



Teaching The Tragedy of the Commons through an Iterative, Performance-based, Embodied Cognition Pedagogy

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ABSTRACT

Garrett Hardin's *The Tragedy of the Commons* is a classic piece of academic literature in geography and cognate fields. Applying theories of embodied cognition and performance pedagogies, this paper presents a classroom-based activity that can be used to teach the concepts of *The Tragedy of the Commons* in a way that will likely intersect with students' own lived experiences more meaningfully than Hardin's central example of a group of livestock owners making use of a shared field for grazing. The activity involves a dialogue among five student volunteer actors that iteratively portrays a group of friends trying to negotiate their own advantages alongside a sense of equity in the context of dividing the cost of a shared meal. During and after the performance, key opportunities are presented for the instructor to lead a discussion about Hardin's "tragedy" as well as the solutions he proposes by which it might be overcome. The model of scripted performance plus impromptu discussion used here can be applied to the teaching of other complex topics in the geography classroom.

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Introduction

Garrett Hardin's *The Tragedy of the Commons* (1968) is a classic piece of academic literature in the environmental sciences, including geography. Hardin's original application – like that of William Forster Lloyd (1833), whose concept he expounded upon – was to the perceived problem of uncontrolled human population growth. The principle that the paper asserts, however, that rational individual decisions can lead to collective tragedy when reward is individually owned but harm is collectively shared, has broad relevance to many instances of common pool and open-access resource use. Both Hardin's essay and the concept it espouses have received substantial criticism (e.g. Boyd et al., 2018; Cox, 1985; Dahlman, 1991; Harvey, 2011; Ostrom, 1990). Critics have questioned the "inevitability" of ruin that Hardin implied, and have suggested that collective governance strategies adapted to specific local conditions can effectively stave off tragedy in common-pool resource systems. Still, *The Tragedy of the Commons* remains an important piece of foundational literature and is widely assigned and (we hope) read in undergraduate courses on economics, environmental science, geography, and sustainability, among other subjects (Burger & Gochfeld, 1998). To understand the criticism, students must first understand the essay itself.

Hardin, following Lloyd, uses the allegory of settled pastoralists who each individually own herds of cattle, which they graze upon a field that is owned collectively. His lesson hinges on the problem by which each herder is incentivized to continually expand the size of his herd, even to the point of overgrazing the field, because the benefits of each additional cow are won exclusively by its owner, while the harm felt from the degradation of the pasture through overgrazing are distributed among all herders. To put it mathematically, where n represents the number of herders sharing access to the pasture, b represents the total benefit from the addition of another cow to one's herd, and h represents the total harm from the same, Hardin explains that, when considering the addition of another animal, each herder recognizes that he stands to gain b benefits but only suffer h/n harm. If any single herder were to limit the size of his own herd in the interest of lessening his environmental impact, it is supposed, the other herders would exploit this restraint by expanding their own herds to fill the gap. The rational decision, made in self-interest, then, is to keep expanding one's herd even to the point of environmental collapse, or, in Hardin's words, "each man is locked into a system that compels him to increase his herd without limit – in a world that is limited" (1968, p. 1244).

To illustrate the fact that the Tragedy of the Commons principle has broad application beyond range management and grazing access, Hardin offers additional analogies: urban parking spaces, US National Park visitation, high seas fisheries, environmental pollution, etc., but continues to return to the "population problem" at the heart of his concern (1968, p.1243 and throughout). Scholars that followed Hardin have identified similar "tragedies" that hamper efforts to address climate change, environmental pollution, overuse of natural resources, and other "wicked problems" (Boyd et al., 2018; Rittel & Webber, 1973, p. 155). While it is not my argument here that yet another analogy will help students to understand the concepts presented by Hardin, it is likely that students in undergraduate geography courses may feel that they have little personal experience with *any* system in which they own resources and make decisions regarding their rational and/or sustainable use. As such, this paper presents a simple classroom exercise that will intersect with most students' lived experience and serves to illustrate not only the general principle behind The Tragedy of the Commons, but also the relative strengths and weaknesses of the various solutions to the problem proposed by Hardin and others who have responded to his widely-cited essay.

