5-2019

Playing games to improve conceptual understanding and cooperation in social dilemmas.

Jason R Bush
University of Louisville

Playing Games to Improve Conceptual Understanding and Cooperation in Social Dilemmas

By

Jason Bush

Submitted in partial fulfillment of the requirements

for Graduation summa cum laude

and

for Graduation with Honors from the Department of Psychology

University of Louisville

March, 2019

Abstract

People make decisions every day that have significant impact on others. The current experiment investigates the learning and decision-making processes involved when small groups confront a complex social dilemma under different learning conditions designed to imitate common educational interventions used in classrooms and non-laboratory settings. Participants (*N*=96) were randomly assigned to one of three conditions. In the Explore-First condition (*n*=32), participants played one round of a simulated social dilemma board game before receiving a lesson on social dilemmas, then played a second round. In the Lesson-First condition (*n*=32), participants received the lesson before playing the game. In the Contrast condition (*n*=32), participants received the lesson without playing the board game. Participants in the Explore-First condition performed significantly better on a quiz assessing their conceptual understanding of social dilemmas and transfer to new dilemmas. Individuals in the Explore-First condition also found the lesson more interesting, and generally showed greater acceptance of public policies intended to improve ecological sustainability. Educational interventions to improve cooperation in social dilemmas may benefit from an initial exploratory phase, where individuals experience critical features of the problem before being taught about them.

Playing Games to Improve Conceptual Understanding and Cooperation in Social Dilemmas

People's decisions impact others, often without their awareness, and can create rivalry that harms society and the natural world. For example, the Ogallala aquifer in the Midwest U.S. provides about 30% of all water used in U.S. agriculture, but this resource is being used faster than it can be replenished. Many individual farmers are not fully aware of the collective impact that they are having on each other, or this limited, shared resource. Those farmers who are aware often compete over water for personal survival and economic viability, increasing rivalry (Royte, 2016). This kind of situation, where individuals are tempted and compelled by self-interest to destroy shared resources they rely on, is a *social dilemma* (Hardin, 1968).

Resource based social dilemmas (*resource dilemmas*) such as the Ogallala aquifer are pervasive in society (Ostrom, 1998), and are a key factor in war, political and social unrest, and ecological collapse (e.g., Kelly et al., 2015). It is for this reason that scientific explanations for decision making are vitally important (Ostrom, 1998). One such explanation, classical rational choice theory (Hardin, 1968; Hobbes, T. 1651-1909), predicts that people are trapped in social dilemmas and will inevitably destroy the resource and themselves because they are too selfish to work together towards mutual benefit.

However, research consistently shows that stakeholders in a social dilemma can, in fact, learn from experience to cooperatively solve these problems (Ostrom, 1998). Research also demonstrates that playing games that simulate the real-world dilemma one is in, as an experience-based teaching tool, can sometimes improve learning and facilitate cooperation in the actual dilemma (e.g., García-Barrios et al., 2011; Meinzen-Dick et al., 2018). However, the underlying social and cognitive mechanisms that promote successful learning and cooperation are poorly understood (Ostrom, 1998; Yu et al., 2016), making it difficult to design effective educational interventions.

The current study uses experimental methods to investigate the decision making and learning processes involved when individuals confront a social dilemma situation. Our research project advances behavioral theory by using simulated social dilemma games to explore how people make complex decisions. By using a board game to let participants experience a social dilemma where their decisions will impact one another, this project will also identify new ways of educating the public on how to recognize the deeper underlying structure of social dilemmas. We will use exploratory and discovery-based learning literature in education psychology to examine the role of exploratory learning in helping participants better learn the deep structure of social dilemmas.

Decision Making in Social Dilemmas

Traditional Rational Choice Theory

Rational Choice Theory was born from the philosophical tradition of utilitarianism, which defines the best action as the one that provides the most utility. It assumes that actors are narrowly self-interested, and that they make their decisions rationally from a position of knowledge. The primary problem with this theory is that traditional RCT focuses nearly exclusively on financial and strategic elements of choice. RCT fails to convincingly account for widespread deviations from narrow self-interest, such as *self-governance*, where individuals band together while making agreements and devising their own effective solutions to social dilemmas (Ostrom, 2010). In addition, it does not anticipate that individuals can learn from prior experience to positively, and holistically, constrain their individual self-interest for mutual benefit to a group and to the environment itself. If placed in a social dilemma, individuals are therefore expected to behave selfishly, destroying the shared resource and free riding on other people's contributions to the group welfare (Hardin, 1968; Hobbes, T. 1651/1909).

Bounded Rationality

Bounded Rational Choice Theory (BRCT) emerged to account for the more nuanced nature of people's values and cooperative decisions (Simon, 1972). BRCT acknowledges that self-interested individuals can learn with experience. BRCT also acknowledges that reality is subjective and socially constructed, and that differences in the way people perceive and understand their decisions influences their cooperative behavior in social dilemmas. Ostrom (1998) in particular argued that people can learn to trust one another and create social and rule-governed systems that facilitate long-term cooperation, despite their inherent self-interest and flawed cognitive faculties.

The issue with BRCT is that it fails to examine fully the factors that contribute to a person's value system and underlying motivations (e.g., fundamental social-psychological needs; DeCaro, 2018). In addition, Ostrom's (1998, 2005) BRCT was underdeveloped in terms of accounting for the hypothesized learning processes that decision makers engage in when learning how to solve complex social-ecological dilemmas. One such process is *Bayesian Reasoning*, wherein a person forms an initial mental representation of the situation (mental model; Jones et al., 2011) then revises their mental model based on experience, as more information about the situation and consequences of one's actions become available (Berkson, 1930). Thus, people learn, but it is not clear how they learn or what conditions facilitate such learning (Meinzen-Dick et al., 2018; Yu et al., 2016). More research needs to be conducted to clarify these motivational and learning processes.

Humanistic Rational Choice

Humanistic Rational Choice Theory (HRCT; DeCaro, 2018) extends Ostrom's (1998, 2010) BRCT by explicitly incorporating broader value systems, perception systems, and learning processes from cognitive and social psychology and shown here in Figure 1.

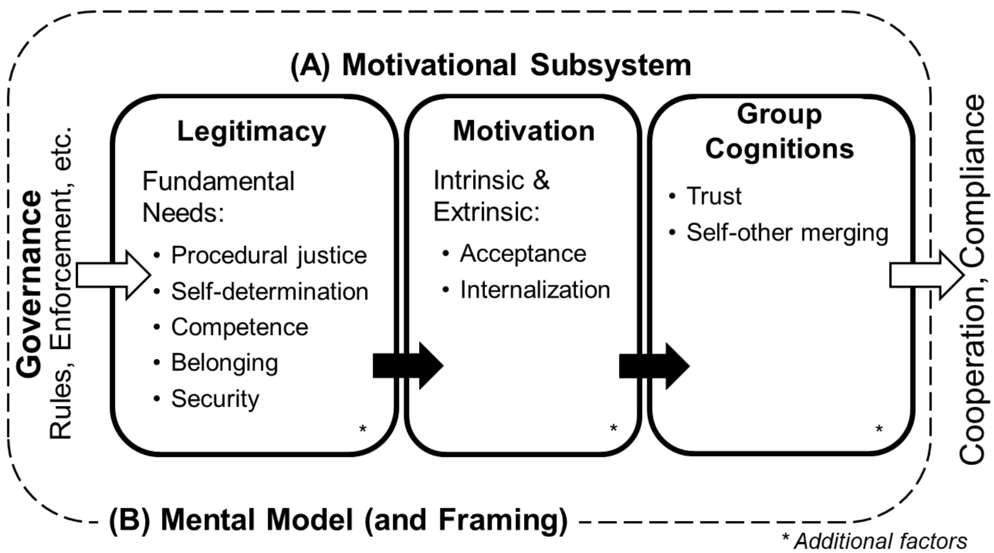

Figure 1. Motivational Framework for Humanistic Rational Choice Theory. Reprinted from *DeCaro, D. (2018). Humanistic rational choice and compliance motivation in complex societal dilemmas. (pp. 126-147). In S. Espinosa, S. Siddiki, & T. Heikkila (Eds.), Contextualizing Compliance in the Public Sector: Individual Motivations, Social Processes, & Institutional Design. Routledge.*

According to HRCT (see Motivational Subsystem, Figure 1; DeCaro, 2018), people look to government systems and each other to satisfy fundamental needs and manage social dilemmas well (e.g., Frey et al., 2004; Tyler, 2006). Mismanagement of social dilemmas and poor governance decrease perceptions of legitimacy and jeopardize these needs and well-being, motivating individuals to learn and try to solve the dilemma (DeCaro, 2019). people are inherently motivated to understand the world and solve difficult problems that affect their core goals, fundamental needs, and well-being (e.g., Bandura, 2001; Ryan & Deci, 2017). When people learn and solve problems as a group it helps them internalize their motivations, which increases trust and cooperation.

For example, consider the classic resource dilemma (Hardin, 1968), where farmers need to share a limited pasture for grazing their cattle. Each farmer seeks to make a profit, grazing as many cattle as they can. Hence, if any farmer feels that the rules or regulations that are used to restrict their individual grazing disadvantage them personally or fail to ensure that others comply with the rules, then their financial (economic) and security needs may be poorly satisfied, reducing cooperation. Moreover, if the farmers' efforts to address their concerns through communication are perceived as unfair, then this can lead to a perception that the decision-making process is illegitimate, undermining their need for procedural justice (fair decision-making procedures) and self-determination. Deficits to these fundamental needs, and recognition that the dilemma is not being managed well, should motivate individuals to try to correct the problem. Communication is a key element in correcting deficits in fundamental needs, as farmers reach out to their neighbors and political representatives to discuss solutions Such group cognition triggering the Bayesian (iterated) learning process identified by Ostrom (2005). Through this process, strictly competitive players may eventually learn mutually beneficial solutions to the dilemma. During this process, they should develop a better understanding of the critical social and ecological features of the problem.

HRCT (DeCaro, 2018, 2019) also states that each person's mental model, or conceptual representation of the decision situation and environment, affects their willingness to cooperate, specifically by altering perceptions of the situation and key elements within it, as we see in the Mental Model Subsystem from Figure 1. An accurate, and shared, mental model of the situation is essential to successfully solving a social dilemma (Ostrom, 1998, 2005) and, ultimately, satisfying one's fundamental needs (e.g., DeCaro et al., 2017). In the previous example, if farmers successfully update their mental model by learning important dynamics of the ecological problem, and better understand the social factors and dimensions of the dilemma that drive their behavior, then they may be able to cooperate better, improve their economic security and welfare, and sustain their resource. However, HRCT has not yet clarified the cognitive mechanisms involved in such learning, or the educational conditions that facilitate optimal learning.

Learning Processes

Social Learning

Behaviorists have long studied the link between the decisions a person makes and their history of learning (i.e., reinforcement and punishment; e.g., Hume, 1738; Skinner, 1969). This link between learning and decision making is expressed as reciprocal determinism, wherein a person's thoughts and feelings (i.e., cognates) both influence and are influenced by their own actions, as well as the actions of others in their environment (Bandura, 1978). Boyd and Richerson (2009) argue that cultural adaptation, the ability to learn from each other, developed over time and lead to natural selection within groups that increasingly favored pro-social behaviors. These cooperative social environments were shaped by social systems of rewards and punishments bound up in moral traditions and gave rise to complex internalized moderators like shame and empathy. This evolutionary model shows how behavioral mechanics and the development of social norms serve to moderate competition and allow people to learn from their mistakes and each other in a social environment (Boyd, 2009).

The relationship between behavior and social norms leads us to mental models, which are learned through interaction with others and refined via rewards and punishments (Bandura, 1978; Skinner, 1969). Mental models are shaped by social learning and can occur via communication, or through direct observation of other's actions and the resulting consequences. Once mental models are well established, a person can become highly intractable in their views of the world and trapped in behavioral sequences that prevent them from being able to solve problems by employing new perspectives and methods (Nickerson, 1998). They may even fail to recognize the social nature of their problem, preventing them from taking the actions that would result in favorable outcomes for both themselves and others (Abrams et al., 1990). When a person's social environment leads to such an uncooperative mental model this can lead to social-ecological dilemmas.

People in a social-ecological dilemma make decisions and learn from one another and the environment, through ongoing interactions. These interactions are not always obvious to those involved and can lead to harmful outcomes. However, the dynamics that lead to more effective cooperation and compliance are not well understood. More research is needed to observe how individuals interact in a typical social-ecological dilemma, in order to identify potentially important cognitive and social learning processes (Anderies et al., 2011; Frey & Goldstone, 2018). Recent advancements in cognition and education, and exploratory learning, could provide additional insight into the fundamental learning processes involved in mental model updating, and learning of important concepts in complex systems, like a social- ecological dilemma.

Exploratory Learning

Traditional instructional in education relies on providing explicit instruction to the learner before having them solve a problem (e.g., providing a lecture on math before asking a student to solve an equation). However, learning from lecture is typically more superficial, and students often forget what they learn shortly thereafter (Dunlosky & Rawson, 2012). In order to promote deeper understanding, instructors are increasingly adopting active, or more discovery-based learning approaches. One such method, *exploratory learning*, changes the lesson order so that an initial problem-solving phase is followed by an instruction phase (Loibl, Roll, & Rummel, 2017). Exploratory learning is thought to promote an increased awareness of the deep structure inherent to the problem, as well as improvements in the learner's ability to transfer what they have learned to other scenarios (Schwartz & Bransford, 1998). By letting the learner experience the problem space prior to receiving instruction, and by allowing the learner's experience with the problem to inform future instruction, exploratory learning facilitates prior knowledge activation, awareness of gaps or errors in one's knowledge and understanding, and recognition of deep problem features that are crucial to the solution (Loibl, Roll, & Rummel, 2017; DeCaro & Rittle-Johnson, 2012).

