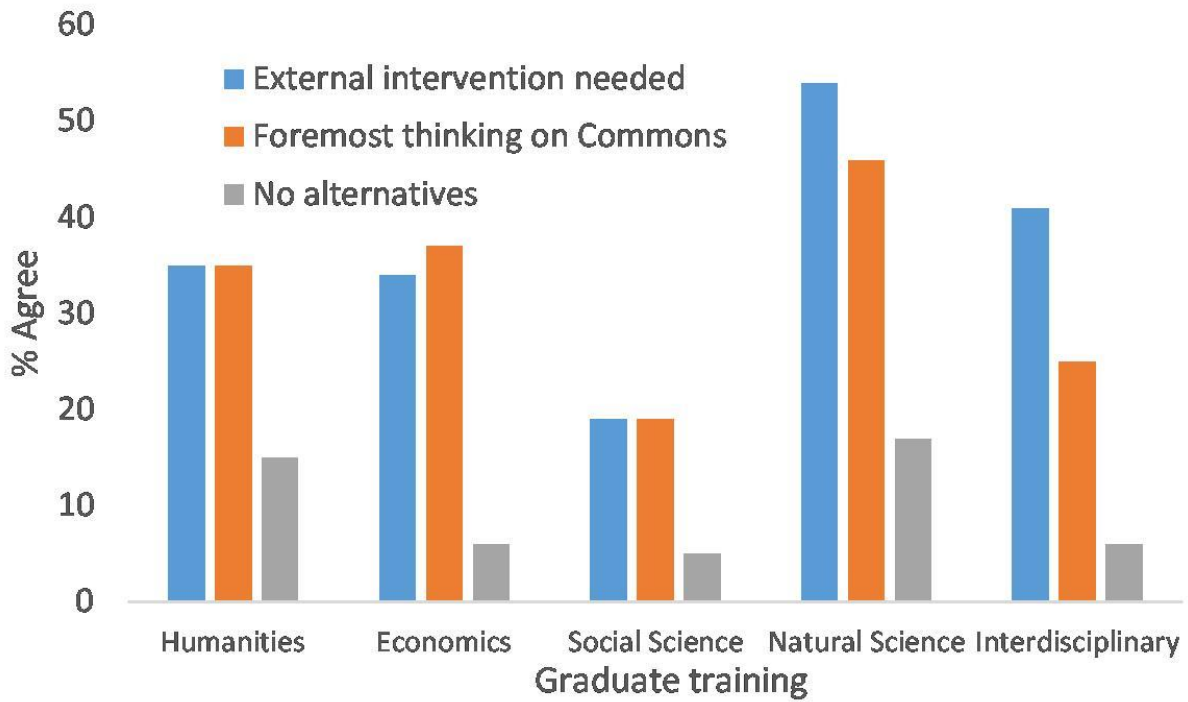


Figure 2. Percentage of respondents classified in five 5 main disciplinary area according to their graduate training, who agree with statements Q4, Q6 and Q7 (see Appendix).