This exercise is an example of a performance-based, embodied cognition pedagogy. The theory of embodied cognition asserts that human thought is not the sole domain of the brain but that the body, too, has agency in the processes of learning and thinking (Alibali & Nathan, 2018; Leitan & Chaffey, 2014; Shapiro & Spaulding, 2021). In making this assertion, embodied cognition represents a critique to the Cartesian idea of an inherent ontological dualism of mind and body (Descartes, 1911) and thus aligns well with critical feminist geographies that focus upon social and spatial constructions of the body (Longhurst, 1995; Moss & Dyck, 2002; Mountz 2018). By creating a classroom environment in which a performance is simultaneously enacted and reflected upon, pedagogical activities such as the one presented here draw also from educational concepts derived from theories of biosemiotics (Peirce, 1991; Von Uexküll, 2013), sometimes termed "edusemiotics," which can alert students and instructors to pre-intentional and pre-verbal aspects of cognition. While teaching across multiple academic fields has

benefitted from edusemiotic and embodied cognition pedagogies (e.g. Campbell, 2016; Deely & Semetsky, 2016; Olteanu & Campbell, 2018; Seif, 2017; Stables & Semetsky, 2015), scholars have identified particular benefit in environmental, geographical, and sustainability education (Campbell et al., 2021; Foster, 2014).

Embodied cognition has received criticism (e.g. Goldinger et al., 2016); still, many educators find that exercises such as the one presented here can enhance student learning when used to augment more traditional pedagogical techniques (Francesconi & Agostini, 2021; McClelland et al., 2014; Shapiro, 2014; Wolfe, 2017). Even in a heavily dialogue-based activity such as this, the student-actors “embody” their roles through subtle actions and gestures, both scripted and ad-libbed, as they seek to convincingly portray the roles they have been assigned (Bryon et al., 2017; Kemp, 2012). An approach to education that embraces the concept of embodied cognition permits new pedagogical possibilities, which benefit from the understanding that, “cognition depends upon the kinds of experience that come from having a body with various sensorimotor capacities” (Varela et al., 1991, p. 173). Some embodied cognition-influenced pedagogical activities, like the one introduced here, rely upon students’ own guided phenomenological analysis of the activity in which they have participated (Laner, 2021; Wilson, 2002). This analysis, when curated intentionally by the instructor, can produce a rich understanding of the concepts taught, owing to the “situated” nature of cognition and the strategic involvement of the body and environment in the coupled processes of teaching and learning (Wilson, 2002, p. 626).

Instructors in a variety of academic disciplines have, in recent years, begun to design and implement classroom activities that make use of the principles of embodied cognition. While the majority of early-adopters have been located broadly within the “cognitive sciences” (including such fields as cognitive anthropology, linguistics, neuroscience, and psychology, among others – see, for example, Clark, 1999), scholars have suggested that the implementation of embodied cognition pedagogies may enhance learning across a broad range of fields (Weisberg & Newcombe, 2017), including topics of particular relevance to geography such as cartographic interpretation (Atit et al., 2016), the geosciences (Jaeger et al., 2016), and spatial thinking (DeSutter & Stieff, 2017). It is my assertion that there remains significant potential for teaching methods informed by theories of embodied cognition within the field of geography. This paper presents one such application, designed to aid in the teaching of the concepts popularized by Hardin in *The Tragedy of the Commons* (1968).

Materials and Methods

Set-up

This classroom exercise takes approximately 45 minutes but could be shortened or expanded, depending upon the time allotted. It involves five students interacting by reading through a scripted performance for the rest of the students in the class to observe. The instructor serves as a narrator but the majority of the action, dialogue, and discussion is led by the students themselves. The dialogue is meant to be both humorous and current and was designed to model the casual speech of American youths. As such, it will need to be revised for use in other cultural contexts and, eventually, to remain relevant as time passes and language evolves. The reference to the smartphone-based mobile payment application

Venmo, for example, may not be meaningful in places where the service is unavailable, nor in the future if it falls out of use, and some of the colloquial language is susceptible to being unfamiliar or to becoming outdated (e.g. “Same” as a statement of assent).

The setting is a restaurant at which a group of four friends has decided to meet regularly for dessert and conversation. The existence of the “commons” in this case rests upon the fact that the restaurant does not allow separate checks for individual members of a single party, but instead presents one bill to each table at the end of their meal. As a general rule, the diners decide to have one person pay the bill entirely and each of the others will pay that person back exactly 25% of the total, that is, they will not calculate their actual individual share but will instead simply split the bill four ways.