For example, DeCaro and Rittle-Johnson (2012) tested the impact of exploratory learning with respect to children's ability to solve unfamiliar math problems. They showed that exploration led children to have a greater understanding of their own ability, be more willing to try new strategies (DeCaro, DeCaro, & Rittle-Johnson, 2012), all of which made them better prepared for future instruction. DeCaro and colleagues have replicated and extended these findings in undergraduate physics courses (Weaver, Chastain, DeCaro, & DeCaro, 2018). Though these previous studies examined conceptual knowledge development in math and science courses, we anticipate that similar learning mechanisms are involved in social dilemmas.

Bayesian Reasoning

Ostrom's (2005) initial theory of Bayesian reasoning provides a framework which combines the cultural evolution and exploratory learning perspectives discussed earlier in a way that helps explain the learning process involved in a social dilemma. Cultural pressures serve to shape a person's mental model, and by extension their perceptions of a given situation, but people do possess the ability to learn from their experiences and revise such models in a process known as *Bayesian Reasoning.*

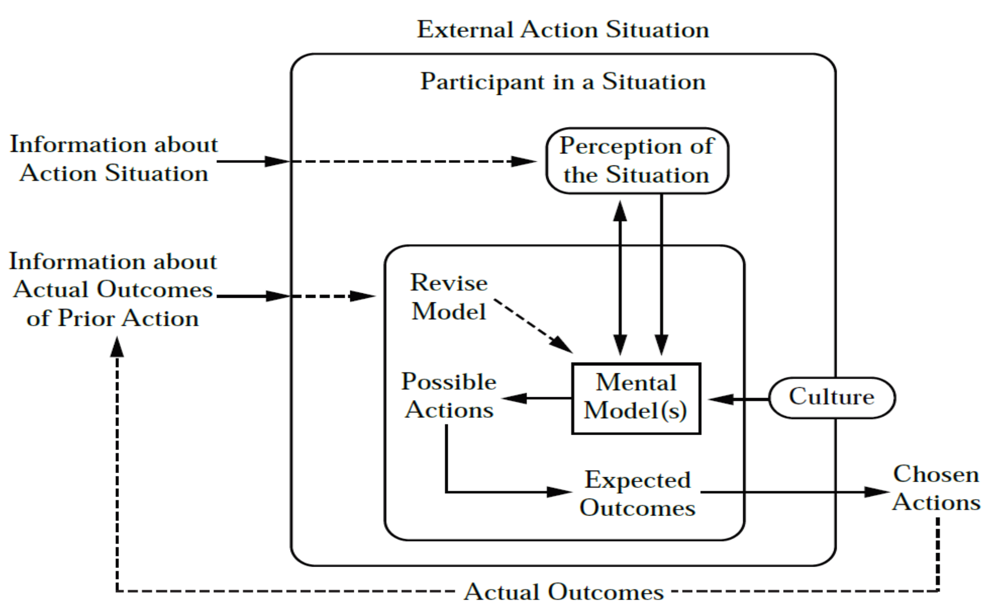

Figure 2. The relationship between information, action-outcome linkages, and *internal mental models.* Reprinted from *Ostrom, E. (2005). Animating Institutional Analysis. In Understanding Institutional Diversity (pp. 99-134). PRINCETON; OXFORD: Princeton University Press.*

Ostrom's model, pictured in Figure 2, outlines the processes that influence a person's decisions (Ostrom, 2005). Here, we focus on how an individual processes information about the social-ecological dilemma situation, in light of previous expectations (e.g., mental models), and learns from prior experience. It is assumed that learning in a social-ecological dilemma is an iterated, reciprical process among the person, their environment (social and ecological), and the outcome of their prior actions over many trials (Bandura, 1978). Depending on the circumstances, experience may lead a person to revise their mental model in ways that improve their individual and collective success (e.g., individual earnings and cooperative outcomes), or increasingly hinder those efforts (i.e., people can learn from their mistakes but only if they see them as mistakes.

This simple process of learning from trial-and-error experience, to update prior expectations, describes the basic concept of *Bayesian Reasoning*. Ostrom (2005) illustrates the *Bayesian Reasoning* process as a series of learning paths. According to Ostrom (1998), communication can help actors pool their information and gather more accurate understanding about the ecological dynamics of a social-ecological dilemma, updating the mental model and potentially leading to more effective resource management. In addition, actors may learn about others' motivations and intentions, and be able to come to agreements that further clarify and constrain people's behaviors, making the social and ecological situation more predictable and secure. If these actors are further able to communicate and govern in ways that satisfy needs for procedural fairness, belonging, and competence, then HRCT predicts cooperation will be internalized, developing robust cooperation (DeCaro, 2018).

However, in order for positive learning outcomes to be achieved, it is imperitive that individuals accurately perceive and understand their own knowledge gaps and the deep structure of the social and decision-making environment when revising their model of the situation (Loibl, Roll, & Rummel, 2017). This may be one way in which communication, as well as the method of educational instruction and learning, become crucial. Specifically, one of the goals of exploratory learning is to aid individuals in the process of understanding deep structures of complex problems by allowing a person to explore the problem space, learning from trial-and-error, as they attempt various solutions within their current conceptualization of the problem space (DeCaro & Rittle-Johnson, 2012). Thus, exploratory learning may be particularly useful to individuals in a social dilemma situation, helping them to better learn from experience and understand underlying crucial features of the problem.

Social dilemmas involving resource management are among the most complex, requiring a deep understanding from stakeholders (i.e., those who depend on the resource) of the interrelationship between the resource being managed and those who seek to utilize it (DeCaro et al., 2017; Meinzen-Dick et al., 2018). Failure to develop a sufficiently accurate mental model of such interrelationships can significantly undermine the stakeholder's ability to contribute in a positive way towards managing the resource and may even lead to over use or depletion. Such a mental model deficit may also make it difficult or impossible for the stakeholder to address their fundamental needs within the collective action space, further eroding their ability to make meaningful contributions (DeCaro, 2018). For example, participants in our social dilemma simulation game who do not have an adequate understanding of the strains they collectively apply to the game's forest resources, or their combined contribution to the siltation levels of the water resources, may not fully understand the need to reduce or restrict access when these resources are in danger of collapse. This misconception can lead to distrust between players, undermining critical conservation efforts. On the other hand, with sufficient education and communication opportunities made available, the players involved may see potential collective action solutions that would otherwise be missed. The current project will investigate these processes, using a simulated social dilemma game.

Using Simulated Social Dilemma Games to Encourage Learning

A simulated social dilemma game emulates the core social and environmental elements of resource conflict (i.e., resource dilemma), or public service or good provision (i.e., public good dilemma), placing individuals in situations where they must interact with one another in competition, or cooperation. Because it is a game, groups can experience the social and environmental outcomes of their behavior, allowing them to learn from their actions, free from real world consequences.

By giving individuals the opportunity to experience and explore a social dilemma in a relatively simple but relevant environment, simulation games could potentially bridge the gap in their mental models, allowing stakeholders to better understand the essential dynamics of a social-ecological dilemma and improving cooperative outcomes. Studies have used simulation games to increase core understanding and real-world efficacy with regard to resource dilemmas such as coffee farming (García-Barrios, Cruz-Morales, Vandermeer, & Perfecto, 2017), ground water management (Meinzen-Dick, et al., 2018), and land usage (García-Barrios, García-Barrios, Waterman., & Cruz-Morales, 2011).

Luis García-Barrios developed a resource dilemma simulation game (*Sierra Springs)* using game theory principles. *Sierra Springs* is a simple way for stakeholders (i.e., people personally invested in the issue) to explore the interconnected social aspects of resource usage and conceptualize expert instruction on solution sets to problems they may face regardless of their education levels (García-Barrios L., García-Barrios, Waterman, & Cruz-Morales, 2011). Garcia-Barrios et al. (2011) demonstrated that *Sierra Springs* can help improve communication between researchers and farmers towards coordinating strategies in response to land management dilemmas, while also allowing them to explore the social nature of such dilemmas and the impact that can have on solution set equitability. Garcia-Barrios et al. (2017) also examines how simulation style board games together with graphical and narrative based presentations can allow coffee farmers with little formal education to engage with scientists in gaining a deeper understanding of the complex social and ecological factors involved with their land and crops (García-Barrios, Cruz-Morales, Vandermeer, & Perfecto, 2017). Both studies show qualitative and quantitative benefits of adapting instruction methods to better reflect the learner's life experience.

These studies continue to be expanded into other resource dilemma scenarios such as groundwater management. Meinzen-Dick et al. (2018) explored how collective action games can increase cooperation between stakeholders, expand their understanding of the complex and interconnected factors involved in groundwater management, and improve sustainability over time. Their research, conducted in Andhra Pradesh, India, shows how communication within a simulation game can increase the likelihood of stakeholders achieving sustainable outcomes for ground water use. It is important to note that this increased cooperation did not become significant until the second year, and outweighed other behavioral factors such as trust levels, education levels, and gender. The study found that use of simulation games can significantly increase the proportion of communities that adopt water registers and rules to govern groundwater use.

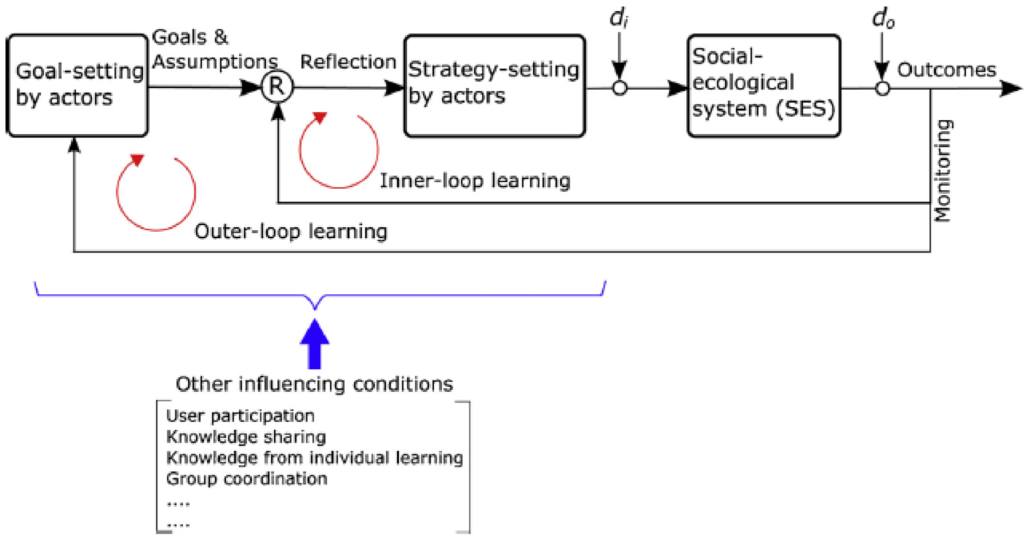

Figure 3. A conceptual diagram of how feedback-driven learning occurs in SESs. The inner-loop (or single-loop) learning entails fine-tuning of specific strategies or actions to better meet existing goals or assumptions. The outer-loop (or double-loop) learning involves updating of goals or assumptions that underlie specific strategies. The circle with letter R represents the process of monitoring of and reflection on past outcomes. The arrow denoted by di represents internal issues (e.g., collective action problems). Environmental variability is represented by the arrows denoted by do (e.g., natural disasters). Several conditions, e.g., user participation in decision-making, knowledge sharing, etc., can influence the loop learning processes. Reprinted from *David, J. Y., Shin, H. C., Pérez, I., Anderies, J. M., & Janssen, M. A. (2016). Learning for resilience-based management: Generating hypotheses from a behavioral study.* Global Environmental Change, 37, *69-78.*

Yu et al. (2016) utilized a simulated resource dilemma task to investigate the relationship between collective action, learning strategies, and success under environmental variability. According to the model employed in the Yu et al. (2016) study we can see the relationship between the goals each member of a group sets, their strategy for achieving such goals, how those strategies interact with the social-ecological system itself, and how the outcomes they achieve are analyzed to improve future decision making. Important contributors to this process are the assumptions a person makes, their reflections on the situation they are in, and most importantly loop learning.

Loop learning, as seen in Figure 3, refers to *Bayesian* feedback loops such as the reciprocal social learning outlined by Bandura (1978). The model employed by Yu et al.

(2016) is similar to Ostrom's (2005) approach: it outlines two types of loop learning, inner-loop learning (entails fine-tuning of specific strategies or actions to better meet existing goals or assumptions), and outer-loop learning (involves updating of goals or assumptions that underlie specific strategies). Their research reveals that coordinated collective action and inner-loop learning elements, such as revised and shared strategies along with active monitoring of the social-ecological systems (SESs) involved, are enough for social-ecological success under stable conditions. Outer-loop learning is critical to social-ecological resilience in circumstances involving variability. In other words, the study employed a simulated social dilemma game to demonstrate that groups who are able to better revise their strategies in response to changing goals and assumptions are more successful than others when dealing with unpredictable circumstances (Yu, Shin, Pérez, Anderies, & Janssen, 2016).

Our experiment looks at the impact of using a social dilemma simulation game to address flawed mental models that interfere with a person's ability to solve problems by employing new perspectives and methods (Nickerson, 1998) or to recognize the social nature of their problem. This process relies on setting the person in a seemingly unrelated task, such as a game, and allowing them to exhaust their fixed methods trying to win at the game. They are given only minimal instruction in the beginning in order to allow them their own perspective of the action space, and only after they have reached an impasse are they guided towards new approaches. The most important aspect of this method involves a gradual association on the part of the person between the game they are participating in, and the larger social dilemma that it represents. The intent of this method is to bypass their previously held biases on a social dilemma, allowing them to gain new outlooks and tools that will enable them to recognize a social dilemma more easily when they are in one. According theoretical developments in educational psychology, such exploratory learning may allow for deeper understanding of underlying concepts when compared to the more traditional explicit instruction (i.e., lecture then task) method of teaching (Loibl, Roll, & Rummel, 2017).