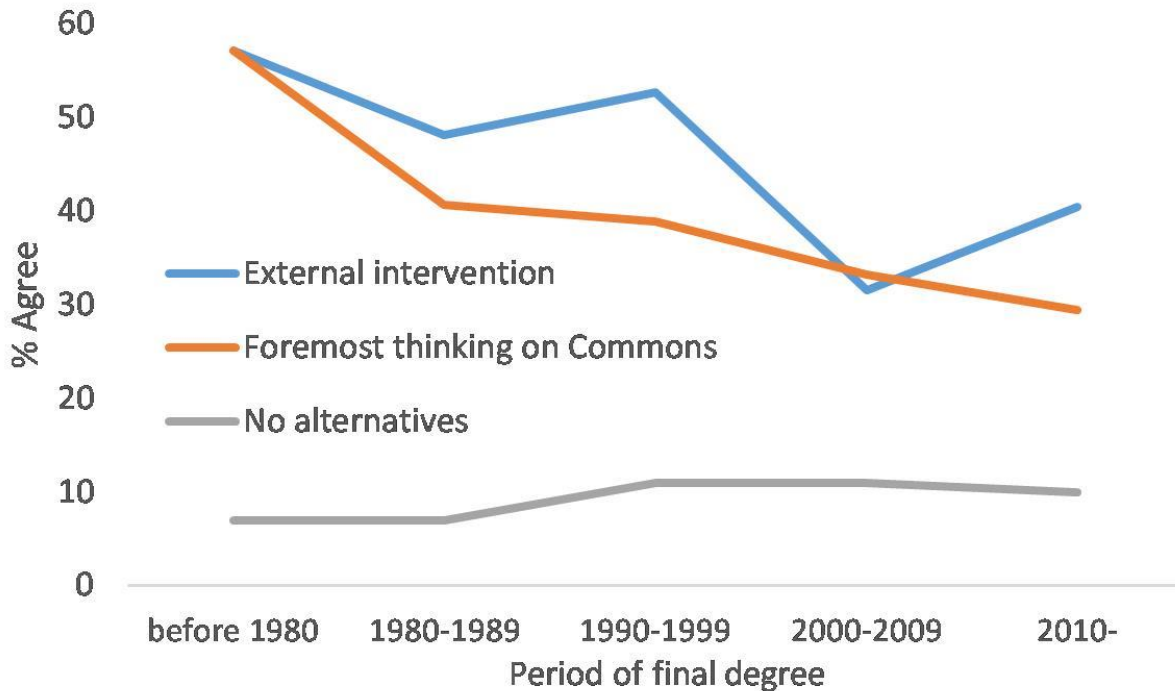


Figure 3. Percentage of respondents classified according to time of finishing highest degree, who agree with statements Q4, Q6 and Q7 (see Appendix).

Statistical analysis

As mentioned before, several of the questions regarding the teaching of TotC in our survey were in the form of five point Likert scale type questions. The differences between “strongly agree,” “agree,” and “neutral” on a Likert scale are not necessarily equal. Such ordinal scale responses can be ranked, but the distance between responses is not measurable. Given categorical responses, the assumptions of Ordinary Least Squares (OLS) regression do not hold. A logistic regression is thus the preferred choice, and since the response categories are ordered, ordered logistic has potentially greater power than baseline-category logistic models (Agresti, 2007; Sullivan & Artino, 2013).

We tried two different specifications of the ordered logistic regression: one based on the disciplinary training of the instructor (table 1) and the other based on the disciplinary program within which they teach (table 2). Interestingly, the correlation between these two variables is significant but the magnitude is not very high (Pearson correlation coefficient = 0.44). This suggests that putting both variables in the same regression may cause multicollinearity problems but it is worth exploring if the story changes depending on which one we choose to use in the regression. Thus we have reported on both specifications in tables 1 and 2, respectively. Results for responses to the following three major questions are reported: Q4 (“It demonstrates that external intervention is needed to avoid a ‘tragedy of the commons’”), and Q6 (“It represents the foremost thinking on the commons; if students learn one thing about commons governance it should be this concept”) and Q7 (“I am not familiar with alternative theories on managing common resources”).

In table 1, year of instructor’s degree and dummies for instructor’s disciplinary training are listed as explanatory variables. The left out (i.e. reference) dummy here is social science and so all coefficients need to be interpreted with reference to it. Thus, for example, the table shows that among the different disciplines, only natural sciences has a significantly different effect (relative to social sciences) on responses to *all* the three major questions. The negative sign on the coefficient for natural sciences implies that if the instructor’s disciplinary background is natural science he is more likely to agree with the statements in Q4, Q6 and Q7; implying greater

misconception of commons. Interestingly, the coefficient for interdisciplinary studies is also statistically different for Q7, implying that if the instructor’s disciplinary background is interdisciplinary studies, then he/she is significantly more likely to agree with the need for external intervention. This is concerning and needs to be addressed. Interestingly, instructors whose disciplinary background is economics or political science (broadly representing disciplines based more on rational choice theory) did not respond significantly differently from those with other social science backgrounds.

The results shown in table 2, with dummies for the disciplinary program shows broadly similar results, with the coefficient of natural sciences being significant for all the three questions. One important exception in this specification is the statistically significant coefficient for humanities for Q7, implying that if the instructor teaches a humanities course he/she is less likely to be familiar with alternative theories on common resources. This also is very concerning and needs to be investigated further. The effect of the year that the instructor got his/her degree is positive everywhere, implying that the later that the degree was obtained less is the misconception. However, this effect is significant only in table 2 for Q4 and Q6. This suggests that the extent of misconception is significantly lower for newer instructors for these two questions.