The performance goes through nine iterations of weekly meetings of this “dessert club.” In each, diners modify their own dessert orders based upon external conditions that are explained either by the narrator or in the dialogue itself, and upon lessons learned in previous iterations. Each diner has the goal of maximizing his or her own value (represented here by the menu price of the dessert each diner orders) and minimizing his or her own cost (the share of the total bill that each diner pays), though, as a group of friends, the diners share an interest in arriving at an equitable division of cost as well. An individual diner achieving a high value-to-cost ratio results in the individual getting more dessert than he or she pays for, but at a social cost that carries implications for future weekly meetings. As such, the simulation borrows from game theory, particularly as an example of a coordination game such as the famous “Prisoner’s Dilemma,” in which an equilibrium is sought among individual players each trying to maximize their own best outcome within a zero-sum environment (Cooper, 1999; Nash, 1950; Tucker, 1983).

Prior to conducting the activity, the instructor should identify an actual restaurant menu - or create a hypothetical one-to use. The instructor should also write out a script and print five copies: one for each of the four students playing diners and another for the student who will play the role of server. It can be useful to provide the script and menu for the entire class to reference, especially if the class is large, in order to help non-acting students follow along. A script is included here as [Appendix 1](#) with the expectation that it will be modified by others who make use of this activity. The menu referred to in this sample script is derived from an actual restaurant menu and is presented in [Figure 1](#).

Finally, prior to the implementation of this learning activity, the instructor should calculate the relevant values for each “weekly” iteration. The calculations made, based upon the menu used by the author, are included here as [Appendix 2](#). Referring to the script, the instructor should calculate the following values for each weekly iteration of the performance:

- (1) The value obtained by each diner, represented here by the menu price of the dessert item that diner orders.
- (2) The cost paid by each diner, represented here by that diner’s share of the total bill, which in most iterations equals exactly 25% of the total bill.
- (3) The total bill for the group.



Figure 1. Modified dessert menu from Bern's Steakhouse in Tampa, Florida, referred to in the sample script for this activity (used by permission). Instructors who adopt this activity are encouraged to create a fictional menu or to choose a menu from a restaurant that would be locally relevant to themselves or their students.

It will be beneficial to create a chart (Figure 2) that shows, on the x-axis, each week's gathering, within which each individual diner's value and cost is displayed. My y-axis represents monetary value and can be used to chart individual cost, individual value, and total group cost. The prices found on the sample menu shown in Figure 1 suggest the creation of a y-axis scale that shows values from \$0.00 to \$90.00. The data that the chart will display include each diner's weekly value received (i.e. the menu price of the dessert item ordered), each diner's weekly cost incurred (normally 25% of the total bill, with an exception for one week which shall be discussed below), and the total bill for the table. In the analogy, each diner's weekly value received represents the individual benefit that each participant in the open-access common resource pool being modeled receives, each diner's weekly cost incurred represents each participant's share of the total environmental harm from the collective resource use, and the total bill for the table represents the total environmental impact of all participants' resource-use activities. The