Current Study

The current study examined the role of exploratory learning, motivation, and social learning and perception in the development of conceptual knowledge, and promotion of cooperation, in a simulated resource dilemma. Participants learned about a real-world resource dilemma in the context of a board game and three different learning conditions: a Contrast condition, in which participants heard a lecture on the topic and board game, then read a detailed article about the real-world dilemma; a Lesson-First condition, in which participants were taught key concepts before playing the game; and an Explore-First condition, in which participants played the game before receiving the lesson.

According to exploratory learning research, letting the learner experience the problem space prior to receiving instruction facilitates prior knowledge activation, awareness of gaps or errors in one’s knowledge and understanding, and recognition of deep problem features that are crucial to the solution (Loibl, Roll, & Rummel, 2017). Therefore, we anticipate that individuals will learn core concepts better when they have the opportunity to experience those concepts themselves. If better understanding of a social dilemma facilitates a perception of responsibility and efficacy to take action, then these participants may also show an increased willingness to support costly public policies designed to ameliorate the social dilemma, and donate money to a relevant charity, if given the opportunity to do so. However, many other factors contribute to policy choice and action, so increased knowledge may not be sufficient (Cornforth, 2009; McKenzie-Mohr, 2000).

According to HRCT, communication may not only improve understanding, but also facilitate cooperation, if used to devise fair and effective strategies and agreements for managing the limited resources in the dilemma (DeCaro, 2018, 2019). However, the current thesis project will focus on the learning processing and outcomes. Social-psychological processes of cooperation will be addressed in later reports.

We employed a Contrast condition in this study. The purpose of the contrast condition was to determine if the board game itself had an impact on any of the observed outcomes, beyond a more traditional lecture and read instructional format. We anticipate that the board game will increase participants core understanding of the social (i.e., self-interest and interdependency) and ecological (i.e., limited resources and tragedy) dynamics involved in a social dilemma, resulting in higher performance from those who play the board game compared to those in the Contrast condition (García-Barrios L., García-Barrios, Waterman, & Cruz-Morales, 2011).

A survey measuring motivations and perceptions (e.g., trust) was given to the Lesson-First and Explore-First conditions at the end of the experiment in order to assess change in fundamental social cognitions proposed by HRCT, as well as a quiz assessing their understanding of social dilemmas and ability to recognize other kinds of dilemmas. The Contrast condition also received a modified version of the survey without measures of perception, as well as the same quiz given to the other two conditions. The survey also asked participants to indicate their willingness to support social and economic policies, such as restrictions on cattle grazing, economic fines for non-cooperation, and increased water conservation. Finally, as a potential measure of real-world cooperation, participants were given the opportunity to donate some of their earnings from the game to a relevant charity.

Methods

Participants and Design

Data for this project was collected Fall 2018 (and is ongoing). Undergraduate students (*N* = 96, Age *M* = 19.06, 40.8% female) were recruited from the University of Louisville psychology subject pool. Due to recruitment constraints, we report the partial data for the experiment. Data collection will be completed later this semester (projected recruitment is 180 participants). Participants (*N* = 96) were randomly assigned to one of three conditions; Explore-First (*n* = 32), Lesson-First (*n* = 32), or a Contrast condition (*n* = 32). Each session of the Lesson-First and Explore-First condition included four to eight participants, and random assignment was used to create one or two groups of four players each (*N* = 16 groups). Participants volunteered for 120 minutes and received research credit, in partial fulfillment of course requirements. In addition, participants were paid based on an in-game economy, to create a compelling economic resource dilemma that allows for competition and rivalry (Hertwig & Ortmann, 2001). Participants could earn up to $16.75 based on their decisions in the game ($13) and learning quiz performance ($3.75). This study was approved by the university IRB.

Procedure

Contrast Condition Basic Gameplay Instructions	Social Dilemma Lesson	*National Geographic* Article	Contrast Survey & Quiz Donation Opportunity	
Lesson First Condition Basic Gameplay Instructions	Social Dilemma Lesson	Game 1 No Communication (20 Min.)	Game 2 Communication Allowed (20 Min.)	Survey & Quiz Donation Opportunity
Explore First Condition Basic Gameplay Instructions	Game 1 No Communication (20 Min.)	Social Dilemma Lesson	Game 2 Communication Allowed (20 Min.)	

Figure 4. Illustration of conditions and order of events.

Participants were randomly assigned to condition. After completing informed consent in a waiting room where they were instructed not to speak with other participants, they were taken to a classroom with two tables and a viewing screen. In the Lesson-First and Explore-First conditions, tables were furnished with one copy each of the Sierra Springs board game. One score card for each player was provided. A laptop computer with an internal camera was set up and angled towards the gameplay board for recording each players actions and communication while retaining anonymity. A backup audio recorder was also utilized. Participants in all conditions received basic gameplay instructions, as well as a brief lesson on the nature of social dilemmas. These instructions were prerecorded for consistency, and approximately 18 minutes long.

Individuals randomly assigned to the **Explore-First condition** played one 20-minute session of the board game *Sierra Springs* (García-Barrios L. R., García-Barrios, Cruz-Morales, & Smith, 2015), without the ability to communicate with other players, giving them the opportunity to experience the social dilemma first-hand. Afterward, they received a brief lesson on the nature of social dilemmas, intended to improve conceptual understanding of the social and ecological situation, and cooperation. They then played another 20-minute session of the game. During Game 2 they were able to communicate with each other. Levels of conflict and in-game cooperation were recorded, comparing Game 1 and Game 2. After playing both rounds of the game they were asked to complete a learning quiz and survey which were administered on a private computer station and given a donation opportunity.

Individuals in the **Lesson-First condition** instead received the lesson before Game 1, so that they played the game as practice, or demonstration, of principles learned from the lesson. All other aspects of the two conditions were identical, so that exploration (order of lesson) was the only difference between conditions. After playing both rounds of the game they were asked to complete a learning quiz and survey which were administered on a private computer station and given a donation opportunity.

Participants in the **Contrast condition** were given the same lesson on the nature of social dilemmas as the other two conditions, and then asked to read the *National Geographic* magazine article *To The Last Drop* (Royte, 2016). The article described an example of a cattle farming dilemma in the Ogallala Aquifer in the U.S. Midwest. Participants in the contrast condition did not play the board game. After completing the article, they were asked to complete a learning quiz and survey which were administered on a private computer station and given a donation opportunity.

Participants were given their payment for quiz and board game earnings in the form of a Visa pre-paid card before being completing the donation activity. Finally, all participants were provided with debriefing material, thanked for their help, and given the opportunity to ask questions about the study.

Materials

Lesson. Participants in all conditions received basic gameplay instructions, as well as a brief lesson on the nature of social dilemmas based on the *National Geographic* magazine article *To The Last Drop* (Royte, 2016). The lesson was designed to teach key social aspects of a social dilemma such as self-interest and interdependence, as well as ecological aspects like resource scarcity and destructive consumption. These instructions were prerecorded for consistency, and approximately 18 minutes long.

Resource Dilemma Game. To simulate a cattle grazing social dilemma, participants in the Explore-First and Lesson-First conditions played *Sierra Springs* (García-Barrios L. R., García-Barrios, Cruz-Morales, & Smith, 2015). We modified the game for the present study. In particular, we began each player with a number of cattle and timber tokens already on the board, and eliminated a mechanic involving the spring which feeds the creeks and provides drinking water for the farmers as we shown in Figure 5. These modifications were made to simplify and speed up game play in order to fit the constraints of our experiment.

Four players take the role of cattle farmers, competing over land and water for economic gain. Each player has a designated plot as illustrated in Figure 5. In the beginning, the playing field is covered in forest tokens and some cattle. Players received \$0.25 for each point earned. Each forest token is worth 1 point (\$0.25); low cattle tokens are worth 2 points ($0.50) and high cattle tokens are worth 3 points ($0.75). The players take turns deciding whether or not to place tokens, and where. Players generally graze as many cattle as they can to earn more points.

It is possible for all players to earn 26 points ($6.50 per game), ensuring a stable and equitable use of the limited grazing fields. However, the actions each person takes to score points also come with economic and environmental costs. Each cattle placed on the board requires the removal of one forest token (i.e., deforestation). In addition, each player's plot abuts two other players' plots, with a shared stream supplying water to the cattle, as seen in Figure 5. Those spaces are allocated to players on a first-come-first-serve basis, creating competition. Finally, deforestation and having too many cattle near water sources threatens players' survival. If 68% (33) of the forest tokens are removed, then a catastrophic event is triggered: top soil becomes compacted and susceptible to mudslides that silt up waterways and make the area uninhabitable. All players lose (and their earnings are lost) if someone fails to correct the problem by removing one of their cattle tokens and replacing it with a forest token. In addition, if two adjacent players (e.g., Player 1 and Player 2) place a total of 3 cattle tokens on their shared creek, then the creek is threatened and all cattle on the creek will die (losing those points) unless one of those players immediately corrects the problem by removing a cattle token. These elements introduce four fundamental problem features characteristic of many social dilemmas: self-interest and competition, collective interdependency, scarcity, and ecological collapse (tragedy).

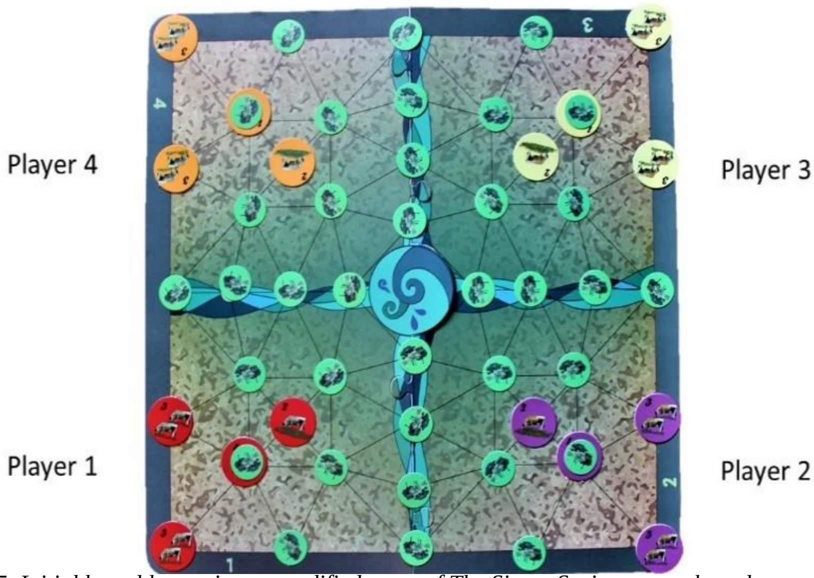

Figure 5. *Initial board layout in our modified setup of The Sierra Springs game board.*

Communication. Communication is a powerful tool to help stakeholders in a social dilemma learn from experience and potentially devise cooperative solutions (Balliet, 2010). During Game 1 players in the Lesson-First and Explore-First conditions were not allowed to communicate. During Game 2 all players were able to talk directly to one another as they played. With permission of the participants, these conversations were audio recorded. In addition, we video recorded the board itself, to have a record of each player's decisions (plays in the game). These data will be analyzed as part of another project, to identify potential agreements, exchange of information and social learning, and social interactions that influence fundamental motivations and behavior.

Outcome Measures

Quiz. Participants completed a quiz to assess conceptual understanding of the defining social and ecological features of a resource dilemma and ability to apply (transfer) what they have learned to real-world social dilemmas (see Appendix A). The quiz consisted of fifteen multiple choice and three short essay questions. Participants were paid for correct answers on the quiz to reward learning and ensure that participants tried their best (Hertwig & Ortmann, 2001). Participants were informed of this payment during the informed consent process, during gameplay instruction, and again prior to finalizing the payment sheet for processing. Participants received \$0.50 for each essay question they attempted, and \$0.15 for each correct multiple-choice item, for a maximum of \$3.75. The computer automatically scored the multiple-choice items and presented the score to the participant and experimenter at the end. Items were separated by social and ecological dimensions to emphasize potential differences in learning these dynamics. The Quiz questions are listed in Appendix A.

Essay. Essay Questions 1 and 2 both assessed the key social and ecological dimensions of the dilemma. Question 1 asked participants to identify and explain the key features of a social dilemma. Question 2 asked participants to do the same specifically for the cattle farming board game. Essay Question 3 asked participants to explain how the cattle farming game represents a complex environmental situation, assessing their deeper knowledge of the ecological dynamics inherent to the dilemma. Items were separated by social and ecological dimensions to emphasize potential differences in learning these dynamics. The results for essay question three were not reported in this paper due to the need for further analysis.

Multiple Choice. Fifteen multiple choice items assessed participants' understanding of the core social concepts and dimensions of the social dilemma, as well as their ability to identify their presence and implications in the cattle farming board game. These concepts included how their own decisions affect others (social interdependency) and self-interest (e.g., competition for shared land, lack of concern for others' welfare). One item (Question 4) was removed from the analyses, because in hindsight there was no single correct answer. Three additional items assessed participants understanding of the ecological dynamics involved in resource dilemmas and the cattle farming game in particular, including regional deforestation, localized creek collapse, and impacts of intensive cattle farming.

Transfer. Transfer items measured the ability of participants to transfer their understanding of the core features of social dilemmas to other kinds of social dilemmas. This step was important to assess the extent to which playing a simulated social dilemma helps to educate people about real-world dilemmas, as well as improve real cooperation. We used two items for assessing identification of resource dilemmas, three items for assessing identification of public good dilemmas, and one (foil) item for assessing discrimination between social dilemmas and other types of dilemmas.