Table 1: Results of Ordered Logistic Model: Responses by disciplinary training of instructor

(Five point Likert scale: 1- Strongly agree; 5- Strongly disagree)

	Q4	Q6	Q7
	Need for external intervention	Represents foremost thinking	Not familiar with alternative theories
Economics, Pol. Science	-0.5029	-1.2341	0.0958

Humanities	-0.5151	-0.8740	-0.8748
Interdisc. studies	-0.8795*	-0.5326	-0.3437
Natural Science	-1.2225***	-1.5001***	-1.4010**
Year of degree	0.0158	0.0139	0.0096
Likelihood ratio chisquare	-323.0792**	-304.6966***	-219.459***
# of observations	184	183	184

Notes: Left out dummy is social sciences (including anthropology)

* Sig at 10% level; ** Sig at 5% level; *** Sig at 1% level

Table 2: Results of Ordered Logistic Model: Responses by Discipline of Program

(Five point Likert scale: 1- Strongly agree; 5- Strongly disagree)

	Q4	Q6	Q7
	Need for external intervention	Represents foremost thinking	Not familiar with alternative theories
Economics, Pol. Science	0.0085	-0.4056	0.2841
Humanities	-0.4812	-0.8537	-1.0741*
Interdisc. studies	-0.0108	-0.3114	-0.1713
Natural Science	-0.6273*	-1.2215***	-1.5256***

Year of degree	0.0211**	0.0198**	0.0084
Likelihood ratio chisquare	-323.0792**	-304.6966***	-219.459***
# of observations	206	205	206

Notes: Left out dummy is social sciences (including anthropology)

* Sig at 10% level; ** Sig at 5% level; *** Sig at 1% level

Comments from participants

In addition to the respondents who explained why they weren't teaching the tragedy of the commons, many respondents who were currently teaching the concept wrote extended, useful feedback to us, either in the survey space provided or in individual emails. Twelve respondents took issue with our scaled survey items (Q1-10, in the Appendix) because two of the questions were double-barreled, because the questions did not allow respondents to provide nuanced information on the context of their teaching, because the term neoliberalism "could mean very different things to different respondents," or because it seemed "like the questions were written by someone unfamiliar with scholarship on sustaining CPRs.[common pool resources]" We were sensitive to these issues, but also mindful of designing the survey to be efficient. It was not within the scope of this survey to reduce longstanding ambiguities of meaning about terms like "neoliberalism" -- which, indeed, means different things even to the several authors of the survey.

One of our concerns about the frequency with which "The Tragedy of the Commons" evidently appears on syllabi was understanding whether it is taught in a critical context. Seven respondents explained that is exactly how they teach it, or how it should be taught if it is taught at all. For example, one respondent called it "analytically incorrect, historically fully falsified, and with very good alternatives available" and said teaching of the concept should be abandoned because the policy consequences are destructive. Another said the article is "utterly wrong...yet is repeatedly used by policy-makers and other scholars to perpetuate myths." One said teaching

of the article should be “accompanied by critique of its racism and sexism,” while another respondent said “Hardin has for too long been taught without critique and the full context of Hardin's larger intellectual project, which was eugenical and racist, is rarely mentioned.”

Another of these respondents mentioned that they teach the full article, rather than an excerpt, so that the more radical of Hardin’s observations and recommendations can be critiqued. Two others said they deconstruct the article in class or use it as a “strawman” argument.

Though we did not reach out directly to Hardin’s students or colleagues at the University of California, Santa Barbara, two respondents to our survey recounted having been students of Hardin’s in the 1970s. Both felt fortunate to have been in a class he taught and had used the article in their subsequent professional careers, with one saying it offered a “brilliant and easy to understand analogy” that teaches respect and responsibility for individual actions which otherwise “appear to have no effect on other people.”

Seven respondents wrote to explain why they think teaching “The Tragedy of the Commons” is important, citing how “Hardin provides a concrete and vivid example....helps make the concept sticky,” that the article is “vastly important,” and “still highly influential in ecological circles," despite or because of the fact that in the article Hardin makes “important errors" and that “reflections of the time, and how governance research has disproven many of its conclusions is important.” Many of these respondents explained how they try to position the article in the context of other research on commons governance. One wrote that, since the article is a clear argument on the role of technology in addressing the policy issue of population growth, it should be taught in the historical policy context of technology and population growth. Four of these seven people mentioned Ostrom explicitly as the intellectual counterpoint for contextualizing Hardin’s article. (It should be noted that our survey explicitly mentioned Ostrom in Q11.) In all, twelve respondents wrote to us to explain that they teach Ostrom alongside Hardin. Other recommendations respondents made about the context in which “The Tragedy of the Commons” should be understood are provided below in our discussion of teaching recommendations.

