Communication trumps penalties in new study of social-ecological systems

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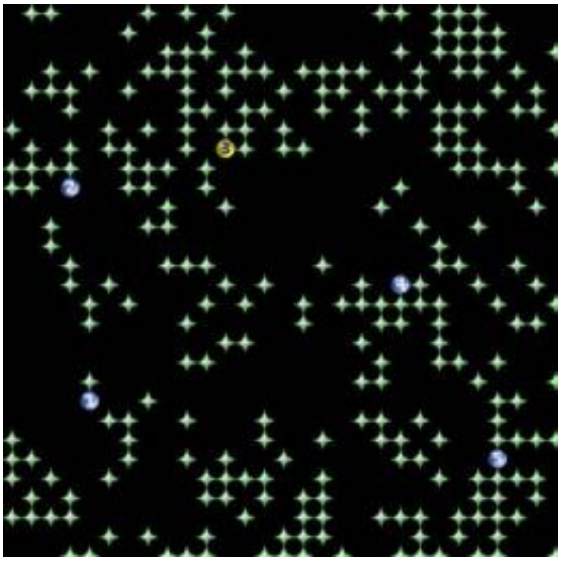

This is a screen shot of the experimental environment. The green star-shaped figures are resource tokens; the circles are avatars of the participants (yellow is participant's own avatar; blue represents other participants). Credit: Arizona State University

Research conducted in a computerized microworld by scientists at Arizona State University and Indiana University, including Nobel laureate Elinor Ostrom, show how common-pool resources - such as fisheries, forests, water systems or even bandwidth - can be managed effectively by self-organized user groups under certain conditions.

The findings are published April 30 in the journal *Science*.

"We use different experiments with specially designed computer simulation games that include costly fines, communication, a combination of both and a period where neither punishment nor communication is allowed. These experiments help us identify which variables increase the level of cooperation," says Marco Janssen, social science modeler at the School of Human Evolution and Social Change in ASU's College of Liberal Arts and Sciences and the study's lead author.

The experiments involve a timed computer game played simultaneously by college students in a lab. The students sit in individual cubicles and have their own avatars in the game. They go about individually "harvesting" a resource - in this case, colored dots - in an experimental environment, along with the other players. If they harvest them too fast, the resource runs out and the game ends. If they manage them sustainably, the dots regenerate, allowing them to harvest more and earn more points. The more points the students have, the more they are paid real dollars at the end, creating an incentive for them to take the game seriously, explains Janssen.

To do well requires the participants to monitor their own behavior, but also to be mindful of what the others are doing, Janssen notes. In some cases, the players are allowed a brief opportunity to communicate via chat rooms to strategize and make decisions regarding where and when to harvest resources, or collect tokens. They also determine whether or not to impose costly fines for overuse of resources by a member of the group, and when to sanction a player.

"Spatial and temporal resource dynamics were included in our laboratory experiments in order to capture these two critical variables," adds Janssen. He explains that adding the space and time complexity component to their experiments illustrated that stronger governance of common-pool resources does not always result in better harvesting.

This finding is contrary to the classic view of options regarding how to manage common resources, such as those based on Garrett Hardin's famed example of the "tragedy of the commons" - the basis for much of the world's policies for managing resources.

When participants make decisions without communicating, they overharvest, notes co-author Ostrom, founding director of ASU's Center for the Study of Institutional Diversity and a professor of political science in Indiana University's College of Arts and Sciences.

When given a chance to communicate, however, participants improve their joint outcomes greatly - and the effect is lasting even when communication is no longer possible, she says, adding, that being able to use costly fines against each other did not improve harvest output.

"This study presents results from a more complex experimental setting than previous laboratory experiments on public goods or common-pool resources. Since we conduct field research as well as experimental research we wanted to develop a more realistic setting than has been feasible in the past to assess how individuals cope with both the complexity and the temptations to overuse," says Ostrom, recipient of the 2009 Nobel Memorial Prize in Economic Sciences.

Other co-authors of the study "Lab Experiments for the Study of Social-Ecological Systems" are Allen Lee, a research at ASU, and IU doctoral student Robert Holahan.

According to Lee, more than 400 students at both universities participated in the experiments.

"With the ability to communicate, the students almost invariably cooperate with each other and improve their earnings by coming up with their own rules to govern how they harvest from the resource. The only

time it breaks down is when there are one or two members in the group that disregard the rules they came up with," says Lee.

A next step is to take the sophisticated simulation games used in the experiments and convert them into educational games for youth.

"My hope is the games will get the next generation to think more deeply about the pressing social-ecological problems we are facing, and what it takes to manage resources sustainably," Lee adds. "Rather than just be entertained, it would be fantastic if the experience from the games ultimately led them to take action."

Provided by Arizona State University