

Cooperation among humans, a question of age

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The image depicts some people involved in the experiment. Credit: Anxo Sánchez/UC3M

According to an article by scientists from the Universities of Barcelona, Carlos III of Madrid, and of Zaragoza which was published in the journal *Nature Communications*, young people between the ages of ten and sixteen demonstrate more fickle behavior when it comes to cooperating, unlike other age groups. People over the age of 66 demonstrated the most cooperative behavior.

The new research paper, which reports on one of the first experimental studies in the world to analyze how cooperative attitudes evolve in different [age](#) ranges, was written by the professors from the OpenSystems research group of the Department Fundamental Physics at the Universidad de Barcelona (UB), Josep Perelló and Mario Gutiérrez-Roig, Anxo Sánchez, of the Complex Systems Interdisciplinary Group (Grupo Interdisciplinar de Sistemas Complejos - GISC) of the Mathematics Department at the Universidad Carlos III de Madrid (UC3M) and the researchers from the Complex Systems and Networks Group (Grupo de Redes y Sistemas Complejos - COSNET Lab) at the Institute for Biocomputation and Physics of Complex Systems (Instituto de Biocomputación y Física de Sistemas Complejos - BIFI) at the Universidad de Zaragoza, Carlos Gracia Lázaro and Yamir Moreno.

The Prisoner's Dilemma, to cooperate or not to cooperate

The experiment, which is presented as a game via a web interface developed by researchers at the Instituto BIFI of the Universidad de Zaragoza, was carried out using 168 subjects between 10 and 87 years of age who had been chosen at random during the DAU Barcelona Board Games Festival (Festival DAU Barcelona de Juegos de Mesa), which was held in Barcelona's "Fábrica de Creación Fabra i Coats" in December of 2012. The experiment was part of the Barcelona Lab platform, promoted by the Dirección de Creatividad e Innovación del Institut de Cultura de Barcelona (ICUB – Management of Creativity and Innovation at the Barcelona Institute of Culture). The team installed a portable laboratory with a dozen computers and took volunteers from among the Festival's visitors until a statistically relevant number of subjects was reached. They repeated the experiment later in order to confirm the results, which were corroborated by 53 twelve- and thirteen-year-old students from the Colegio Jesuites Casp de Barcelona. A virtual version of the Prisoner's

Dilemma was used in the study; the problem comes from game theory and is used as a model for studying human behavior and, in this case, cooperation among people.

The Prisoner's Dilemma plays a central role in this experiment, which continues the work done in previous studies by some of the same researchers, because it is a way to "ask" people how cooperative they are. The participants were divided into groups of four based on different age ranges. There was a control group, as well. During the 25 consecutive rounds they had to choose between cooperating and not cooperating, receiving different rewards for each action. Rewards for the people who are interacting come when they collaborate; if one collaborates and the other doesn't, the latter receives a greater reward than former, who collaborates; but if nobody collaborates, then nobody receives any reward. The participants had information regarding their opponents' actions and the rewards received by each one. When the rounds finished, the total number of points obtained by each participant was transformed into money, which they received immediately (in the case of minors, their parents received it).

More unpredictable decisions by young people

The most remarkable results of the experiment show clearly differentiated behavior in the youngest age range. "In general, people consider what others have done when they collaborate, but our experiments show that adults also consider their own previous actions; that is to say, there is a different strategy in the way they act and there is a tendency to end up cooperating; the way they act is more predictable and it helps a bit in keeping up the cooperation," explains Yamir Moreno. However, the behavior of the youngest participants does not follow this pattern. "According to our study, kids are more volatile in their decisions; they don't follow a definite strategy, and they are essentially conditional cooperators, because they pay more attention to

those around them. Kids' tendency is to watch what the other players are doing and react according to their response, instead of being conditioned by their own past actions. This makes it difficult for a cooperative environment to be generated," explains Mario Gutiérrez-Roig. On the opposite side, there is another peculiarity in the results, points out Professor Anxo Sánchez: "Those who are over 65 seem to be more cooperative than those in other age groups, although in this case we don't have a great deal of statistical information and we would have to test it further." This suggests, as another study indicated, that "lowering the retirement age may not be beneficial for companies and it might be interesting to find ways to keep this group working or in an alternate situation where they can continue to be cooperative," indicates Sánchez.

In the second experiment, with students from the Jesuïtes Casp School, which was carried out to corroborate the results, the conclusions were the same. "These kids were more cooperative, but their behavior remained equally unpredictable", recalls Carlos Gracia-Lázaro. "These results lead us to think that there is an evolutionary and cultural component throughout the life cycle, and that being prone to cooperate is a quality that can be learned," emphasizes Gracia-Lázaro.

The results also hold implications with regard to strategies that can be used to foment collaboration among this age group. "It would be necessary to develop specific strategies, different from those used with adults, to promote the transition toward more persistent pro-social conduct and to help kids understand the need for a level of perseverance. Applying this to the area of education, for example, this could be translated into establishing clearer rules in group projects to facilitate the students' coming to agreements that would be beneficial for everyone," explains Josep Perelló.

In previous experiments it had already been observed that children between 6 and 10 years of age develop a sense of cooperation and this

study pinpoints the moment in which this changes: adolescence. "The causes are not clear, but we think that what may happen is that in the earlier phases they begin to develop a 'theory of the other', as the psychologists call it, which allows them to empathize and be altruistic; however, as they get older they could have a phase in which they believe that understanding the other puts them in a position to take advantage of him," explains Anxo Sánchez. "The idea is a bit intuitive, so it would be necessary to perform further experiments to clarify the causes of this change," points out Yamir Moreno.

A unique space to do experiments on human behavior

This study, carried out in the unique space that is the DAU is the result of collaboration between the research team and the ICUB, which is the result of the creation of the Barcelona Lab and the Ciencia Ciudadana (Citizen Science) group. Thus, thanks to the collaboration of the OpenSystems, COSNET Lab and GISC groups, it has been possible to obtain a more representative sample than what is habitually used in behavioral studies. As researcher Josep Perelló explains, "studies of this kind normally use samples made up of social science and economics students, with what that implies as far as the subjects' profile of having a university level education and a certain economic level. Furthermore," the expert continues, "they could even be influenced by the very economic theories that they learn in class. Our sample is more diverse in terms of age and socio-educational level, which makes our conclusions more general. The idea is that the DAU Barcelona (directed by Oriol Comas and organized by the ICUB) can also be an experimental space where it would be possible to do studies on [human behavior](#) through games with and for society," notes Perelló. "The idea is to facilitate experimental laboratory activities where the public's participation is important, and this scientific article is the first relevant result that has come out of this collaboration," explains Perelló. "Studies such as this one allow the public to participate in scientific studies from the very

beginning and they also help to explain how science works and show the different phases of the scientific method," concludes Mario Gutiérrez-Roig.

More information: Transition from reciprocal cooperation to persistent behavior in social dilemmas at the end of adolescence. Mario Gutiérrez-Roig, Carlos Gracia-Lázaro, Josep Perelló, Yamir Moreno, Ángel Sánchez. Nature Communications. [DOI: 10.1038/ncomms5362](https://doi.org/10.1038/ncomms5362).

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