In particular, the transfer questions assess: (a) participants ability to recognize similar types of resource dilemmas in the real-world, such as the real-world Ogallala Aquifer cattle dilemma; (b) resource dilemmas in different sectors, for example, competition over fisheries, oil, or timber; (c) different kinds of social dilemmas, in particular, a public good dilemma, where individuals need to contribute time or personal resources (e.g., money) to produce something beneficial for everyone (e.g., blood donation, paying taxes); and (d) the ability of participants to distinguish social dilemmas from other kinds of societal problems and games that lack social interdependency (e.g., the game of solitaire, natural disaster).

Interest, Enjoyment, and Engagement. Four survey items ($\alpha = .93$) assessed participants' level of interest, enjoyment, and engagement with the experiment, as a way to determine how interesting and engaging participants found the three different learning conditions. These items were selected from a larger pool of items assessing motivation and perceptions that will be included in later projects.

Policy Preferences. Six survey items assessed participants' support of costly economic and conservation policies related to the cattle farming social dilemma. Item 1 assessed willingness to support policies that reduce the number of cattle raised in the Ogallala Aquifer region of the United States. Item 2 assessed policies that monitor water use and require water conservation. Item 3 assessed willingness to pay higher prices to improve farmers' livelihoods and environmental conservation, whereas Item 4 assessed willingness to pay higher prices to reduce the number of forests cut down to make room for farms. Item 5 assessed belief that cattle farming in the United States should continue operating like it currently is, and Item 6 assessed belief that cattle farming in the United States should be increased, with more cattle and more large-scale farms.

Donation Activity. We identified charitable causes and organizations (See Appendix B) related to the focal social dilemma (cattle ranching, water scarcity), and other dilemmas. We carefully selected two charities that were directly related to economic, social, and economic sustainability of U.S. farming (Farm Aid, Cornucopia Institute); one charity that is related to environmental conservation in general (The Conservation Fund); and one charity related to social welfare (The Rotary Foundation). In addition, these charities accepted small online donations (necessary for the experiment), were highly regarded by third party charity report organizations (e.g., Charity Navigator), and did not explicitly take a particular political stance (e.g., conservative, liberal).

Participants were given the opportunity (choice) to donate some of their earnings to the charity, as a tangible indicator of cooperation. Donations were handled privately via computer, and blinded from the experimenter, so that individuals could make a voluntary decision free from social pressure (See Appendix B for procedures). The amount of money donated anonymously to charities at the end of the experiment was used to assess differences in participants' understanding of deep mechanics within social dilemmas, as well as their ability to transfer what they have learned to real world dilemmas.

Cooperation and Conflict. Communication will be analyzed at a later date, along with game play choices concerning threat events (such as deforestation and creek collapse), in order to explore overall cooperation levels between condition.

Results

Analyses

These analyses are based on partial data and should therefore be considered preliminary results, or trends that will be finalized when data collection is complete. It is our judgment that there is sufficient data to do such preliminary analyses, and we will point out any analyses for which there is insufficient data to make observations on. In keeping with standard practice in education research and social dilemma research we report the overall significant tests for condition comparisons in this paper, but proceed to use planned comparisons of specific conditions, regardless of overall significance because we made a-priori predictions about the relationships between the conditions (Howell, 2011).

Learning Quiz

In this section, we report the findings for participants' conceptual understanding as measured by multiple choice and essay quiz responses.

Multiple Choice. Overall, there was a non-significant difference among conditions for multiple choice performance of social concepts, $F(2,90) = 2.54$, $p = .085$, $\eta^2 = 0.05$. there was also a non-significant difference among conditions for multiple choice performance of ecological concepts, $F(2,90) = 3.30$, $p = .720$, $\eta^2 = 0.01$. However, because we made a-priori predictions about specific relationships among groups, we conducted planned comparisons to examine this potential trend further.

Social Concepts. As illustrated in Figure 6, participants in the Explore-First condition (M = 83.07% correct, SE =1.61) performed significantly better than those in the Contrast condition (M = 77.01%, SE = 2.70), $t(90) = 2.09$, $p = .039$, $\hat{d} = 0.53$, and marginally better than those in the Lesson-First condition (M = 78.13%, SE = 1.75), $t(90) = -1.75$, $p = .083$, $\hat{d} = 0.44$. Scores of participants in the Contrast and Lesson-First conditions were not significantly different, $t(90) = 0.38$, $p = .702$, $\hat{d} = 0.10$.

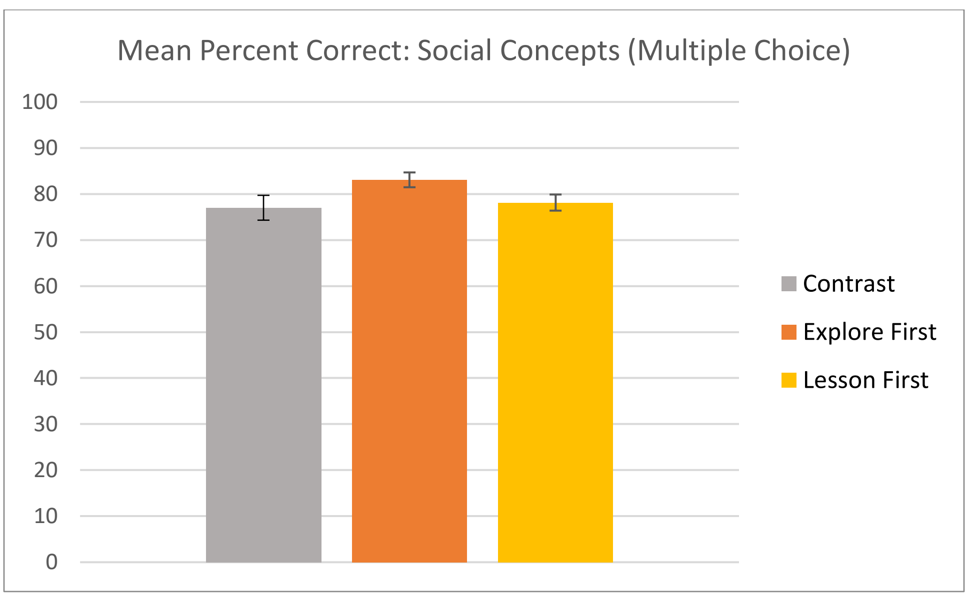

Figure 6. *Error bars represent 95% confidence intervals.*

Ecological Concepts. When looking at the items that assess participants' understanding of the ecological dynamics of social dilemmas, we found no significant difference in participant's performance, $F < 1$, $\eta^2 = 0.01$. As shown in Figure 7, participants in the Explore-First condition (*M* = 61.46% correct, *SE* = 2.64) did not significantly differ from those in the Contrast condition (*M* = 58.62%, *SE* = 2.70), $t(90) = .709$, $p = .480$, $\hat{d} = 0.19$. The same was found when comparing participants in the Contrast and Lesson-First conditions (*M* = 61.46%, *SE* = 3.03), $t(90) = .709$, $p = .480$, $\hat{d} = 0.19$. When comparing participants in the contrast condition to those in the Explore-First condition we see no statistical difference between the two conditions $t(90) = .000$, $p = 1.00$, $\hat{d} = 0$.

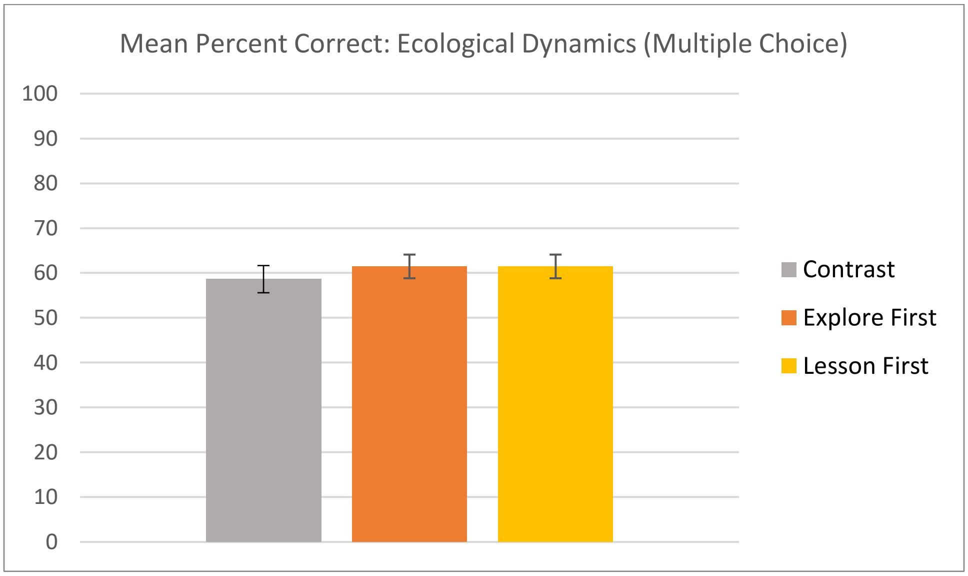

Figure 7. *Error bars represent 95% confidence intervals.*

Essay. I report the results of each essay question separately to illustrate participants' general (Essay 1), and specific (Essay 2) conceptual understanding. The social and ecological dimensions of Essays 1 and 2 are emphasized to highlight the differential learning of these concepts.

Essay 1. Essay 1 assessed participants' ability to identify four critical features of resource social dilemmas in general. We found a significant difference among conditions, $F(2,90) = 6.50$, $p = .002$, $\eta^2 = 0.13$. As seen in Figure 8, participants in the Explore-First condition ($M = 83.59\%$, $SE = 4.71$) displayed a significantly higher level of understanding than participants in the Contrast condition ($M = 52.59\%$, $SE = 7.27$), $t(90) = 3.60$, $p = .001$, $\hat{d} = 0.92$, and those in the Lesson-First condition ($M = 67.19\%$, $SE = 6.09$), $t(90) = 1.95$, $p = .05$, $\hat{d} = 0.40$. The difference between participant performance in the Lesson-First and Contrast conditions was not significant: $t(90) = 1.69$, $p = .09$, $\hat{d} = 0.36$. Given the moderately strong effect size, we believe this lack of significance is due to small sample size.

Participants in all three conditions performed similarly in terms of their ability to identify key ecological features of a resource social dilemma, $F < 1$, $\eta^2 = 0.009$. As seen in Figure 8, participants in the Contrast condition ($M = 37.07\%$, $SE = 7.30$) did not show a significant difference from those in the Explore-First condition ($M = 29.69\%$, $SE = 6.39$), $t(90) = -.767$, $p = .445$, $\hat{d} = 0.25$, or the Lesson-First condition ($M = 29.69\%$, $SE = 6.59$), $t(90) = -.767$, $p = .445$, $\hat{d} = 0.24$. This lack of significance may be due to small sample size. Participants in the Explore-First condition showed no significant difference from those in the Lesson-First condition, $t(90) = .000$, $p = 1.000$, $\hat{d} = 0.01$.

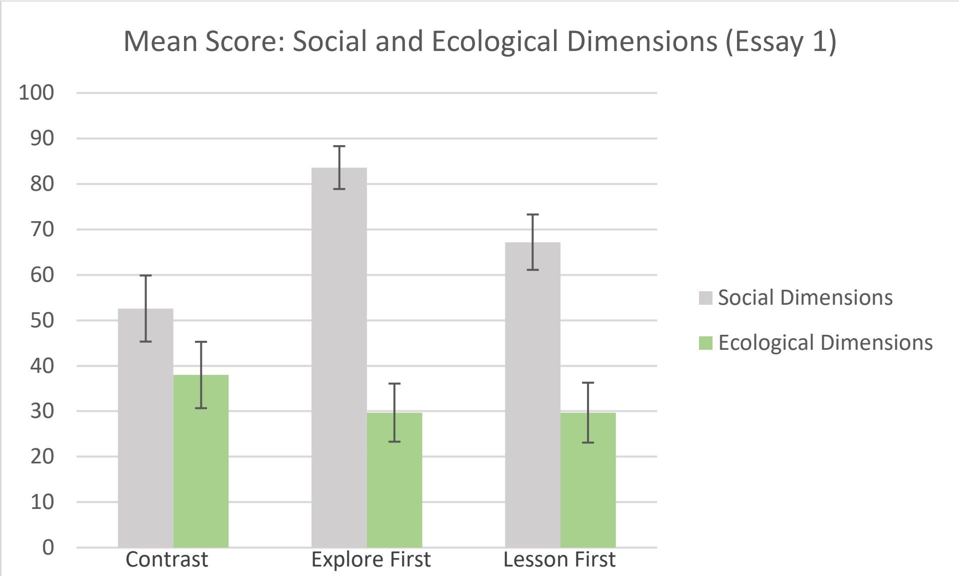

Figure 8. *Error bars represent 95% confidence intervals.*

Essay 2. Essay 2 assessed participants' ability to identify four critical features of resource social dilemmas that were particular to the simulated social dilemma board game. When we looked at the elements measuring understanding of social dimensions, we found a significant effect among conditions, $F(2,90) = 5.77$, $p = .004$, $\eta^2 = 0.11$. As seen in Figure 9, participants in the Explore-First condition ($M = 90.63\%$, $SE = 3.51$) displayed a significantly higher level of understanding than those in the Contrast condition ($M = 63.79\%$, $SE = 6.97$), $t(90) = 3.29$, $p = .001$, $\hat{d} = 0.84$, as well as those in the Lesson-First condition ($M = 71.88\%$, $SE = 6.33$), $t(90) = 2.35$, $p = .021$, $\hat{d} = 0.59$. Participants in the Lesson-First condition showed no significant difference from those in the Contrast condition, $t(90) = .989$, $p = .325$, $\hat{d} = 0.25$.