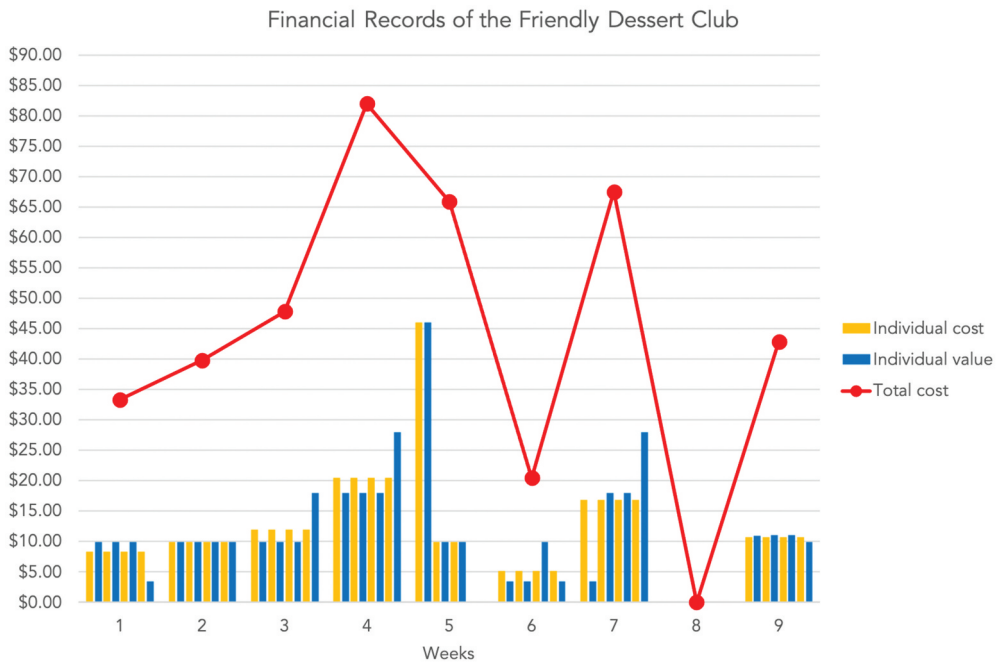


Figure 2. Chart showing the weekly amounts in US\$ for three values: 1. Light columns: each diner’s individual value received (the cost of the dessert ordered, used in this allegory to represent individual gain from participation in the use of a common-pool resource), 2. Dark columns: each diner’s individual cost incurred (the diner’s share of the total bill, used in this allegory to represent individual share of the cost from the environmental degradation associated with the use of a common-pool resource), 3. Line with points: the total bill for the table (used in this allegory to represent the total environmental degradation associated with the use of a common-pool resource). Within each week, the cluster of columns is made up of four pairs (one light, one dark) representing each diner’s value and cost in order from Diner 1 to Diner 4.

instructor should explain the symbolic meaning of each of these values after the first iteration of the activity, while displaying only the portion of the chart having to do with Week 1.

Activity

Ideally, the concept of The Tragedy of the Commons will already have been introduced either earlier in the class session or in a previous session. The instructor should assign Hardin’s paper as a reading to be completed before the class session in which this activity is conducted. In addition to, or alternatively instead of, the reading, the instructor may choose to show the brief animated “Chalk Talk” videos produced by the US National Science Foundation (NSF 2012a, 2012b), or a similar resource, as an introduction to the concept, depending upon the degree to which it has been covered previously in the class.

The instructor begins by asking the class for five volunteers to take part in a demonstration. Four of the volunteers are seated around a table, ideally at the front of the classroom where all the other students can see and hear the performance that will take place. Each of these four students plays the role of a diner, designated in the script simply as Diner 1, Diner 2, and so

forth. The fifth student plays the role of the restaurant's server. The instructor gives each volunteer a copy of the script and a copy of the menu. The instructor should allow some time for students to familiarize themselves with both documents, and to mark their own lines in the dialogue for quick reference.

The performance begins with the instructor, acting as narrator, explaining the scenario. A group of four friends has decided to institute a "dessert club" with the goal of meeting once each week for food and conversation. They have picked a restaurant with a strict policy against separate checks; the only billing option is to have a single check delivered to the table at the end of the meal and to pay the bill with a single diner's credit card.

Following this introduction, the students begin reading their lines and enacting the performance, which follows the dessert club's meetings from week to week. The instructor interjects both narration and explanation, pointing out the changes that diners make in their dessert-ordering strategies from week to week as well as the effects that these changes have on each diner's value received, each diner's cost incurred, and the total cost of the table's bill. At the end of each week's iteration, the relevant section of the chart (Figure 2) is revealed on the screen. The chart shows, for each week, the cost incurred by each diner, the value received by each diner, and the cost of the total bill. The instructor should remind the class that these figures represent, respectively, each participant's individual share of the overall environmental degradation of the system, each participant's individual earnings from their own resource exploitation, and the total environmental impact of all participants' resource exploitation. Discussion and questions are welcomed from the student-actors and from the students who are observing the performance.

Results

At the end of the performance, the complete chart (Figure 2) has been revealed and the instructor leads a discussion with the class about the trends that it shows. At this point, it is beneficial to make concrete the allegorical nature of the performance, specifically, the evolving strategies and attempts at regulation illustrated in each week's events. The breadth of the post-performance discussion is variable, depending upon the context of the course in which this activity takes place. For broader courses on sustainability, the instructor should remind students of the "triple bottom line" (TBL) model for sustainability (Elkington, 2018), the concept of sustainable development (United Nations, 1987), or the 17 United Nations' Sustainable Development Goals (United Nations, 2021). For classes more focused upon environmental policy or specific human-environment interactions (e.g. fisheries), the instructor should refer to the real-world case of the particular resource use being modeled and some of the actual or hypothetical policy instruments available to regulate that use.

The instructor should explain that Weeks 1 through 4 represent unregulated open-access use of a common-pool resource. As each diner realizes the implications of the system – specifically the individual nature of reward and the shared nature of harm – he or she will adapt accordingly, following what Hardin calls "the only sensible course" (1968, p. 1244), which is to exploit more of the resource (in the case of the analogy, by

ordering more expensive items for dessert), because “each [is] pursuing his own best interest” despite the fact that “ruin is the destination to which all men rush” (Hardin, 1968, p. 1244). “Ruin,” in the analogy, is represented both by increased individual costs incurred by each diner and by the increased total bill for the table, which represents the entire environmental impact of the resource exploitation system. In open-access fisheries, for example, this would be seen in the overexploitation of fish stocks, which negatively impacts each participant’s catch as well as the ocean ecosystem itself. The result of this trend is that individual costs, individual rewards, and the total cost of the bill for the table all increase during the first four weeks. The latter value corresponds to increasing environmental degradation of the ecosystem supporting the resource pool being modeled.