Discussion

Hardin’s argument for external intervention to govern the commons was not novel (Feeney et al., 1990). Gordon (1954) and Scott (1955) for example introduced mathematical models of resource

management inspired by fisheries, that defined the conventional theory of the commons. Perhaps the succinct metaphor and catchy title boosted the appeal of Hardin's article (Burger and Gochfeld, 1998; Banner, 2018; Boyd et al. 2018). One reason its appeal endures is that though Hardin was dramatic about the need for action, he was vague about how action should be taken, leaving ample space for interpretation. "Mutual coercion, mutually agreed upon," was an afterthought in his 1968 article (Hardin, 1998) that he didn't go on to elaborate in most of his arguments except to say, "only under a strong and farsighted sovereign -- which could be the people themselves, democratically organized -- can a population equilibrate" but "a restriction of the usual democratic franchise would be appropriate and just in this case" (Hardin, 1974). People have taken inspiration from Hardin to justify their own ends. Readers can assume what Hardin assumed, which was that common property needed to be eliminated through privatization or nationalization (Feeny et al., 1990), but since Hardin's constitution of global human carrying capacity as a commons was problematic, so, too, are these prescriptions. Feeny et al. (1990) even point out that "mutual coercion, mutually agreed upon" is consistent with communal-property arrangements, although he [Hardin] appears to have meant state institutions" (p. 13). The potential interpretation of Hardin's polemic argument as an argument for community-based resource use and management is supported by comments from at least one of our survey respondents, who wrote, "I was taught to scorn this paper and the supposed argument in graduate school, until I finally read it, and thought it was pretty good." A lesson to be learned, perhaps as authors more so than instructors, is that openly-interpretable motivational texts have a place in the imaginations of students that endures into their professional careers.

There are several questions we didn't ask instructors in our survey because we either did not believe these could be effectively answered in a survey of this format, or because we prioritized other questions in the effort to make the survey quick for participants to complete. We didn't ask what knowledge of commons governance theory instructors have. We didn't ask whether instructors had read "The Tragedy of the Commons" when they themselves were students. We didn't ask whether, when assigning the article, instructors used an abridged or anthologized version instead of the original (five-and-a-half page) article as it appeared in *Science*. We didn't ask about whether instructors teach "The Tragedy of the Commons" in Hardin's originally intended context, i.e., human overpopulation (or in its mythical context, the enclosure movement in England).

We might concede that there is a place for teaching the concept of the tragedy of the commons as a model, like the Prisoner's Dilemma, -- a null hypothesis about the outcomes of rational action that is frequently disproven by reality. However, in this context we would also urge students to complement the thought experiment with empirical research, as Ostrom did and other commons scholars continue to do. Economics has a history of argument from first principles that is well-balanced by interdisciplinary anthropological methods³. Berkes et al. (1990) cautiously framed Hardin's contribution in this way: "Hardin's model provides insight about the divergence between individual and collective rationality. But it fails to take into account the self-regulating capabilities of [common resource] users...[showing] the dangers of trying to explain resource use in complex socio-ecological systems with simple deterministic models" (pp. 92, 93).

When asked about teaching recommendations a common response of the respondents was the use of games, whether they are board games or computerized versions, to experience the tragedy of the commons and explore solutions. Another recommendation is to use case study material of successful cooperative governance of the commons. Finally, many respondents recommended using the work of Ostrom to contrast Hardin's analytical argument with an empirical, well tested conceptual framework.

Our findings are compatible with studies of interdisciplinarity in sustainability education cited earlier which suggest that interdisciplinary environmental science and environmental studies programs (i.e., sustainability programs) tend to be dominated by natural science curricula and that publishing in sustainability science is more interdisciplinary at the fringes than in respective efforts grounded in social sciences and natural sciences, which have accounted for the bulk of articles in sustainability. We share an interest in increasing the effective interdisciplinarity of sustainability education, and submit that the "conventional wisdom" on commons governance may be symptomatic of the challenges the academy faces in meaningfully integrating disciplinary approaches.

Conclusions

³ To borrow another example from Coase, generations of economists used the metaphor of the lighthouse as an essential public good, tragically prone to under-provisioning, without bothering with the historical realities of lighthouse construction and upkeep [Coase, 1974].

In this article we presented results of a survey of instructors of introductory courses in sustainability teach Hardin's concept of the tragedy of the commons in their course. However, there is a wide variation among the instructors on how they interpret the material itself and whether they provide alternative viewpoints.

Among scholars of resource governance, it is commonly accepted that Hardin's essay is incomplete and dangerous as argued by some. Still the concept is widely taught in introductory courses in sustainability and, based on this survey, sometimes by instructors who have limited familiarity with the study of resource governance. We found that especially in sustainability-related courses in nature science programs, in contrast to social science and economics programs, there was significantly greater misunderstanding of the current knowledge of commons governance.

Misunderstanding of the ways shared resources can be governed has important implications for solutions to conflicts. In order for students to derive a proper understanding of governance concepts about shared resources, there is a need to improve teaching material. Free educational materials on the governance of the commons for the undergraduate level are available as a textbook (Anderies and Janssen, 2016) and a MOOC (Merino Pérez, 2018). However, given the persistence of misconceptions on the subject, special effort is needed to better inform instructors on the current state of knowledge, especially among environmental science scholars.