When we looked at the elements measuring understanding of ecological dimensions, we found no significant difference among conditions, $F < 1$, $\eta^2 = 0.00$. As seen in Figure 9, participants in the Explore-First condition ($M = 71.09\%$, $SE = 5.63$) displayed no significant difference from those in the Lesson-First condition ($M = 68.75\%$, $SE = 6.64$), $t(90) = .264$, $p = .792$, $\hat{d} = 0.07$, or those in the Contrast condition

(M = 68.97%, SE = 6.87), $t(90) = 2.34$, $p = .816$, $\hat{d}$ = 0.06. Participants in the Lesson-First condition did not significantly differ from those in the Contrast condition, $t(90)$ = -.024, $p = .981$, $\hat{d}$ = 0.01.

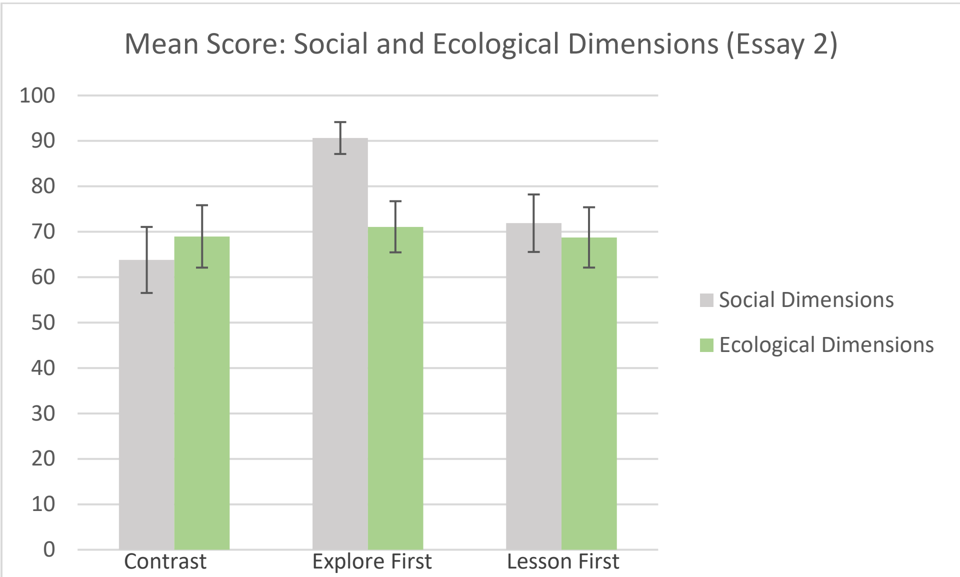

Figure 9. *Error bars represent 95% confidence intervals.*

Transfer

Resource Dilemmas. No significant difference among conditions was found when analyzing participants' ability to identify resource dilemmas, $F < 1$, $\eta^2 = 0.01$. A small but non-significant effect was found between participants in the Contrast condition (M = 72.41% correct, SE = 5.31) and those in the Explore-First condition (M = 64.06%, SE = 5.60), $t(90) = -1.047$, $p = .298$, $\hat{d}$ = 0.27. This is seen in Figure 10. Participants in the Contrast condition showed no significant difference from those in the Lesson-First condition (M = 67.19%, SE = 5.77), $t(90) = -.655$, $p = .514$, $\hat{d}$ = 0.17. There was no significant difference between participants in the Lesson-First condition and those in the Explore-First condition either, $t(90) = .402$, $p = .689$, $\hat{d}$ = 0.10.

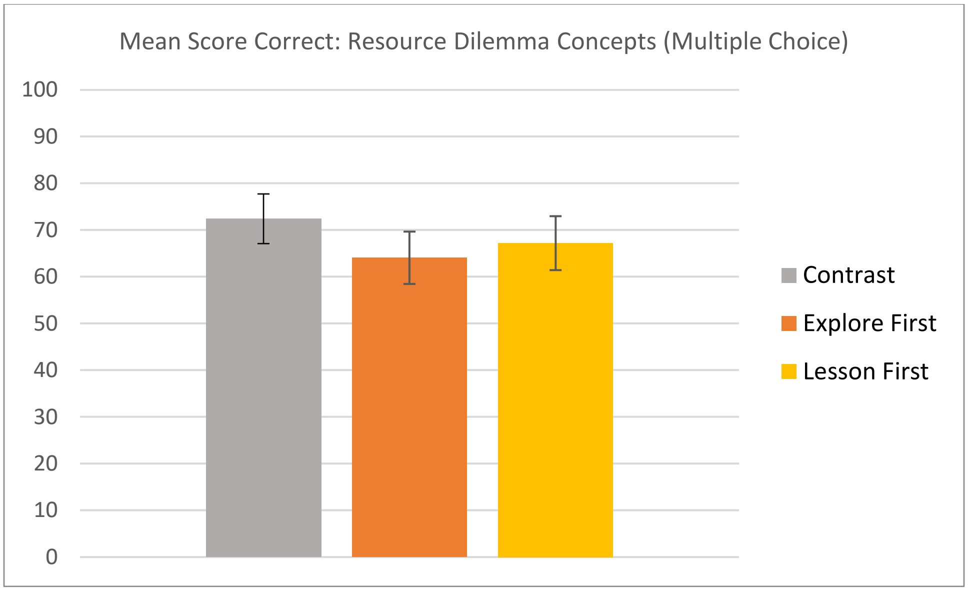

Figure 10. *Error bars represent 95% confidence intervals.*

Public Good Dilemmas. Overall, there was no significant difference among conditions, in terms of ability to transfer their knowledge of resource social dilemmas to identify public good dilemmas, $F(2,90) = 2.16$, $p = .121$, $\eta^2 = 0.05$. However, as illustrated in Figure 11, for novel public good dilemmas participants in the Explore-First condition ($M = 71.88\%$ correct, $SE = 4.99$) performed significantly better than those in the Lesson-First condition ($M = 57.29\%$, $SE = 5.45$), $t(90) = -2.018$, $p = .047$, $\hat{d} = 0.50$. Participants in the Explore-First condition did not score significantly higher than those in the Contrast condition ($M = 67.82\%$, $SE = 5.09$), $t(90) = 0.55$, $p = .585$, $\hat{d} = 0.14$. The difference between participants in the Lesson-First and those in the Contrast conditions was not significant, $t(90) = -1.420$, $p = .159$, $\hat{d} = 0.36$.

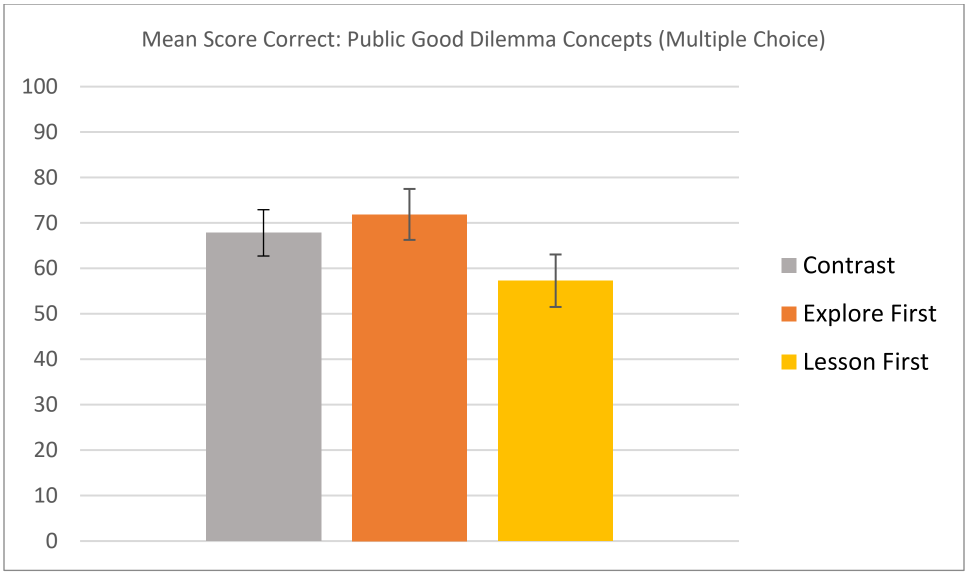

Figure 11. *Error bars represent 95% confidence intervals.*

Foil. As we see in Figure 12, there were no significant difference between conditions on the foil item, $F(2,90) = .12$, $p = .899$, $\eta^2 = 0.002$. Though not significant, participants in the Contrast condition had the highest percentage correct ($M = 82.76\%$, $SE = 7.14$) compared to those in the Lesson-First condition ($M = 81.25\%$, $SE = 7.01$), $t(90) = -.147$, $p = .884$, $\hat{d} = 0.04$, and those in the Explore-First condition ($M = 78.13\%$, $SE = 7.43$), $t(90) = -.451$, $p = .653$, $\hat{d} = 0.12$. There was no significant difference between participants in the Lesson-First condition and those in the Explore-First condition, $t(90) = .312$, $p = .756$, $\hat{d} = 0.08$.

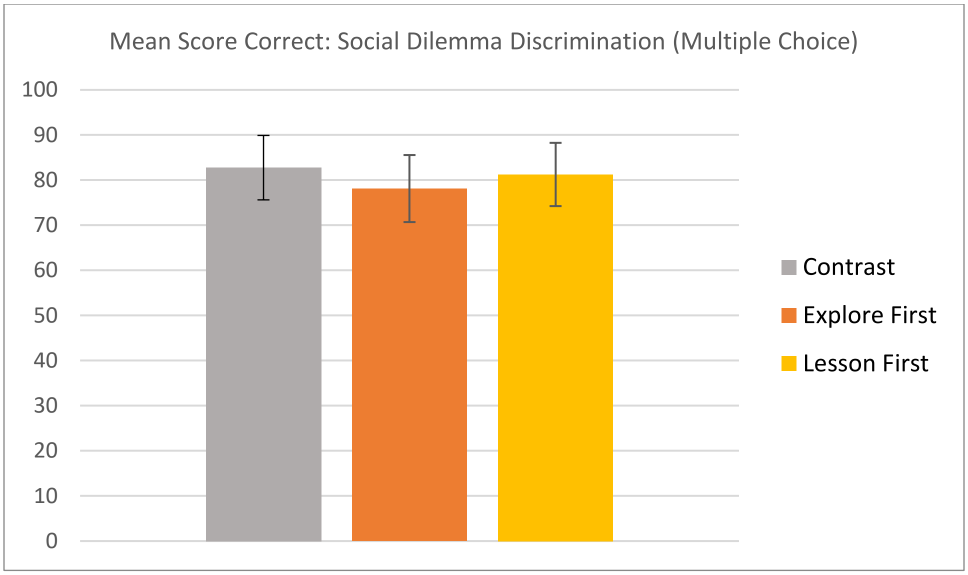

Figure 12. Error bars represent 95% confidence intervals.

Interest, Enjoyment, and Engagement

We found a significant effect when we looked at overall level of interest by condition, $F(2,92) = 14.55$, $p < .001$, $\eta^2 = .24$. Participants in the Lesson-First condition ($M = 5.98\%$ correct, $SE = .20$) reported finding the experiment significantly more interesting than those in the Contrast condition ($M = 4.48\%$, $SE = .21$), as did participants in the Explore-First condition ($M = 5.70\%$, $SE = .20$). Participants in the Explore-First condition and those in the Lesson-First condition showed no significant difference, as seen in Figure 13.

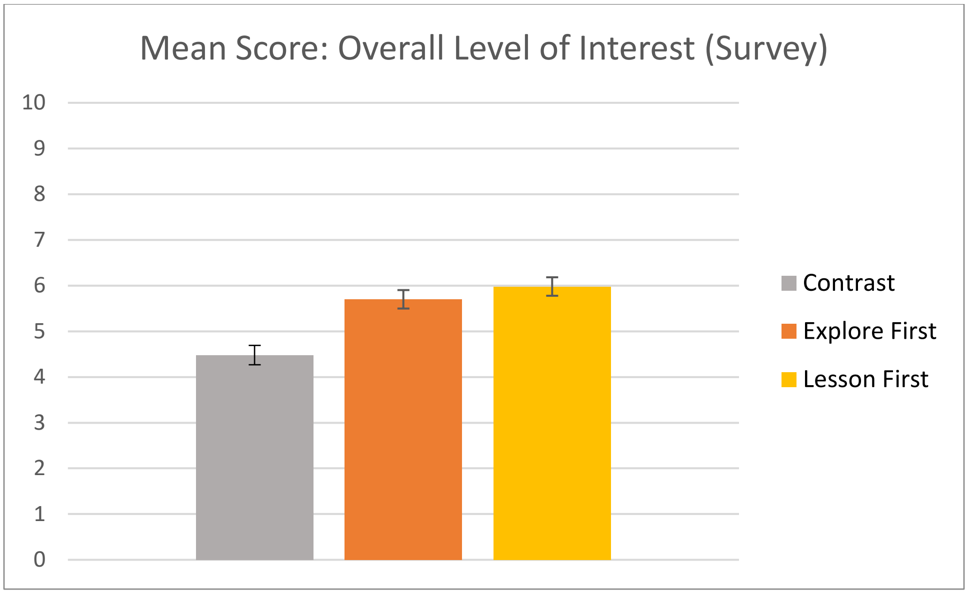

Figure 13. Error bars represent 95% confidence intervals.

Policy Preferences

Question 1. This question looked at preference to support policies that reduce the number of cattle raised in the Ogallala Aquifer region of the United States. As we see in Figure 14, we found no significant difference by condition, $F(2,90) = 1.56$, $p = .216$, $\eta^2 = .03$. Those in the Explore-First condition ($M = 2.72\%$, $SE = .15$) were not significantly different than those in the Lesson-First condition ($M = 2.38\%$, $SE = .18$), $t(90) = 1.550$, $p = .125$, $\hat{d} = 0.38$, or those in the Contrast conditions ($M = 2.38\%$, $SE = .14$), $t(90) = 1.493$, $p = .139$, $\hat{d} = 0.38$. There was no significant difference between participants in the Lesson-First and Contrast conditions, $t(90) = -.019$, $p = .985$, $\hat{d} = 0$.