Week 5 introduces the concept of privatization – a frequently suggested remedy to the Tragedy of the Commons (Anderson & Hill, 1983; Baland & Platteau, 1994; Wang & Chen, 2021), and one that Hardin (1968) both discusses and dismisses. By insisting that the restaurant provide individual bills for each diner, the dessert club effectively ceases to exist as a commons and instead is converted into a loose parallel affiliation defined by private ownership. A real-world analogue to this situation might be the private ownership of land and the mineral rights that go along with it by a mining operation. In this situation, the total environmental impact is indeed brought down from the last unregulated example, but at the cost of equity. Specifically, owing to the misfortunes that have befallen Diner 4, this member of the dessert club is completely shut out of the resource pool, having no capital with which to enter. Returning to the fisheries example, this could be explained as representing some of the equity issues that must be considered when fisheries are privatized (Hannesson, 2004).

Weeks 6 and 7 introduce appeals to conscience, here representing the nonbinding targets often suggested by governments or intergovernmental panels to corporations or individuals engaged in resource exploitation (Bodansky et al., 2007; Dorsey, 2016; Gasser, 1998; H eritier, 2002; Victor, 1997). The progression from Week 6, in which one club member violates the trust of the others and benefits from this violation, to Week 7, in which all but one club member follow suit, illustrates the problem of voluntary limits to resource exploitation and the penalties sometimes endured by those who “play by the rules” when others do not.

Week 8 is something of an interlude in which no resource exploitation occurs. Of course, in this situation, the total environmental impact is zero, but the individual value received by each dessert club member is also zero, which can be likened unto a complete lack of availability of necessary resources such as food or energy. As the post-performance discussion focuses upon the events of Week 8, the instructor can guide the students through a consideration of the effects – on economics, public health, or standards-of-living, for example, – of naive suggestions that sometimes arise in discussions about sustainable development that we simply “ban fisheries,” or completely cease other forms of resource exploitation (Bennett, 2020). This portion of the discussion usually centers around the balance among, on the one hand, the “environmental” bottom line and, on the other, the “social” and “economic” bottom lines of the TBL model.

Table 1. The ratio of value received to cost incurred by each diner in the simulation, by week. In the allegory, value received symbolizes the benefit or profit received by an individual participating in the exploitation of a common-pool resource and cost incurred symbolizes each individual's share of the environmental degradation that results from the exploitation. The symbol “–” indicates no value received and no cost incurred. Standard deviations are included as an indicator of equity: lower values mean greater equity within each week.

Diners	Weeks								
	1	2	3	4	5	6	7	8	9
1	1.19	1.00	0.83	0.88	1.00	0.68	0.21	–	1.02
2	1.19	1.00	0.83	0.88	1.00	0.68	1.07	–	1.03
3	1.19	1.00	0.83	0.88	1.00	1.95	1.07	–	1.03
4	0.42	1.00	1.51	1.37	–	0.68	1.66	–	0.93
Standard deviation	0.39	0.00	0.34	0.24	0.50	0.63	0.60	–	0.05

Week 9 illustrates Hardin's concept of “mutual coercion” (1968, p. 1247) by introducing a limit within which some individual freedom can be exercised. In doing so, the solution proposed by Diner 1 in the dialogue can be seen as an example of Hardin's call for policies that “legislate temperance” (1968, p. 1245). The proposal that everyone orders the dessert of their choice, under the limit of a specific, agreed-upon maximum price, is presented as an example of Hardin's “carefully biased options” (1968, p. 1247). While the peaceful and pleasant outcome of this coercion is certainly dramatized for the performance, it illustrates how various actors in a common-pool resource exploitation system can creatively work within limits that they feel allow an acceptable degree of freedom and accountability.

If the concept of equity is at all relevant to the course (and here I would respectfully submit that it *ought* to be), the instructor should summarize the individual cost/value ratios from week to week in a table displayed on the screen (Table 1). These values can be interpreted as representing each individual's own assessment of his or her own weekly outcome. The standard deviations across these ratios by week can indicate the overall equity of the week's outcome. Lower standard deviations represent more equitable outcomes owing to less variance among cost/value ratios. In the classroom discussion that follows the performance, while discussing the issue of equity, the instructor should remind the students of Hardin's assertion that, “An alternative to the commons need not be perfectly just to be preferable” (1968, p. 1247). Within a reasonably talkative class, this statement can provoke robust and rewarding discussions.