Notes on contributors

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Appendix A

Recruitment email to instructors

Dear Professor \${m://LastName},

2018 marks the 50 year anniversary of the Science article “The Tragedy of the Commons” of Garrett Hardin. We contact you as an instructor of an undergraduate course within sustainability or environmental science related programs. I am recruiting instructors to investigate how Hardin’s essay is used in higher education. We will describe the results in a scholarly paper.

The survey will take approximate 5 minutes to complete.

Follow this link to the Survey:

[\\${1://SurveyLink?d=Take the Survey}](#)

Or copy and paste the URL below into your internet browser:

[\\${1://SurveyURL}](#)

If you know other instructors who may want to participate in this study you can forward this email.

Your participation is voluntary and all individual responses will be confidential. If you have any questions concerning the research study, you can contact me at Marco.Janssen@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the Office of Research Integrity and Assurance at Arizona State University, at (480) 965-6788.

Thank you for your precious time.

Marco Janssen

Professor

School of Sustainability

Arizona State University

Follow the link to opt out of future emails:

[\\${1://OptOutLink?d=Click here to unsubscribe}](#)

Recruitment email send to listserv of the Association for Environmental Studies and Sciences

Dear colleagues

2018 marks the 50 year anniversary of the Science article “The Tragedy of the Commons” of Garrett Hardin. I am recruiting instructors in environmental studies and sciences to investigate how Hardin’s essay is used in higher education. We will describe the results in a scholarly paper.

The survey will take approximate 5 minutes to complete.

You can access the survey in the following link:

https://asu.co1.qualtrics.com/jfe/form/SV_9HrWw5k4NE1OmiN

Your participation is voluntary and all individual responses will be confidential. If you have any questions concerning the research study, you can contact me at Marco.Janssen@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the Office of Research Integrity and Assurance at Arizona State University, at (480) 965-6788.

Thank you for your precious time.

Marco Janssen
Professor
School of Sustainability
Arizona State University

Appendix B

Survey on Commons in Higher Education

50 years ago, biologist Garrett Hardin's essay "The Tragedy of the Commons" was published in Science, and this essay has since become one of the most- assigned readings in American colleges. We are doing a survey among instructors in colleges and universities in the U.S.A. about how they use the concepts popularized by this essay in their courses. You are invited to participate in this survey if you have recently taught an undergraduate course related to environmental and/or sustainability topics.

There are two pages to this short survey. The first asks about learning objectives associated with teaching this concept. The second page invites you to share background and feedback about your teaching of this concept in undergraduate courses

Q0. Do you teach the concept of the "tragedy of the commons"?

<Choose: Yes, I currently teach this concept; Not currently, but I have in the past; No>

<If "No" was selected:>

This survey is primarily concerned with understanding how the concept is being taught. If you'd like to share your reasons for not teaching "the tragedy of the commons," please use the space below to give us feedback.

<Free form text entry>

You are welcome to view or complete the remainder of this short survey, or simply skip to the end to submit your reply.

<Otherwise>

Please indicate how much you agree or disagree with the following reasons for teaching the concept "the tragedy of the commons."

- Q1. It is required in a course curriculum I am responsible for teaching.
<Rank 1-5: Strongly agree, Somewhat agree, Neither agree or disagree, Somewhat disagree, Strongly disagree>
- Q2. Teaching alternative theories on the governance of commons confuses students.
<Rank 1-5: Strongly agree, Somewhat agree, Neither agree or disagree, Somewhat disagree, Strongly disagree>
- Q3. It is convenient to teach because it is in existing course materials; I would teach something else if the materials were easily available.
<Rank 1-5: Strongly agree, Somewhat agree, Neither agree or disagree, Somewhat disagree, Strongly disagree>