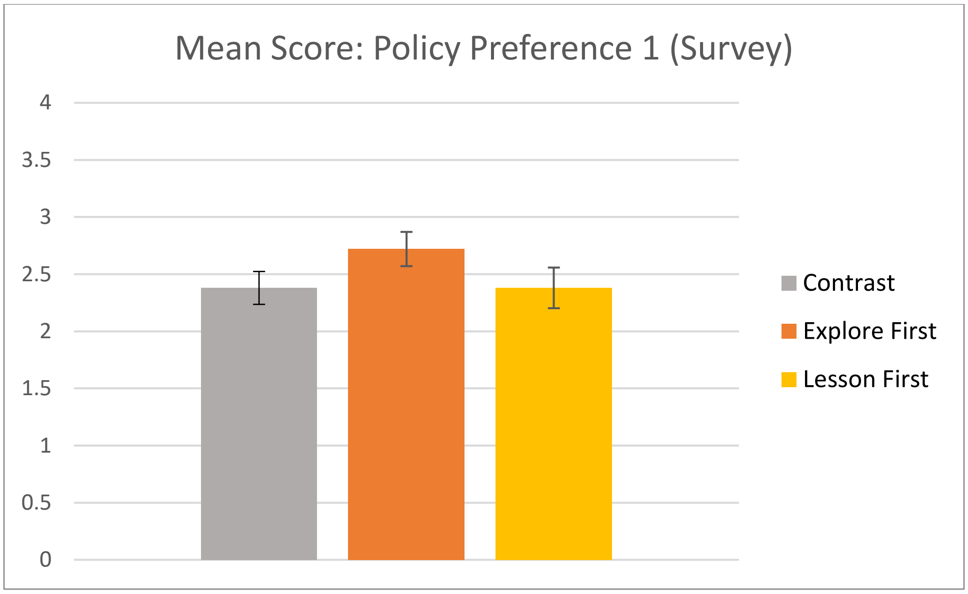

Figure 14. *Error bars represent 95% confidence intervals.*

Question 2. This question looked at willingness to support policies that monitor water use and require water conservation. As illustrated in Figure 15, there was a significant difference between conditions $F(2,90) = 3.12$, $p = .049$, $\eta^2 = .06$. Participants in the Explore-First condition ($M = 3.13\%$, $SE = .14$) showed a moderate and significant effect in willingness to support such policies when compared to those in the Contrast condition ($M = 2.62\%$, $SE = .182$), $t(90) = 2.246$, $p = .027$, $\hat{d} = 0.58$, as did participants in the Lesson-First condition ($M = 3.09\%$, $SE = .15$), $t(90) = 2.107$, $p = .038$, $\hat{d} = .53$. Participants in the Explore-First condition showed no significant difference from those in the Lesson-First condition, $t(90) = .143$, $p = .887$, $\hat{d} = 0.05$.

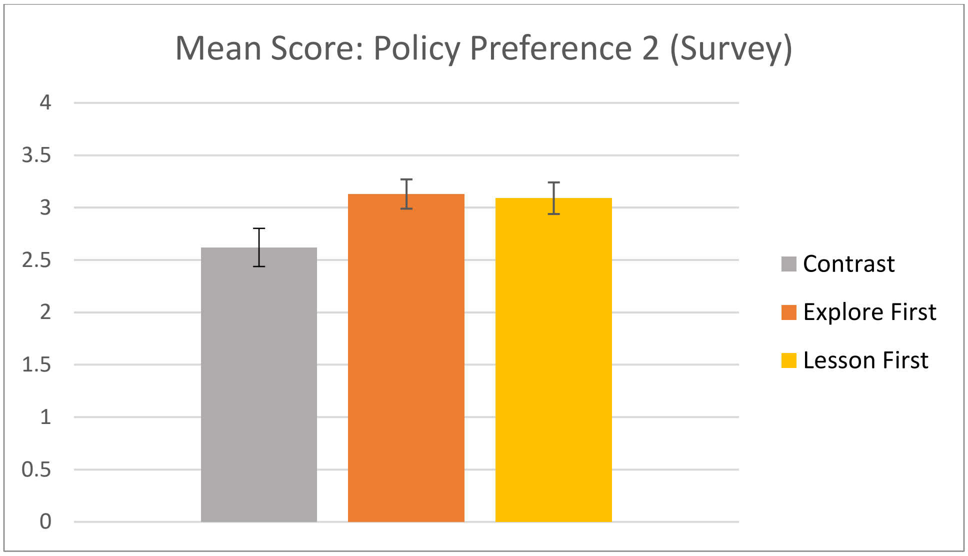

Figure 15. Error bars represent 95% confidence intervals.

Question 3. This question examined participants' willingness to pay higher prices in order to improve farmers' livelihoods and environmental conservation. As seen in Figure 16, there was no significant difference between conditions $F(2,90) = .085$, $p = 0.919$, $\eta^2 = .002$. Participants in the Lesson-First condition ($M = 3.00\%$, $SE = .19$) showed no significant difference in willingness to support such policies when compared to the those in the Contrast condition ($M = 2.90\%$, $SE = .17$), $t(90) = .407$, $p = .685$, $\hat{d} = 0.10$, nor did those in the Explore-First condition ($M = 2.94\%$, $SE = .18$), $t(90) = .161$, $p = .872$, $\hat{d} = 0.04$. Participants in the Lesson-First and Explore-First conditions showed no significant difference, $t(90) = -.252$, $p = .802$, $\hat{d} = 0.06$.

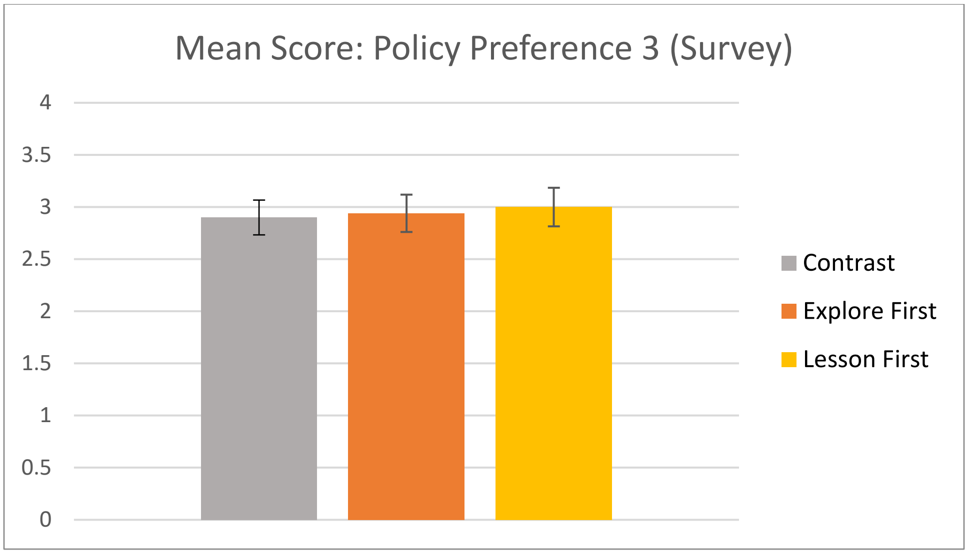

Figure 16. Error bars represent 95% confidence intervals.

Question 4. This question measured willingness to pay higher prices in order to reduce the number of forests cut down to make room for farms. As seen in Figure 17, we found no significant difference by condition $F(2,90) = 1.65$, $p = 0.198$, $\eta^2 = .04$. Participants in the Explore-First condition ($M = 2.81\%$, $SE = .16$) showed a small but non-significant effect in willingness to support such policies when compared to those in the Contrast condition ($M = 2.38\%$, $SE = .18$), $t(90) = 1.69$, $p = .094$, $\hat{d} = 0.43$, and no significant difference from participants in the Lesson-First condition ($M = 2.75\%$, $SE = .20$), $t(90) = .250$, $p = .803$, $\hat{d} = 0.06$. Participants in the Lesson-First condition also showed a small but non-significant effect when compared to those in the Contrast condition, $t(90) = 1.448$, $p = .151$, $\hat{d} = 0.37$.

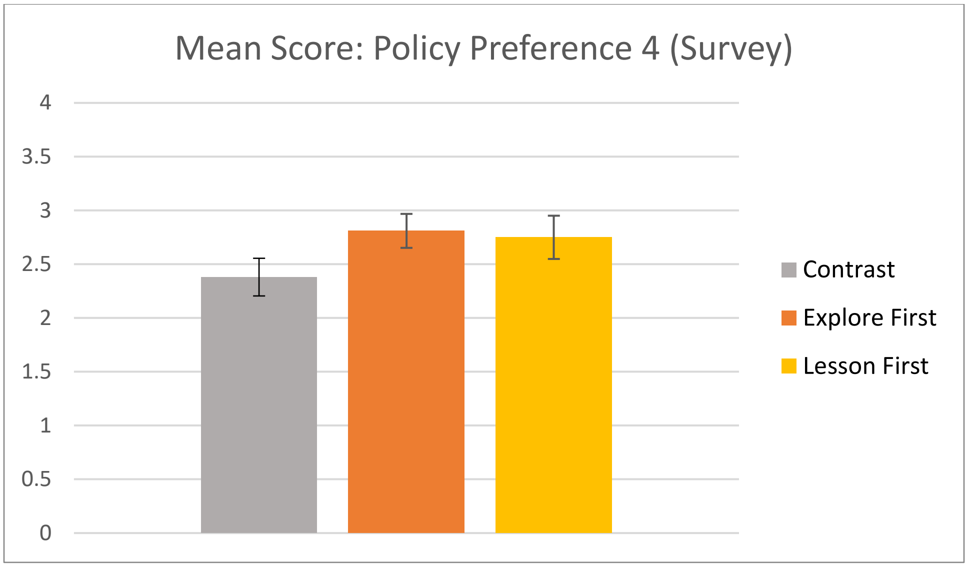

Figure 17. Error bars represent 95% confidence intervals.

Question 5. This question asked about belief that cattle farming in the United States should continue operating like it currently is. Overall, we found no significant difference based on condition $F(2,90) = .78$, $p = 0.460$, $\eta^2 = .02$. This is illustrated in Figure 18. Those in the Explore-First condition ($M = 1.41\%$, $SE = .10$) showed a small but non-significant effect in their lower support for such a policy when compared to those in the Lesson-First condition ($M = 1.59\%$, $SE = .10$), $t(90) = -1.24$, $p = .216$, $\hat{d} = 0.30$, and no significant effect compared to those in the Contrast condition ($M = 1.52\%$, $SE = .13$), $t(90) = -.718$, $p = .474$, $\hat{d} = 0.18$. Participants in the Lesson-First condition showed no significant difference from those in the Contrast condition, $t(90) = .495$, $p = .622$, $\hat{d} = 0.12$.

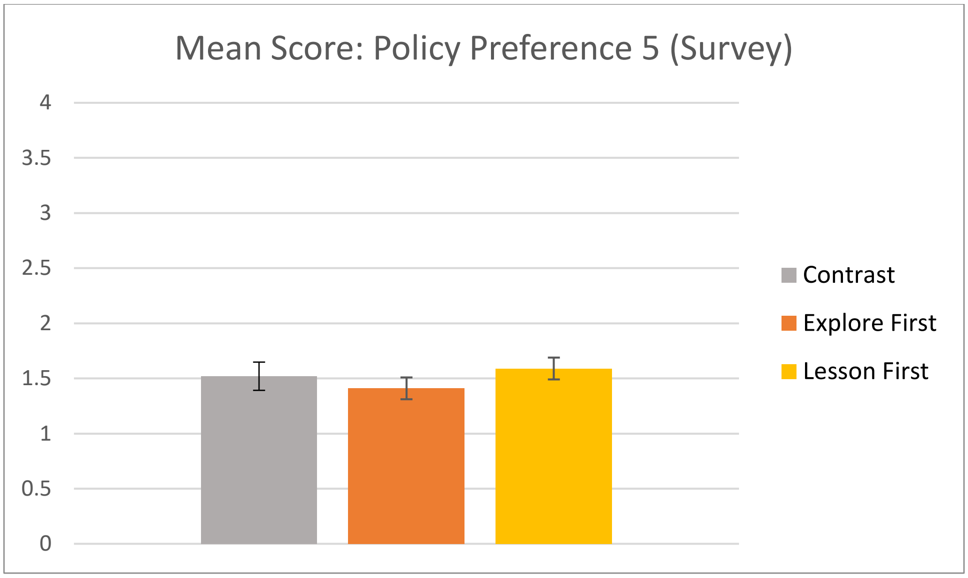

Figure 18. *Error bars represent 95% confidence intervals.*

Question 6. This question looked at belief that cattle farming in the United States should be increased, with more cattle and more large-scale farms. As shown in Figure 19, we found no significant difference based on condition $F(2,90) = 1.55$, $p = 0.219$, $\eta^2 = .03$. Participants in the Contrast condition ($M = 1.28\%$, $SE = .14$) showed a small but non-significant difference in their lower support for such policies when compare to those in the Lesson-First condition ($M = 1.59\%$, $SE = .14$), $t(90) = 1.65$, $p = .102$, $\hat{d} = 0.41$, and no significant difference from those in the Explore-First condition ($M = 1.34\%$, $SE = .12$), $t(90) = .35$, $p = .725$, $\hat{d} = 0.08$. Participants in the Explore-First condition showed a small but non-significant effect in their lower support for such a policy when compared to those in the Lesson-First condition, $t(90) = -1.33$, $p = .186$, $\hat{d} = 0.33$.

