Real-time tacit bargaining, payoff focality, and coordination complexity: Experimental evidence ☆

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A B S T R A C T

We conduct a bargaining experiment where interaction is tacit and payoffs are earned and cumulated in real time. We test hypotheses about the interaction between the focal properties of payoffs and the complexity of coordinating on an intertemporal behavior that achieves them. The general finding is that when a payoff focal outcome requires a complicated coordination scheme bargainers tend to settle on a simpler and sometimes inefficient behavior.

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The study of tacit bargaining – bargaining in which communication is incomplete or impossible – assumes importance, therefore, in connection with limited war, or, for that matter, with limited competition, jurisdictional maneuvers, jockeying in a traffic jam, or getting along with a neighbor that one does not speak to. (Schelling, 1960, p. 53)

1. Introduction

In this paper we report the findings from an experiment that aims to capture bargaining environments with the following features. First, decisions are *non-cooperatively* made in *real time* – the players cannot sign binding contracts that regulate their current and future behavior, and there are no externally imposed constraints on how often players can revise their decisions. Second, there is a surplus that consists of one or more *indivisible items* (such as parcels of land, fishing spots, or geographically distinct sales districts).[1] The surplus renews continuously, and the players' chosen actions generate payoffs that they *immediately* receive and *cumulate* over the time period. Third, the stage game played at every time instant

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has multiple Nash equilibria, and the players prefer different equilibria. Finally, interaction is *tacit* – the players can not communicate via cheap talk (see, e.g., Farrell and Rabin, 1996 and Schelling, 1960).

Let us describe some real world situations with the features described above.

Duopoly Two firms, producing an identical good and selling it in two geographically separated markets, choose non-cooperatively, tacitly, and in real time how much to offer for sale in each market, and cumulate profits over time. Each market can only sustain one firm, and markets differ in profitability.

Neighbors Two neighbors who cannot or prefer not to talk (cf. the quote from Schelling above) decide when and for how long to use a shared outdoor area, playground, and parking area. Each facility has capacity for a single user only, or the neighbors prefer not to meet at the same place.

Common pool resource Fishermen from different villages who do not communicate with each other decide in real time which fishing spots to occupy and for how long (this is a common pool resource situation – see Ostrom et al., 1994). Each fisherman prefers to get a fishing spot for him or herself, but if several fishermen try to take the same spot, there will be a costly dispute.

These situations are not 'standard' negotiation situations – no discussion takes place around a negotiation table, there is no exchange of offers and counteroffers, and no contracts are signed. Nevertheless, our environment has an essential element of bargaining at its core, since there are many possible ways the players can divide the assets between them over the time period, and there is a conflict of interest (each would like to consume all the resources at every moment in time); and a failure to 'agree' (which in our context means that the assets are in dispute) leads to an inferior outcome for all players. However the players are not only faced with the problem of tacitly agreeing on which overall payoffs they should aim for – they need to coordinate on an intertemporal behavior that achieves these overall payoffs. There are many of these, so this amounts to solving a coordination problem. Thus the players effectively face both a bargaining and a coordination problem, and both must be tackled simultaneously, tacitly, and in real time.[2]

We focus on two aspects that we thought would be important in a real-time tacit bargaining environment. First, a well-known hypothesis is that bargainers may be able to coordinate on a focal outcome of the game (see Isoni et al., 2014; Roth, 1985, 1995, and Schelling, 1960).[3] We expected that payoff-based sources of focality (*payoff focality*), such as equality, efficiency, and total payoff maximization, would influence behavior.[4]

Second, we conjectured that the complexity of coordinating on an intertemporal behavior that achieves the focal payoffs (*coordination complexity*) would also be behaviorally relevant.

We observe that high coordination complexity is detrimental to coordination. Also, bargainers tend to settle on equal and inefficient payoffs if the behavior giving equal and efficient payoffs is too complex. Furthermore, coordination complexity affects how bargainers trade off equality and efficiency.

These findings strongly suggest that we cannot expect outcomes of real-world ongoing tacit bargaining situations to be efficient, if efficiency requires an intertemporal behavior that is too complex relative to other behaviors that give inefficient but reasonable payoffs. Moreover, we can not deduce bargainers' efficiency and equality concerns from their observed behavior, since this also depends on coordination complexity.

We are, to the best of our knowledge, the first to report experimental data for real time bargaining situations, but there are clear connections to several other research areas.[5] A recent group of papers study strategic environments where decisions are made and payoffs earned in real (effectively, continuous) time. See, for example, Bigoni et al. (2015), Friedman et al. (2004, 2015), Friedman and Oprea (2012), Oprea et al. (2011, 2014), but as far as we know no study considered bargaining situations.[6]

We also contribute to the experimental bargaining literature by considering a setting where players make moves and earn payoffs in real time. We can interpret this as an environment where there are no property rights, or they are not enforced. There is no third party who can impose and enforce some notion of 'agreement' (or an exogenous disagreement outcome), and who can prevent players from claiming parts of the surplus whenever they wish.

There are also several important differences between the environment studied in the current paper and those considered in the experimental and theoretical literature on cooperative behavior in repeated games (see, for example, Bhaskar, 2000;

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[2] We thank a reviewer and the Associate Editor for their comments which helped us to clarify the relationship between the bargaining and coordination element.

[3] In general, sources of focality include symmetry, payoff efficiency, payoff equality, total payoff maximization, earned entitlements, and historical precedent (see for example Van Huyck et al., 1990 and Huyck et al., 1992; Anbarci and Feltovich, 2013, 2016; Gächter and Riedl, 2005; Galeotti et al., 2016; Isoni et al., 2013, 2014; Janssen, 2006; Roth and Murnighan, 1982; Schelling, 1960; Sugden, 1986, and Young, 1993). There is also an experimental literature on 'label salient' focal points; see Blume and Gneezy (2000, 2010), Crawford et al. (2008), Isoni et al. (2013, 2014).

[4] In this paper "efficiency" means Pareto-efficiency, measured in money terms. A "total payoff maximizing outcome" maximizes the sum of players' money earnings. Such an outcome is efficient, but the converse is not true. As an example, consider two Player 1 and 2 money divisions, $(6, 6)$ and $(5, 10)$. Both are efficient, but only the latter maximizes total payoffs.

[5] In his book, *The Strategy of Conflict* (1960), Thomas Schelling gives a general discussion of tacit bargaining situations (see for example p. 102–108) and describes in Schelling (1961) an experimental design where pairs of subjects tacitly decide which parts of the United States to occupy. Some preliminary experimentation was done but no data were published (Schelling, personal communication).

[6] In Camerer et al. (2015) and Galeotti et al. (2016) players make proposals in real time, but earnings are not cumulated over time, and an agreement is assumed to be binding and terminates interaction.