



# An experiment on cooperation in ongoing organizations<sup>☆</sup>

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## ABSTRACT

We study experimentally whether an overlapping membership structure affects the incentives of short-lived organizational members. We compare organizations in which one member is replaced per time period to organizations in which both members are replaced at the same time. We find at best weak support for the hypothesis that an overlapping membership structure is conducive to cooperation in ongoing organizations. Incoming members are sensitive to the organizational history when membership is overlapping, as they should according to the cooperative equilibrium, but this is not enough to substantially increase cooperation levels in the organization.

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## 1. Introduction

In an important paper, [Cremer \(1986\)](#) shows that cooperation among the members of an organization is possible, even if members have finite lives, as long as the organization itself is ongoing. The key condition is that members are not all replaced by new members at the same time. If members share a common last round, the standard backward induction argument of unraveling of cooperation applies. If, however, membership is overlapping (staggered) there is no common last round. There is always a member whose horizon extends beyond that round, and who needs to take into account the strategy of a new incoming member. If this strategy involves a reward for cooperative behavior, cooperation can be sustained as an equilibrium outcome.

The model of [Cremer \(1986\)](#) is an application of the overlapping generations model introduced by [Samuelson \(1958\)](#). Its relevance extends beyond cooperation in organizations. Other models analyze, for instance, the sustainability of pay-as-you-go pension plans ([Hammond, 1975](#)), the supply of intergenerational club goods ([Sandler, 1982](#)), the scope for arms control between countries ([John et al., 1993](#)), the interaction between junior and senior members of a political party ([Alesina and](#)

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**Table 1**  
Prisoner's dilemma game.

		B	
		C	D
A	C	(2,2)	(0,3)
	D	(3,0)	(1,1)

**Table 2**  
Players with 2-round memberships and 1-round overlapping memberships.

Role	Round					
	1	2	3	4	5	...
A	$A_0$	$A_2$	$A_2$	$A_4$	$A_4$	...
B	$B_1$	$B_1$	$B_3$	$B_3$	$B_5$	...

Spear, 1988), and the collaboration between regulatory agents and firm managers (Salant, 1995). Several studies indicate that the scope for cooperation between finitely-lived players is furthered by the condition that life spans and terms overlap rather than fully coincide (Salant, 1991; Kandori, 1992a; Smith, 1992).

In the present paper we put this argument to the test. We set up a laboratory experiment in which an organization exists for an indefinite number of rounds. In each round, an organization is inhabited by two members who play a prisoner's dilemma game. The two members interact with each other for a fixed number of rounds (either one or three rounds). We implement two different term structures: an overlapping (OL) structure in which the two members are replaced by new members in different rounds, and a non-overlapping (NoOL) structure in which the two members are replaced in the same round. In line with the analysis of Cremer (1986), we hypothesize that the average cooperation rate will be higher in organizations with an overlapping structure than in those with a non-overlapping structure.

The experimental results show at best weak support for our main hypothesis. Cooperation rates are not significantly different between organizations with an overlapping membership structure and those with a non-overlapping structure. Moreover, this holds for the case in which members overlap for one round and the case in which they overlap for three rounds. This does not imply that play is completely insensitive to the overlapping membership structure. We find that junior (incoming) members cooperate at a higher rate than senior (outgoing) members. Also, junior members cooperate at a higher rate when the senior member they interact with cooperated in the previous round. Such strategic play is not strong enough though to induce substantially higher rates of cooperation.

There are a few related experimental studies on cooperation in games with an overlapping generations structure. Van der Heijden et al. (1998) examine whether the provision of information feedback on the history of play has an effect on the level of inter-generational transfers. It turns out that it does not have an effect, suggesting that players do not use this information in a strategic way. Offerman et al. (2001) use the strategy method to study play in an inter-generational prisoner's dilemma game. They find that relatively few subjects use history-dependent strategies, such as trigger strategies, even when recommended to do so by the experimenters. A recent study by Duffy and Laffky (2016) has a focus similar to ours. It compares contributions in public goods games with and without an overlapping generations structure. They find that average contribution levels are not affected by the matching structure, but that the pattern of contributions over time is more stable with overlapping matches.

## 2. Theoretical framework

Our theoretical framework is based on models that study the scope for cooperation in games with an overlapping membership structure (Cremer, 1986; Salant, 1991; Kandori, 1992a; Smith, 1992). It involves an organization that lasts for an indefinite number of rounds. In each round there are two members (players) in the organization. One member is assigned role  $A$  and the other is assigned role  $B$ . The two members play a symmetric prisoner's dilemma (PD) game as displayed in Table 1.

The membership of the organization changes over time. Let  $i_\tau$  denote the member of role  $i$  coming to the organization in round  $\tau$ , where  $i \in \{A, B\}$  and  $\tau \in \{0, 1, 2, 3, \dots\}$ . Except for  $A_0$  who is only active for one round, each member stays in the organization for two rounds. Once a member finishes her membership in the organization, she is replaced by an incoming member of the same role. In each round, one member in the organization is replaced. Hence, the membership of each member overlaps the membership of one other member for one round. This matching structure with 2-round memberships and 1-round overlapping memberships is depicted in Table 2.

If the PD game is played repeatedly by finitely lived players with overlapping memberships, there exist subgame perfect equilibria with cooperative outcomes. In a player's last round in the organization, it is always optimal to defect since there is no shadow of the future. Cooperative incentives can only emerge before players are in the last round of their membership. Label players in their first (last) round in the organization as junior (senior). Consider the strategy profile in which players cooperate if and only if they are juniors and they see that all preceding members cooperated when they were juniors. It is

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