Discussion

This activity's main pedagogical strength is its ability to present a new analogy for an old concept by using a method that both captures students' attention and promotes dialogue within the classroom. A week or so after the most recent time I used this activity in class, I asked students to reflect on it. One responded that, “I was able to see [The Tragedy of the Commons] in a perspective that I was able to relate to, thus understanding how the

original concept was taken.” Another student remarked that “the opportunity to guess what will happen to the chart after each scenario” was an effective way to incentivize listening and learning, even among students not picked for one of the five “active” roles.

The iterative, performance-based, embodied cognition activity described here can be an easily-implemented and effective way to teach the Tragedy of the Commons to an undergraduate geography class. It may also fit well within classes on environmental economics, environmental studies, natural resources, and sustainability. The departure from lecture-based class sessions is often welcomed by students and a certain degree of ad-libbing may allow for a more entertaining performance. Like the “fish-bowl” technique of in-class discussion (Dutt, 1997), this activity involves a set of observers (i.e. all students who do not play one of the five speaking roles in the dialogue) who are invited to discuss the implications of the scene they watch and to make explicit the connections among the allegory, Hardin’s The Tragedy of the Commons, and the real-world use of natural resources that they know from previous classes or outside reading and experience.

Arguing for the value of discussion in the classroom, American educator Walter C. Parker cited an adage stating, in the hypothetical words of a student, that, “I know what I think once I hear what I say” (2001, p. 113). While many educators trust in the pedagogical effectiveness of student-centered classroom discussions, some find it difficult to catalyze such discussions. The use of a scripted performance by a few students, observable by the rest of the class and open for comment by all, can be an effective way to get students thinking, talking, and acting. The volunteer actors and student observers who join the discussion may find themselves knowing what they think – to expand upon Parker’s adage – once they hear the lines they and their classmates read, feel the actions and gestures they perform, and experience the characters they embody through their performance.

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Appendix

Appendix 1: Script

Scene: four friends decide to get together one night per week for dessert.

Week 1 (Mood: Happy)

Server: Hi! Welcome to the Dessert Room at Bern’s. My name is _____ and I’ll be your server.

Just so you know, we don’t allow separate checks, ok? What can I get for you?

Diner 3: Guys, let’s just order what we want and split the check equally. That’ll be easiest. I’ll put it all on my card and then we can just divide the total by four and Venmo each other the money.

Diner 1: Works for me. [to server] I’ll have the chocolate cheese pie, please.

Diner 2: Mmm, that sounds good. I’d like the chocolate cheese pie too, please.

Diner 3: Make it three; I’ll have the chocolate cheese pie as well.

Diner 4: You know, I’m pretty full from dinner. I’ll just have a coffee.

Narrator: [Discuss the breakdown of costs and values for each diner.]

Total cost = \$33.35

Cost each = \$8.34

Value for Diners 1-3 = \$9.95 each

Value for Diner 4 = \$3.50

Week 2 (Mood: Even happier)

Server: Hey, welcome back to the Dessert Room at Bern's! You remember me—my name's _____ and I'll be your server again. You remember the rule against separate checks too, right? What can I get for you today?

Diner 1: New week, new dessert. I'd like to try the banana cheese pie, please.

Diner 2: Mmm, that sounds good. I'd like the banana cheese pie too.

Diner 3: Make it three; I'll have the banana cheese pie as well.

Diner 4: Well, I learned my lesson last week. I'm not skipping dessert this time if I'm going to have to pay anyway. I'll have a banana cheese pie too.

Narrator: [Discuss the breakdown of costs and values for each diner with entire class.]

Total cost = \$39.80

Cost each = \$9.95

Value each = \$9.95

Week 3 (Mood: Oh so happy)

Server: Three weeks in a row! You're my favorite customers. What can I get for you?

Diner 1: [to friends] This is great. I love our weekly dessert club. And I love my friends. [to server] I'm going to try the cheesecake Gert this time, please.

Diner 2: Mmm, that sounds good. I'd like the cheesecake Gert too.

Diner 3: Make it three; I'll have the cheesecake Gert as well.

Diner 1: Hey, I'm noticing a trend here. Why don't you guys ever pick your own desserts?

Diner 2: What are you talking about?