- Q4. It demonstrates that external intervention is needed to avoid a "tragedy of the commons."
<Rank 1-5: Strongly agree, Somewhat agree, Neither agree or disagree, Somewhat disagree, Strongly disagree>
- Q5. It illustrates the fundamental dilemma that occurs when people share resources.
<Rank 1-5: Strongly agree, Somewhat agree, Neither agree or disagree, Somewhat disagree, Strongly disagree>
- Q6. It represents the foremost thinking on the commons; if students learn one thing about commons governance it should be this concept.
<Rank 1-5: Strongly agree, Somewhat agree, Neither agree or disagree, Somewhat disagree, Strongly disagree>
- Q7. I am not familiar with alternative theories on managing common resources.
<Rank 1-5: Strongly agree, Somewhat agree, Neither agree or disagree, Somewhat disagree, Strongly disagree>
- Q8. It provides a neoliberal perspective on managing common resources.
<Rank 1-5: Strongly agree, Somewhat agree, Neither agree or disagree, Somewhat disagree, Strongly disagree>
- Q9. It serves as a useful counterpoint to empirical research on governance of commons.
<Rank 1-5: Strongly agree, Somewhat agree, Neither agree or disagree, Somewhat disagree, Strongly disagree>
- Q10. It establishes the utility of a system of property rights.
<Rank 1-5: Strongly agree, Somewhat agree, Neither agree or disagree, Somewhat disagree, Strongly disagree>
- Q11. In what context do you teach the concept of "the tragedy of the commons"?
Choose the answer that best fits:
- a. As part of a program in action research
 - b. As a standalone concept or unit on governance in a course
 - c. In a survey of contrasting philosophies of governance (e.g., political economy or political ecology)
 - d. As a social science perspective on coping with shared natural resources
 - e. As background for common pool resource governance scholarship (e.g., Ostrom)
 - f. In a historical context (e.g., social and political movements)
 - g. Other (please specify):
- Q12. How much time in the course is devoted to teaching about commons governance overall (including both "the tragedy of the commons" and other theoretical or empirical approaches)?
- a. Part of a class
 - b. A whole class

- c. A week
- d. More than a week

- Q13. What is the type of program in which this course is taught? (E.g., Social Science; Natural Science; Humanities; Engineering; Business/Economics)
- Q14. What is the typical class size of this course?
- Q15. In what field(s) or discipline(s) did you receive your graduate degree(s)?
- Q16. In what year(s) did you receive your graduate degree(s)?
- Q17. Do you have suggestions for improving teaching material, or other ideas to contribute to this survey?
- Q18. Do you want to receive notification of the outcomes of this research?
<Choose: Yes; No>

Appendix C: Descriptive statistics

Do you teach the concept of the tragedy of the commons?

	ASHEE	AESS	Total
Yes	154 (87%)	66 (67%)	220 (80%)
No, but did in the past	12 (7%)	18 (18%)	30 (11%)
No	11 (6%)	14 (14%)	25 (9%)
total	177	98	275

Only people who have used TotC in past.

It is required in a course curriculum I am responsible for teaching.

	ASHEE	AESS	total

Strongly agree	66 (42%)	19 (25%)	85 (37%)
Agree	29 (19%)	14 (18%)	43 (19%)
Neutral	21 (13%)	18 (24%)	39 (17%)
Disagree	14 (9%)	8 (11%)	22 (9%)
Strongly Disagree	26 (17%)	17 (22%)	43 (19%)
N	156	76	234

Teaching alternative theories on the governance of commons confuses students.

	ASHEE	AESS	total
Strongly agree	4 (3%)	1 (1%)	5 (2%)
Agree	9 (6%)	3 (4%)	12 (5%)
Neutral	30 (19%)	8 (11%)	38 (16%)
Disagree	45 (29%)	17 (22%)	62 (27%)
Strongly Disagree	68 (44%)	47 (62%)	115 (50%)
N	156	76	232

It is convenient to teach because it is in existing course materials; I would teach something else if the materials were easily available.

	ASHEE	AESS	Total
Strongly agree	3 (2%)	2 (3%)	5 (2%)
Agree	13 (8%)	3 (4%)	16 (7%)

Neutral	37 (24%)	14 (18%)	51 (22%)
Disagree	44 (28%)	20 (26%)	64 (28%)
Strongly Disagree	58 (37%)	37 (49%)	95 (41%)
N	155	76	231

It demonstrates that external intervention is needed to avoid a "tragedy of the commons."

	ASHEE	AESS	total
Strongly agree	28 (18%)	10 (13%)	38 (16%)
Agree	44 (28%)	16 (21%)	60 (26%)
Neutral	30 (19%)	10 (13%)	40 (17%)
Disagree	27 (17%)	18 (24%)	45 (19%)
Strongly Disagree	27 (17%)	22 (29%)	49 (21%)
N	156	76	232

It illustrates the fundamental dilemma that occurs when people share resources.

	ASHEE	AESS	Total
Strongly agree	58 (37%)	22 (29%)	80 (34%)
Agree	61 (39%)	32 (42%)	93 (40%)
Neutral	11 (7%)	3 (4%)	14 (6%)
Disagree	8 (5%)	10 (13%)	18 (8%)
Strongly Disagree	18 (12%)	9 (12%)	27 (12%)

N	156	76	232
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It represents the foremost thinking on the commons; if students learn one thing about commons governance it should be this concept.