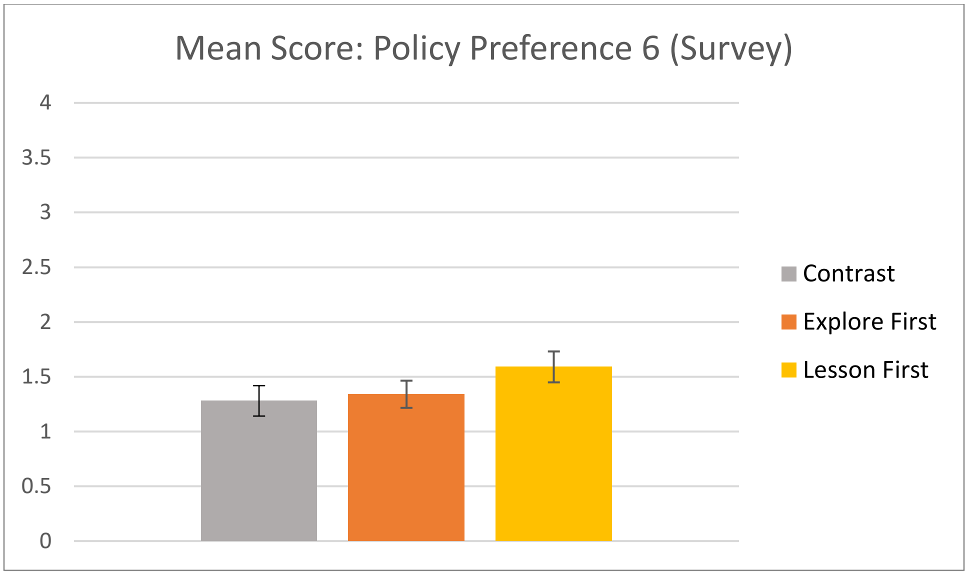

Figure 19. *Error bars represent 95% confidence intervals.*

Donation Amount. When looking at charitable donations, the *Median* donation amount was $0 in all conditions. In the Contrast Condition, 31% of participants (n = 10) donated, 25% of the participants in the Explore-First condition (n = 8) donated, and 40% of the participants in the Lesson-First condition (n = 13) donated. Given the very low rate of donation in each condition, there was not enough data to make any meaningful comparisons.

Cooperation and Conflict. Communication and game play choices concerning threat events (such as deforestation and creek collapse) will be analyzed at a later date.

Game Earnings. When looking at overall earnings between conditions $F(1,62)$ = .101, p = .751, η^2 = .002, the *Median* was $11.13.

Discussion

In this study we used multiple-choice and short answer essay questions, together with earnings and decisions from a simulated social dilemma board game to assess the impact of lesson order on participants' ability to cooperate, learn core social dilemma concepts, and transfer what they have learned to other types of dilemmas. We examined these measures across three different conditions: Lesson-First, which played two 20-minute rounds of the board game after receiving a lesson on social dilemmas, Explore-First, which played one 20-minute round of the board game before and after receiving the lesson, and a Contrast condition that received the lesson and read the article it was based on but did not play the board game at all.

Some potential benefits of this research include informing our understanding of the relationship between exploratory learning and conceptual understanding in a problem space, thus shedding light on the dynamics that lead to more effective cooperation and compliance in social dilemmas. This preliminary report will be followed by additional data collection and analysis, with the belief that our current findings justify further study. Although many factors have yet to be analyzed do to time and complexity, and some failed to provide useful insight due to small sample size, we have, nevertheless, made several noteworthy observations.

One encouraging finding of this study relates to participant’s significant ability to identify novel public good dilemmas in the Explore-First condition when compared to the Lesson-First condition. This suggests that the ability to explore the problem space before receiving the lesson increased conceptual understanding of how dilemmas occur beyond just the social dilemma that participants learned about. Participant’s motivation in learning tasks also showed a significant increase when using the simulated social dilemma board game. People assigned to the conditions that engaged with the board game reported higher levels of interest and enjoyment than those in the contrast group, which did not play the board game. This has important implications for teaching methods that involve active learning tasks, suggesting that the board game increases engagement in learning about social dilemmas.

When we looked at the essay question assessing understanding of social dimensions and ecological dimensions within a social dilemma, we found no significant difference between condition and ecological dimension understanding, but we did see a significant difference in understanding of social dimensions. Participants in both Explore-First and Lesson-First conditions showed a greater understanding of social dimensions within a social dilemma than in the Contrast condition, with the Explore-First condition showing a significant advantage. This outcome was repeated in the essay question assessing understanding of social dimensions and ecological dimensions within the social dilemma simulation game, with no significant difference in ecological understanding but a significant advantage in social dimension understanding shown by participants in the Explore-First condition. This finding may be due to the way in which participants encounter the social dilemma in practice, and as a group in both Explore-First and Lesson-First conditions. They must navigate such social dimensions in order to play the game, whereas ecological dimensions must be triggered in order to learn from them. If groups did not trigger the ecological dimensions, such as creek collapse or deforestation, they would not learn from them.

This benefit of exploration was also found on survey items related to policy preferences. We found a pattern whereby participants in both Explore-First and Lesson-First conditions showed a greater willingness to support conservation-based policies than the Contrast condition. Those in the Explore-First condition tended to show more support for conservation-based policies, and less willingness to support non-conservation-based policies than the Lesson-First condition. This finding continues to suggest that engaging with a simulation game has a positive impact on learning outcomes, and that exploration followed by instruction outperforms traditional lecture and task approaches for at least some learning outcomes. We believe that quiz scores may correlate with policy preferences such that those conditions that engaged with the game in general, and Explore-First in particular, gained a greater understanding of core social dilemma concepts which lead to greater preferences for policy solutions. This connection should be explored further as the research progresses.

The multiple-choice findings are somewhat consistent with the essay findings. Some findings of interest from the multiple-choice items include a significantly higher ability for the Explore-First condition to recognize the core features of public good dilemmas. While not statistically significant, several other multiple-choice items trended towards the Explore-First condition, suggesting that further study could support an advantage in exploring first with regards to recognizing core problem features and transferring knowledge. The Contrast condition tended to perform worse than both Lesson-First and Explore-First, suggesting the use of a social dilemma simulation game has a positive impact on learning. When we looked at multiple choice items designed to assess learning by condition, we found many items that offered no significant findings. This may be due to our low number of participants, in which case we would expect a change in results as we move forward with further data collection. We hope to understand these effects better as this study progresses.

This research holds implications for the way in which we approach teaching complex ecological concepts, and for developing tools to increase cooperation among stakeholders. Using simulated social dilemma games appears to increase interest and enjoyment, while also leading to deeper levels of understanding with regard to certain elements inherent in such problems, such as social dynamics, and the importance of conservation. As we continue this study we hope to further explore and revise our understanding of the theoretical frameworks provided by HRCT and Ostrom's concepts of *Bayesian Reasoning* and mental models. The practical benefits of this include a more robust knowledge of the processes that drive learning and cooperation, leading to the development of new techniques and materials that can be used in a variety of learning environments to help increase awareness and encourage greater support for conservation efforts.

References

Abrams, D., Wetherell, M., Cochrane, S., Hogg, M. A., & Turner, J. C. (1990). Knowing what to think by knowing who you are: self-categorization and the nature of norm formation, conformity, and group polarization. *British Journal of Social Psychology*, 29:97-119.

Anderies, J. M., Janssen, M. A., Bousquet, F., Cardenas, J. C., Castillo, D., Lopez, M.-C., . . . Wutich, A. (2011). The challenge of understanding decisions in experimental studies of common pool resource. *Ecological Economics, 70*, 1571–1579.

Balliet, D. (2010). Communication and cooperation in social dilemmas: A meta-analytic review. *Journal of Conflict Resolution, 54*(1), 39-57.

Bandura, A. (1978). The self system in reciprocal determinism. *American Psychologist, 33*(4), 344-358. doi:10.1037/0003-066X.33.4.344

Bandura A. (2001) "Social cognitive theory: an agentic perspective" Annual Review of Psychology, 52(1): 1–26.

Berkson, J. (1930). Bayes' Theorem. *Ann. Math. Statist, 1*(1), 42-56. doi:https://doi.org/10.1214/aoms/1177733259

Boyd, R., & Richerson, P. J. (2009). Culture and the evolution of human cooperation. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *364*(1533), 3281-8.

Cameron, J. E. (2004). A Three-Factor Model of Social Identity, Self and Identity. *3*(3), 239-262. doi:10.1080/13576500444000047

Colquitt, J. (2001). On the Dimensionality of Organizational Justice: A Construct Validation of a Measure. *The Journal of applied psychology, 86,* 386-400. doi:10.1037//0021-9010.86.3.386

Cornforth, A. 2009. Behaviour change: insights for environmental policy making from social psychology and behavioural economics. *Policy Quarterly* 5(4):21-28.

David, J. Y., Shin, H. C., Pérez, I., Anderies, J. M., & Janssen, M. A. (2016). Learning for resilience-based management: Generating hypotheses from a behavioral study. *Global Environmental Change*, *37*, 69-78.

De Cremer, D., & Tyler, T. (2007). The effect of trust in authority and procedural fairness on cooperation. *The Journal of applied psychology, 92,* 639-649. doi:10.1037/0021-9010.92.3.639

DeCaro, D. A. (2018). Humanistic rational choice and compliance motivation in complex societal dilemmas. In S. Espinosa, S. Siddiki, & T. Heikkila (Eds.), *Contextualizing Compliance: Individual Motivations, Social Processes, and Institutional Design.* Routledge.

DeCaro, D. A. (2019). Humanistic rational choice: understanding the fundamental motivations that drive self-organization and cooperation in commons dilemmas. (Pages 117-131). In B. Hudson., J. Rosenbloom, & D. Cole (Eds), Routledge Handbook of the Study of the Commons. Routledge, New York, USA.

DeCaro, D. A., Janssen, M. A., & Lee, A. (2015, November). Synergistic effects of voting and enforcement on internalized motivation to cooperate in a resource dilemma. *Judgment and Decision Making, 10*(6), 511-537.

DeCaro, D. A., Arnold, C. A., Frimpong Boamah, E., & Garmestani, A. S. (2017). Understanding and applying principles of social cognition and decision making in adaptive environmental governance. Ecology and Society 22(1):33. https://doi.org/10.5751/ES-09154-220133

DeCaro, M. S., & Rittle-Johnson, B. (2012, Dec). Exploring mathematics problems prepares children to learn from instruction. *Journal of experimental child psychology, 113*(4), 552-568. doi:10.1016/j.jecp.2012.06.009

DeCaro, M. S., Van Stockum, C. A., & Wieth, M. B. (2017). The relationship between working memory and insight depends on moderators: Reply to Chuderski and Jastrzêbski (2017). *Journal Of Experimental Psychology: Learning, Memory, And Cognition, 43*(12), 2005-2010. doi:10.1037/xlm0000460

Dunlosky, J., & Rawson, K. A. (2012). Overconfidence produces underachievement: Inaccurate self evaluations undermine students' learning and retention. *Learning and Instruction, 22(4),* 271–280. http://dx.doi.org/10.1016/ j.learninstruc.2011.08.003.

Frey B. S., Benz M., and Stutzer A. (2004) "Introducing procedural utility. Not only what, but also how matters" Journal of Institutional and Theoretical Economics, 160: 377–401.

Frey, Seth, & Goldstone, R. L. (n.d.). "Cognitive mechanisms for human flocking dynamics." arXiv preprint arXiv:1506.05410(2015).

Fyfe, E. R., DeCaro, M. S., & Rittle-Johnson, B. (2015). When feedback is cognitively-demanding: the importance of working memory capacity. *Instructional Science, 43*(1), 73-91. doi:10.1007/s11251-014-9323-8

García-Barrios, L. R., García-Barrios, J., Cruz-Morales, & Smith, J. A. (2015). When death approaches: reverting or exploiting emergent inequity in a complex land-use table-board game. *Ecology and Society, 20(2): 13*. doi:http://dx.doi.org/10.5751/ES-07372-200213

García-Barrios, L., Cruz-Morales, J., Vandermeer, J., & Perfecto, I. (2017). The Azteca Chess experience: learning how to share concepts of ecological complexity with small coffee farmers. *Ecology and Society, 22*(2). doi:10.5751/ES-09184-220237

García-Barrios, L., García-Barrios, R., Waterman, A., & Cruz-Morales, J. (2011). Social dilemmas and individual/group coordination strategies in a complex rural land-use game. *International Journal of the Commons, 5*(2), 364-387. doi:10.18352/ijc.289

García-Barrios., L., García-Barrios, R., Waterman., A., & Cruz-Morales, J. (2011). Social dilemmas and individual/group coordination strategies in a complex rural land-use game. *International Journal of the Commons, 5*(2), 364-387. doi:10.18352/ijc.289

Goldstone, R. L., Wisdom, T. N., Roberts, M. E., & Frey, S. (2013). Learning along with others. *Psychology of Learning and Motivation, 58*, 1-45.

Hardin, G. (1968, December 13). The Tragedy of the Commons. *Science, 162*(3859), 1243-1248. doi:10.1126/science.162.3859.1243

Hertwig, R. and Ortmann, A., 2001. Experimental practices in economics: A methodological challenge for psychologists?. *Behavioral and Brain Sciences*, *24*(3), pp.383-403.

Hobbes, T. (1651-1909). *Leviathan.* Oxford: Clarendon.

Hume, D. (1738). *A Treatise of Human Nature.* Oxford University Press.