Diner 1: Never mind.

Diner 4: Ok, so the first time we got together I paid more than eight dollars and all I got was coffee. Last week I paid ten dollars and got a sweet dessert. I see how this goes. If I'm going to have to pay I might as well go big. I'll have the Taste of Bern's, please.

Narrator: [Discuss the breakdown of costs and values for each diner with entire class.]

Total cost = \$47.85

Cost each = \$11.96

Value for Diners 1-3 = \$9.95 each

Value for Diner 4 = \$18.00

Week 4 (Mood: A bit dark among diners, server is cheery as always)

Server: Hey, hey, look who's back. What can I get for you today?

Diner 1: [to self] Man, last week I got cheated. I paid twelve dollars for a ten-dollar dessert. I'm getting my money's worth this time. [to server] I'll go with the Taste of Bern's.

Diner 2: Taste of Bern's for me too, please. Got to get mine.

Diner 3: You guys are a bunch of thieves. [to server] Give me a Taste of Bern's.

Diner 4: I own this system! [to server] Bananas Foster, please.

Diners 1-3: [silent reactions of shock]

Server: [to Diner 4] Excellent choice, but that dessert is meant for two. Are you going to be sharing it with one of your friends?

Diner 4: No, why?

Server: . . .

Diner 4: . . .

Server: Right. Three Tastes of Bern's and one Bananas Foster coming right up.

Narrator: [Discuss the breakdown of costs and values for each diner with entire class.]

Total cost = \$82.00
 Cost each = \$20.50
 Value for Diners 1-3 = \$18.00 each
 Value for Diner 4 = \$28.00

Week 5 [after a break of several weeks] (Mood: Cautiously optimistic)

Diner 1: [to friends] Ok, if we're going to keep this dessert club going we're going to need to change our plans. How about this: we put our foot down with this server and simply demand separate checks. Each of us just pays for what we get.

Server: Hi! Welcome back to...

Diner 3: [cutting off the server] Separate checks or we don't eat here anymore.

Server: Ok, look for *you* I'll see what I can do. [goes away and comes back] My manager says just this once, we can do separate checks.

Diner 1: Sweet. Guys, I just sold a load of Bitcoin yesterday and I'm rolling! [to server] I'll go with the Taste of Bern's *and* the Bananas Foster.

Diner 2: Wow, good for you. [to server] Just a chocolate cheese pie for me, please.

Diner 3: Good call on going back to the classic. [to server] I'll have a chocolate cheese pie too, please.

Diner 4: Guys, it's been a rough week. I lost my job, my bank account got hacked, and I was mugged on my way to the restaurant just now. I haven't had a proper meal in three days and I'm broke. No dessert for me. [to server] Is there any way I could just get some free bread? Even if it's stale.

Server: [to Diner 4] No. You have to leave.

Narrator: [Discuss the breakdown of costs and values for each diner with entire class.]

Total cost = \$65.90
 Cost and value for Diner 1 = \$46.00
 Cost and value for Diner 2 = \$9.95
 Cost and value for Diner 3 = \$9.95
 Cost and value for Diner 4 = \$0

Week 6 (Mood: Back to happy)

Server: Hey guys, last week was a special treat but my manager said I'm not allowed to give you separate checks anymore. You're just going to need to figure out a way to split the bill, ok? What can I get for you?

Diner 4: Well, things are getting a little better for me. I got the bank account sorted out and I had a job interview today. Still, I want to be sure to watch the budget so nothing fancy for me tonight. [to server] I'll just go with a coffee.

Diner 1: I think we should all just get coffee. You know, for solidarity and for fairness. [to server] I'll have a coffee too.

Diner 2: All for one and one for all. [to server] Coffee for me too, please.

Diner 3: Now is my chance! [to server] I'll have a chocolate cheese pie, please.

Diner 4: I hate you.

Diners 1 and 2: Same.

Server: You, know, I'm actually starting to hate all of you.

Narrator: [Discuss the breakdown of costs and values for each diner with entire class.]

Total cost = \$20.45
 Cost each = \$5.11
 Value for Diners 1, 2, and 4 = \$3.50 each
 Value for Diner 3 = \$9.95

Week 7 (Mood: Very dark among diners, even the server is pessimistic)

Diner 1: [to friends] Why do we keep doing this? Seriously, we need to stick to the plan. Let's each get coffee. Only coffee. Ok?

Diner 2, Diner 3, and Diner 4: Ok

Server: Wow, I did *not* expect to see the four of you sitting at a table here again. What can I get for you?