	ASHEE	AESS	Total
Strongly agree	15 (10%)	5 (7%)	20 (9%)
Agree	48 (31%)	12 (16%)	60 (26%)
Neutral	25 (16%)	12 (16%)	37 (16%)
Disagree	28 (18%)	15 (20%)	43 (19%)
Strongly Disagree	39 (25%)	32 (42%)	71 (31%)
N	155	76	231

I am not familiar with alternative theories on managing common resources.

	ASHEE	AESS	Total
Strongly agree	5 (3%)	1 (1%)	6 (3%)
Agree	15 (10%)	1 (1%)	16 (7%)
Neutral	12 (8%)	6 (8%)	18 (8%)
Disagree	35 (22%)	16 (21%)	51 (22%)
Strongly Disagree	89 (57%)	52 (68%)	141 (61%)
N	156	76	232

It provides a neoliberal perspective on managing common resources.

	ASHEE	AESS	Total
Strongly agree	13 (8%)	9 (12%)	22 (10%)
Agree	44 (29%)	27 (36%)	71 (31%)
Neutral	58 (38%)	25 (33%)	83 (36%)
Disagree	21 (14%)	5 (7%)	26 (11%)
Strongly Disagree	18 (12%)	10 (13%)	28 (12%)
N	154	76	230

It serves as a useful counterpoint to empirical research on governance of commons.

	ASHEE	AESS	Total
Strongly agree	8 (5%)	13 (17%)	21 (9%)
Agree	37 (24%)	19 (25%)	56 (24%)
Neutral	76 (49%)	23 (30%)	99 (43%)
Disagree	21 (13%)	11 (14%)	32 (14%)
Strongly Disagree	14 (9%)	10 (13%)	24 (10%)
N	156	76	232

It establishes the utility of a system of property rights.

	ASHEE	AESS	Total
Strongly agree	12 (8%)	3 (4%)	15 (6%)
Agree	65 (42%)	27 (36%)	92 (40%)

Neutral	38 (25%)	17 (22%)	55 (24%)
Disagree	26 (17%)	16 (21%)	42 (18%)
Strongly Disagree	14 (9%)	13 (17%)	27 (12%)
N	155	76	231

In what context do you teach the concept of "the tragedy of the commons"?

	ASHEE	AESS	total
Part of program in action science	1 (1%)	0 (0%)	1 (0%)
Stand alone concept on governance	17 (11%)	8 (11%)	25 (11%)
Part of a survey on governance	15 (10%)	22 (15%)	26 (12%)
Social science perspective on coping with shared natural resources	54 (35%)	20 (31%)	76 (34%)
Background on common pool resource scholarship	35 (23%)	20 (28%)	55 (25%)
Historical context	8 (5%)	2 (3%)	10 (4%)
Other	22 (14%)	9 (13%)	31 (14%)
N	152	72	224

How much time in the course is devoted to teaching about commons governance overall (including both "the tragedy of the commons" and other theoretical and empirical approaches)?

	ASHEE	AESS	Total
Part of a class	67 (44%)	27 (37%)	94 (42%)

A whole class	41 (26%)	18 (25%)	59 (26%)
A week	30 (20%)	22 (30%)	52 (23%)
More than a week	13 (9%)	6 (8%)	19 (8%)
N	151	73	224

What is the type of program in which this course is taught?

	ASHEE	AESS	total
Economics & Political Science (rational choice)	16 (10%)	6 (8%)	22 (9%)
Engineering	2 (1%)	2 (3%)	4 (2%)
Humanities (incl. Env Ethics)	12 (7%)	1 (1%)	13 (5%)
Interdisciplinary (incl. Env. Studies)	42 (26%)	26 (36%)	68 (29%)
Natural resources management	3 (2%)	2 (3%)	5 (2%)
Natural science (incl. Env. Science)	43 (26%)	16 (22%)	59 (25%)
Public administration and planning	3 (2%)	3 (4%)	6 (3%)
Social science (Anthro & sociology)	29 (18%)	16 (22%)	45 (19%)
Other –general –unk.	14 (9%)	1 (1%)	15 (6%)
N	164	73	237

Based on Romero & Silveri (2006) and Vincent & Focht (2010) we defined 8 types of disciplines and a rest category. We classified each program based on the information provided.

What is the typical class size of this course?

	ASHEE	AESS	total
(0,10]	6 (4%)	4 (5%)	10 (4%)
(10,30]	60 (39%)	40 (55%)	100 (44%)
(30,100]	68 (44%)	22 (30%)	90 (40%)
(100,500]	19 (12%)	7 (10%)	26 (12%)
N	153	73	226

In what field(s) or discipline(s) did you receive your graduate degree(s)?