Jones, N. A., Ross, H., Lynam, T., Perez, P., & Leitch, A. (2011). Mental models: an interdisciplinary synthesis of theory and methods. *Ecology and Society, 16*(1), 46. Retrieved from http://www.ecologyandsociety.org/vol16/iss1/art46/

Karremans, J. (2002). Forgiveness: Examining its consequences. Doctoral dissertation. *Free University Amsterdam, the Netherlands.*

Kelley, C. P., Mohtadi, S., Cane, M. A., Seager, R., & Kushnir, Y. (2015). Climate change in the Fertile Crescent and implications of the recent Syrian drought. *Proceedings of the National Academy of Sciences, 112*(11), 3241-3246. doi:https://doi.org/10.1073/pnas.1421533112

Kuhn, S. (2017). *"Prisoner's Dilemma".* (E. N. Zalta, Ed.) Retrieved from The Stanford Encyclopedia of Philosophy (Spring 2017 Edition): https://plato.stanford.edu/archives/spr2017/entries/prisoner-dilemma/

Loibl, K., Roll, I., & Rummel, N. (2017). Towards a Theory of When and How Problem Solving Followed by Instruction Supports Learning. *Educ Psychol Rev, 29*(4), 693-715. doi:10.1007/s10648-016-9379-x

Meinzen-Dick, R., Janssen, M. A., Kandikuppa, S., Chaturvedi, R., Rao, K., & Theis, S. (2018). Playing games to save water: Collective action games for groundwater management in Andhra Pradesh, India. *World Development, 107*, 40-53. doi:10.1016/j.worlddev.2018.02.006

McKenzie-Mohr, D. 2000. Promoting sustainable behavior: an introduction to community-based social marketing. *Journal of Social Issues* 56(3):543-554.

Nickerson, R. S. (1998). Confirmation bias: a ubiquitous phenomenon in many guises. *Review of General Psychology*, 2 (2);175-220.

Ostrom, E. (1998). A behavioral approach to the rational choice theory of collective action: Presidential address, American Political Science Association, 1997. *American Political Science Review, 92*(1), 1-22. doi:10.2307/2585925

Ostrom, E. (2005). Animating Institutional Analysis. In *Understanding Institutional Diversity* (pp. 99-134). PRINCETON; OXFORD: Princeton University Press. Retrieved from http://www.jstor.org/stable/j.ctt7s7wm.8

Ostrom, E. (2010). Analyzing collective action. *Agricultural Economics, 41*, 155-166. doi:10.1111/j.1574-0862.2010.00497.x

Ostrom, E., Walker, J., & Gardner, R. (1992). Covenants with and without a sword: Self-governance is possible. *American political science Review, 86*(2), 404-417.

Royte, E. (2016, August). To The Last Drop. *National Geographic*, pp. 86-111.

Ryan, Richard M., Stefano I. Di Domenico, William S. Ryan, and Edward L. Deci. "Pervasive influences on wellness and thriving: Cultural, political, and economic contexts and the support of basic psychological needs." (2017).

Simon, H. (1972). Theories of bounded rationality. (pp. 161-176). In C. B. McGuire, & R. Radner (Eds.), *Decision and Organization: A Volume in Honor of Jacob Marschak.* Amsterdam, North Holland.

Schwartz, D. L., & Bransford, J. D. (1998). A time for telling. *Cognition and Instruction, 16*(4), 475–522.

Skinner, B. F. (1969). *Contingencies of reinforcement: A theoretical analysis.* New York: Appleton-Century-Crofts.

Tyler T. R. (2006) “Psychological perspectives on legitimacy and legitimization” Annual Reviews of Psychology, 57: 375–400.

Weaver, J. P., Chastain, R. J., DeCaro, D. A., & DeCaro, M. D. (2018). Reverse the routine: Problem solving before instruction improves conceptual knowledge in undergraduate physics. *Contemporary Educational Psychology*, *52*, 36-47.

Weber, J. M., Kopelman, S., & Messick, D. M. (2004). "A conceptual review of decision making in social dilemmas: applying a logic of appropriateness". *Personality and Social Psychology Review*, *8*(3), 281-307.

Appendix A

List of All Questions That Appear on the Learning Quiz

Quiz Instructions

**** Important Instructions ****

Next, we will test your understanding of key concepts. The questions in this quiz test your knowledge of concepts from the Cattle Farming Board Game, the real-world situation that the game is based on, and other information you saw or experienced in today's experiment.

The questions in this section have correct and incorrect answers.

There are 3 short essay questions, and 15 multiple choice questions. **You will be paid $0.50 (50 cents) for each short essay question, and $0.15 (15 cents) for each multiple choice question you answer correctly. If you answer all questions correctly, you can earn $3.75 for this quiz.** Try your best to get each question correct.

Quiz Short Essay Items

***Instructions:* Short Essay Questions**

There are 3 questions in this section. You will receive $0.50 (50 cents) for each question in this section.

Defining a Social Dilemma

Item Prompt: What are the key features or characteristics of a situation that make it a social dilemma? Briefly explain each feature.

Click the box below to type your response.

____

Defining a Social Dilemma Game

Item Prompt: Briefly explain how the Cattle Farming Board Game is a social dilemma. What aspects of the game make it a social dilemma? Give examples from the game to explain your answer.

Click the box below to type your response.

____

Defining Environmental Complexity

Item Prompt: Briefly explain how the Cattle Farming Board Game is a complex environmental situation.

Click the box below to type your response.

Quiz Multiple Choice Items

Instructions: **Multiple Choice Questions**

There are 15 questions in this section. You will receive $0.15 (15 cents) for each question you anwer correctly.

Multiple Choice: Social Dilemma Item 1

Item Prompt: What is a social dilemma? *Choose the single best answer.*

1. A situation where one person does not get what he or she wants.
2. A situation where people are fighting.
3. A situation where individual goals conflict with what is best for the group.
4. All of the above.

Multiple Choice: Social Dilemma Item 2

Item Prompt: Which of the following situations is a Resource Dilemma? *Choose the single best answer.*

1. Each roommate in a sorority house needs to contribute some time and energy to get all the chores done.
2. Students in the library must wait for an open computer station, in order to use a computer.
3. Several students enter a bus, and there are plenty of seats for everyone.
4. Several students are having an argument about something they learned in class.

Multiple Choice: Social Dilemma Item 3

Item Prompt: True or False: In social dilemma situations like the cattle farming situation in the United States' Ogallala Aquifer and the Cattle Farming Board Game…

	True or False	
	True	False

People's decisions do not affect other people.	○	○
Cooperation is guaranteed.	○	○
If each person acts selfishly, everyone could suffer.	○	○
Groups get better outcomes (e.g., more money) if everyone works together.	○	○

Multiple Choice: Social Dilemma Item 4

Item Prompt: In the Cattle Farming Board Game, one of the Players tends to have an advantage in the game. Who is it?

1. Player 1.
2. Player 2.
3. Player 3.
4. Player 4.

Multiple Choice: Social Dilemma Item 5

Item Prompt: Here is a picture of the Cattle Farming Board Game. Which Players can affect Player 1's earnings? Select all that apply.

☐ Player 1

☐ Player 2

☐ Player 3

☐ Player 4

Multiple Choice: Social Dilemma Item 6

Item Prompt: In the United States, some of the actions cattle farmers take directly (or indirectly) increase competition and make it harder for other farmers to earn money.

Use what you have learned today about cattle farming to <u>select each action that increases competition</u> among farmers. *Select all that apply.*

	Does this increase competition?	
	Yes	No
Putting a lot of cattle in a single area of your pasture.	○	○
Cutting down a few trees from your forest for timber.	○	○
Letting your cattle drink from the creek that is shared between you and other farmers.	○	○
Cutting down a forest to make room for more cattle on your pasture.	○	○
Removing some cattle from your pasture and planting some new trees/forests.	○	○

Multiple Choice: Ecological Dilemma Item 1

Item Prompt: What happens when a lot of forests are cut down to make room for more cattle? *Choose the single best answer.*

1. There is more open land for cattle grazing, so the farmers can earn even more money by taking more cattle to the market.
2. The area cannot sustain the cattle or farmers because the soil and land becomes barren.
3. More forests will grow back and replace the old forests.
4. Nothing. The number of trees or forests has no effect on cattle or farmers.

Multiple Choice: Ecological Dilemma Item 2

Item Prompt: In the Cattle Farming Board Game, why can't you place two High Cattle Tokens near each other (connected by a line) in the pasture? *Choose the single best answer.*

1. There would be too many cattle to sustain enough plant life to feed the cattle.
2. There is not enough physical space for the cattle. They do not fit.
3. Having too many cattle attracts predators that might eat the cattle.
4. Having too many cattle in one area creates an over-supplied market, decreasing their value.

Multiple Choice: Ecological Dilemma Item 3

Item Prompt: In the Cattle Farming Board Game, what happens if there are two cattle tokens in the same creek? *Choose the single best answer.*

1. Players (farmers) can continue to put as many cattle on the creek as they want until it is full.

2. The cattle have access to fresh water, so they become healthier (High Cattle Tokens), which are worth more money at the market.

3. If anyone puts more cattle on the creek, the creek will dry up and the cattle will die.

4. Nothing. Players (farmers) are not allowed to put any cattle in the creeks, because of pollution it might cause.

Instructions Social Dilemma Items

Instructions: **Identifying Social Dilemmas**

Next, we would like to see your ability to recognize real-world social dilemmas. Some of the situations we show or describe in this section are social dilemmas like the one in the cattle farming board game, others are different kinds of social dilemmas, and others are not dilemmas at all.

Please try your best to identify the social dilemmas.

You will earn $0.15 (15 cents) for each correct answer.

Dilemma 1: Fossil Fuel Common Pool Resource Dilemma

Item Prompt: Most people in the world use fossil fuels (e.g., petroleum and oil) to fuel their vehicles, transport goods, and power machinery for making other goods. There is a limited supply of fossil fuel in the world. Many countries, companies, and people want to use the valuable fossil fuels.

Is this a social dilemma?

1. Yes
2. No

Dilemma 2: Black Friday Common Pool Resource Dilemma

Item Prompt: On Black Friday in the U.S., a limited number of highly desired electronics (e.g., video game systems, televisions) go on sale for one day. These products are discounted substantially, so many people come to stores, camping out the night before, in order to be the first person to get in the store and reach the sale items.

Is this a social dilemma?

1. Yes
2. No

Dilemma 3: Water Public Good Dilemma

Item Prompt: The City of Louisville needs to raise about $4.3 Billion in order to fix old water delivery pipes and sewer pipes, pumps, and water treatment facilities. To do this, the City may raise taxes, and the Metropolitan Sewer District may raise its monthly fees. Everyone would benefit from improved water systems, even people who do not pay for them, or pay less.

Is this a social dilemma?

1. Yes
2. No

Dilemma 4: Blood Drive Public Good Dilemma

Item Prompt: In a typical blood drive, hospitals would like as many people as possible to donate blood for people who need a blood transfusion in a medical emergency. Everyone can benefit from the blood that is donated, but few people donate their blood.

Is this a social dilemma?

1. Yes
2. No

Dilemma 5: Group Project Public Good Dilemma

Item Prompt: Instructors sometimes require their students to work in groups, for a group project. Everyone in the group gets the same grade, even students that do not do as much work.

Is this a social dilemma?

1. Yes
2. No

Dilemma 6: Party Foil

Item Prompt: A group of college students has gathered for a party. There are a lot of people there, and just as many boxes of pizza, bags of chips, drinks and other food for everyone. The party is being held in one of the largest sorority houses on campus, late into the night. A few people get into an argument about something one of them posted online in social media.

Is this a social dilemma?

1. Yes
2. No

Appendix B

List of Charitable Organizations Participants Could Donate to

Participants were given the opportunity (choice) to donate some of their in-game earnings to the charity, as a tangible indicator of cooperation. Donations were handled privately via computer, and blinded from the experimenter, so that individuals could make a voluntary decision free from social pressure. The amount of money donated anonymously to charities at the end of the experiment was used to assess differences in participant's understanding of deep mechanics within social dilemmas, as well as their ability to transfer what they have learned to real world dilemmas.

1. **Farm Aid**

   Farm Aid's mission is to keep family farmers on the land. We're best known for our annual music, food and farm festival, but the truth is we work each and every day, year-round to build a system of agriculture that values family farmers, good food, soil and water, and strong communities. Learn more about our day-to-day work to celebrate and strengthen farmers, advocate for fair farm policies, connect farmers and eaters, and bring family farm food to everyone.

   Click Link: https://www.farmaid.org/our-work/ *Scroll to middle of page to find donation area.

2. **The International Union For the Conservation of Nature**

   The International Union for Conservation of Nature (IUCN) is a membership union uniquely composed of both government and civil society organisations. It provides public, private and non-governmental organisations with the knowledge and tools that enable human progress, economic development and nature conservation to take place together. Our experts are organised into six commissions dedicated to species survival, environmental law, protected areas, social and economic policy, ecosystem management, and education and communication.

   Click Link: https://www.iucn.org/donate *To enter your own dollar amount, look for the empty box.

3. **The Cornucopia Institute**

   The Cornucopia Institute engages in educational activities supporting the ecological principles and economic wisdom underlying sustainable and organic agriculture. Through research and investigations on agricultural issues, the Cornucopia Institute provides needed information to consumers, family farmers, and the media.

Click Link: https://www.cornucopia.org/donate/

4. The Rotary Foundation

The Rotary Foundation is a not-for-profit corporation funded solely by voluntary contributions from members and friends of Rotary who support its mission to advance world understanding, goodwill, and peace. Using Rotary Foundation grants, Rotary's 34,000 clubs across the globe develop and carry out sustainable humanitarian projects and provide scholarships and professional training opportunities that promote peace, fight disease, provide clean water, sustain mothers and children, improve education, and strengthen local economies.

Click Link: https://my.rotary.org/en/donate

If you make a donation, be sure to close the webpage when you finish. And, fill out the confidential Donation Form, which is on the desk.