Diner 1: [to server, *matter-of-fact*] Coffee.

Diner 2: [to server, *sketchily*] . . . um . . . Taste of Bern's?

Diner 3: [to server, *defiantly*] Taste of Bern's!

Diner 4: [to server, *triumphantly*] Bananas Foster!!

Diner 1: Why are we even friends?

Server: My question exactly.

Narrator: [Discuss the breakdown of costs and values for each diner with entire class.]

Total cost = \$67.50

Cost each = \$16.88

Value for Diner 1 = \$3.50

Value for Diners 2 and 3 = \$18.00 each

Value for Diner 4 = \$28.00

Week 8 [The mood is the darkest it's been.]

Server: You four again? Really? Well, who am I to judge? What can I get for you?

Diner 1: Let's just hang out and not order anything. [to server] Nothing for me.

Diner 2: Nothing for me.

Diner 3: Nothing for me.

Diner 4: Nothing for me.

Server: This isn't a public park. I'm going to have to ask you to leave.

Narrator: [Discuss the breakdown of costs and values for each diner with entire class.]

Total cost = \$0

Cost and value each = \$0

Week 9 [The mood gradually progresses from worse to better throughout the interaction.]

Diner 1: So, I'm taking this geography class and this week we learned all about the Tragedy of the Commons. According to the author, the only thing that works in situations with individual reward but shared harm is gentle coercion. People need to feel like they have some control over their own life choices but they can't be allowed to just take and take from a common resource pool. Does that remind you all of anything?

Diner 2: Actually yeah, my grandfather raises sheep in England and the farmers there all share the same pasture. . .

Diner 1: [interrupting] Anyway, I was thinking, how about if we make a new rule? We can each order whatever we want as long as it's eleven dollars or less. That way we can choose our desserts within reason. Then we'll split the check four ways like always.

Diner 3: Works for me.

Diner 4: Sounds good.

Diner 2: Hmm, we'll see how this goes.

Server: Hi! Welcome to. . . You? Again? Some people. . . Anyway, what can I get you?

Diner 3: I'll have the vintage chocolate lush sundae.

Diner 4: I'd like the chocolate cheese pie.

Diner 2: I've been wanting to try the brown sugar. I'll go with that please.

Diner 1: I'm so happy right now! I'll have the roasted pineapple.

Server: [cheerily] Wow! You did it! Coming right up! I'm so glad you got it figured out. It sounds like you're taking a spectacular geography class. You should definitely give your professor good marks on the end-of-semester evaluations. Oh, and your dessert club is welcome here at Bern's anytime!

Narrator: [Discuss the breakdown of costs and values for each diner with entire class.]

- Total cost = \$42.90
- Cost each = \$10.73
- Value for Diner 1 = \$10.95
- Value for Diner 2 = \$11.00
- Value for Diner 3 = \$11.00
- Value for Diner 4 = \$9.95

Appendix 2: Calculations

Weekly calculations of each diner's individual value received, each diner's individual cost incurred, and the total cost of the table's bill for the dessert club simulation of the Tragedy of the Commons.

	Weeks								
	1	2	3	4	5	6	7	8	9
Diner 1 cost	\$8.34	\$9.95	\$11.96	\$20.50	\$46.00	\$5.11	\$16.88	\$0.00	\$10.73
Diner 1 value	\$9.95	\$9.95	\$9.95	\$18.00	\$46.00	\$3.50	\$3.50	\$0.00	\$10.95
Diner 2 cost	\$8.34	\$9.95	\$11.96	\$20.50	\$9.95	\$5.11	\$16.88	\$0.00	\$10.73
Diner 2 value	\$9.95	\$9.95	\$9.95	\$18.00	\$9.95	\$3.50	\$18.00	\$0.00	\$11.00
Diner 3 cost	\$8.34	\$9.95	\$11.96	\$20.50	\$9.95	\$5.11	\$16.88	\$0.00	\$10.73
Diner 3 value	\$9.95	\$9.95	\$9.95	\$18.00	\$9.95	\$9.95	\$18.00	\$0.00	\$11.00
Diner 4 cost	\$8.34	\$9.95	\$11.96	\$20.50	\$0.00	\$5.11	\$16.88	\$0.00	\$10.73
Diner 4 value	\$3.50	\$9.95	\$18.00	\$28.00	\$0.00	\$3.50	\$28.00	\$0.00	\$9.95
Total bill	\$33.35	\$39.80	\$47.85	\$82.00	\$65.90	\$20.45	\$67.50	\$0.00	\$42.90