	ASHEE	AESS	total
Economics & Political Science (rational choice)	20 (12%)	15 (17%)	35 (14%)
Engineering	4 (2%)	0 (0%)	4 (2%)
Humanities (incl. Env Ethics)	16 (10%)	4 (5%)	20 (8%)
Interdisciplinary (incl. Env. Studies)	34 (21%)	15 (17%)	49 (20%)
Natural resources management	7 (4%)	6 (7%)	13 (5%)
Natural science (incl. Env. Science)	44 (27%)	15 (17%)	59 (24%)
Other –general –unk.	21 (13%)	17 (20%)	38 (15%)

Public administration and planning	8 (5%)	3 (3%)	11 (4%)
Social science (Anthro & sociology)	10 (6%)	11 (13%)	21 (8%)
N	164	86	250

Based on Romero & Silveri (2006) and Vincent & Focht (2010) we defined 8 types of disciplines and a rest category. We classified each final degree based on the information provided.

What year did you get your latest graduate degree?

	ASHEE	AESS	total
<1980	11 (7%)	3 (4%)	14 (6%)
1980-1989	22 (15%)	5 (7%)	27 (12%)
1990-1999	24 (16%)	12 (17%)	36 (16%)
2000-2009	40 (26%)	17 (24%)	57 (26%)
2010-2019	54 (36%)	35 (49%)	89 (40%)
N	151	72	223

It demonstrates that external intervention is needed to avoid a "tragedy of the commons." (kind of course)

	Economics	Social Science	Natural Science	Interdisciplinary	Total
Strongly agree	1 (5%)	7 (16%)	12 (20%)	11 (16%)	38 (16%)
Agree	6 (27%)	9 (20%)	19 (32%)	17 (25%)	60 (26%)

Neutral	5 (23%)	9 (20%)	10 (17%)	7 (10%)	40 (17%)
Disagree	6 (27%)	7 (16%)	11 (19%)	12 (18%)	45 (19%)
Strongly Disagree	4 (18%)	13 (29%)	7 (12%)	21 (31%)	49 (21%)
N	22	45	59	68	232

It represents the foremost thinking on the commons. If students learn one thing about commons governance it should be this concept. (kind of course)

	Economics	Social Science	Natural Science	Interdisciplinary	Total
Strongly agree	0 (0%)	2 (4%)	6 (10%)	8 (12%)	20 (9%)
Agree	6 (29%)	10 (22%)	22 (37%)	12 (18%)	60 (26%)
Neutral	4 (19%)	6 (13%)	13 (22%)	8 (12%)	37 (16%)
Disagree	5 (24%)	6 (13%)	11 (19%)	13 (19%)	43 (19%)
Strongly Disagree	6 (29%)	21 (47%)	7 (12%)	27 (40%)	71 (31%)
N	21	45	59	68	231

I am not familiar with alternative theories on managing common resources. (kind of course)

	Economics	Social Science	Natural Science	Interdisciplinary	Total
Strongly agree	0 (0%)	0 (0%)	3 (5%)	1 (1%)	6 (3%)
Agree	1 (5%)	2 (4%)	9 (15%)	2 (3%)	16 (7%)

Neutral	0 (0%)	4 (9%)	7 (12%)	5 (7%)	18 (8%)
Disagree	4 (18%)	6 (13%)	18 (31%)	13 (19%)	51 (22%)
Strongly Disagree	17 (77%)	33 (73%)	22 (37%)	47 (69%)	141 (61%)
N	22	45	59	68	232

Restricting it to those who have taught the TotC, N = 228

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Q2	0.092								
Q3	0.077	0.147							
Q4	0.067	0.329	0.079						
Q5	0.181	0.293	0.022	0.543					
Q6	0.139	0.394	0.129	0.611	0.557				
Q7	0.008	0.374	0.271	0.420	0.312	0.459			
Q8	0.050	-0.093	0.182	-0.193	-0.271	-0.248	-0.077		
Q9	0.114	0.071	0.213	0.218	0.118	0.066	0.148	0.129	
Q10	0.195	0.077	0.058	0.156	0.208	0.246	0.099	-0.132	0.176

Q1=It is required in a course curriculum I am responsible for teaching.

Q2=Teaching alternative theories on the governance of commons confuses students.

Q3=It is convenient to teach because it is in existing course materials¼ I would teach something else if the materials were easily available.

Q4=It demonstrates that external intervention is needed to avoid a "tragedy of the commons."

Q5=It illustrates the fundamental dilemma that occurs when people share resources.

Q6=It represents the foremost thinking on the commons¼ if students learn one thing about commons governance it should be this concept.

Q7=I am not familiar with alternative theories on managing common resources.

Q8=It provides a neoliberal perspective on managing common resources.

Q9=It serves as a useful counterpoint to empirical research on governance of commons.

Q10=It establishes the utility of a system of property rights.