The prisoners may be in two minds

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Abstract

Recognise that people have many, possibly conflicting, aspects to their personality. We hypothesise that each separate characteristic of a personality may be treated as an independent player in a non-zero sum many player game. This idea is applied to the two person Prisoners’ Dilemma as an introductory example. We assume each prisoner has a “mercenary” characteristic as well as an “altruistic” characteristic, and find that all Nash equilibria of the Prisoners’ Dilemma has each prisoner in an internal conflict between their two characteristics. The hypothesis that people are composed of more than one “player” may explain some of the anomalies that occur in human experiments exploring game theory.

1 Introduction

In reviewing the implications of some psychological research in game playing, Matthew Rabin comments

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humans differ from the way they are traditionally described by economists ... it is sometimes misleading to conceptualise people as attempting to maximize a coherent, stable and accurately perceived [utility] $U(x)$.  

Rabin [4, p.12]

To include emotions into artificial intelligences, some computer scientists explore the modelling of human emotions: Smith and Ellworth, see [1, §8.2] for example, identified a six dimensional “affective space” to capture 15 emotions.\footnote{Smith and Ellworth’s axes for the six dimensional affective space are called: pleasantness, anticipated effort, certainty, attentional activity, responsibility and control. The fifteen categorised emotions are: happiness, sadness, anger, boredom, challenge, hope, fear, interest, contempt, disgust, frustration, surprise, pride, shame and guilt.} This suggests humans are reasonably modelled by six “appraisal” dimensions. Crucially, these appraisal dimensions are independent. Maybe humans playing games, including the game called economics, act according to the diverse needs of such internal characteristics of a complex personality; and not according to maximising a single well defined utility.

2 The prisoners’ dilemma

As a first tentative exploration of the idea of multiple game players within one person, we explore two people, P and Q, playing the Prisoners’ Dilemma. Suppose each person has an altruistic, cooperative side and a mercenary, uncooperative side to their personality. These characteristics are not to be considered as opposites, but as independent characteristics, independent “players”,
within each person. Perhaps view it as each person having two independent dimensions to their character.\footnote{Of course, we presume that a more realistic model of personality would have more than two independent dimensions.}

Thus within person P we have two independent players, $P_a$ and $P_m$, the pair of altruistic and mercenary characters respectively within person P. Similarly $Q_a$ and $Q_m$ are independent characteristics of person Q. Be careful of the distinction between people and players: each person is supposed to be a composite of independent players. The two people then face a four-player Prisoner’s Dilemma—two players per person. Each player has a choice between the two strategies of cooperation $C$ (remaining silent) and defecting $D$ (informing). We suppose, within any one person, that if either of the internal players defect, whether the mercenary or the altruistic, then the person does defect—a chain is only as strong as its weakest link. That is, both aspects of a person’s character have to cooperate in order for the person to actually cooperate.

For simplicity we rate the outcomes on a four point scale of preferences for each player. The preferences are not symmetric, but we suppose symmetry between the pair of mercenary players and between the pair of altruistic players. We also assume the preferences of a player only depend upon the other person’s actual action: that is, whether they actually cooperate or defect. Thus the preferences only depend upon the other person’s players strategies in the combinations \{CC\} and \{CD, DC, DD\}. We suppose the following preferences for the two types of player within each person.

**Mercenary.** These players only care about the actual outcome and thus the preferences depend upon his/her persons actual actions, that is, \{CC\} and \{CD, DC, DD\}. As in the
### 2 The prisoners’ dilemma

Table 1: payoff preferences for P-mercenary, P-altruistic, Q-mercenary and Q-altruistic. The best response actions are indicated in *italic*, and the four Nash equilibria in **bold italics** are seen in the middle of the payoffs.

|       | \(Q_m = C\)                | \(Q_m = D\)                |
|-------|----------------------------|----------------------------|
| \(P_m = C\) | \(Q_a = C\) \(3\) \(3\) \(3\) \(3\) \(1\) \(1\) \(4\) \(3\) \(Q_a = D\) | \(Q_a = C\) \(1\) \(1\) \(4\) \(4\) \(1\) \(1\) \(4\) \(3\) \(Q_a = D\) |
| \(P_m = D\) | \(P_a = C\) \(4\) \(4\) \(1\) \(1\) \(2\) \(2\) \(2\) \(1\) \(P_a = D\) \(4\) \(3\) \(1\) \(1\) \(2\) \(1\) | \(2\) \(2\) \(2\) \(2\) \(2\) \(2\) \(2\) \(1\) | \(2\) \(1\) \(2\) \(2\) \(1\) |
1. \(\{CC, CD, DD\} \times \{CD, DC, DD\}\) when the person cooperates but the other defects, or the altruistic player defects and the other person defects;

2. \(\{DC\} \times \{CD, DC, DD\}\) when both people defect but only via the mercenary player;

3. \(\{CC, CD, DD\} \times \{CC\}\) when both cooperate, or when the altruistic player defects and the other person cooperates;

4. \(\{DC\} \times \{CC\}\) when only the mercenary player defects and the other person cooperates.

These altruistic preferences are shown in red and green in Table 1.

Inspect the consequent preferences shown in Table 1. The best response [2, §2.8,e.g.] for each player as as function of the other three players choices are shown in italic. A Nash equilibrium corresponds to any cell with all four preferences being such a best response. See the four Nash equilibria (in the middle of the table) are obtained from the strategies:

\[\{CD\!\!CD, C\!\!D\!\!DC, D\!\!C\!\!CD, D\!\!C\!\!D\!\!C\}\].

Remarkably, the four Nash equilibria correspond to both prisoners being in two minds about what action to take. Perhaps this indicates something about the internal stress suffered by a person in a Prisoner’s Dilemma. The stress comes from the internal conflict between the different characteristics within each person.

Since the four-player Prisoner’s Dilemma only involves preferences the Nash equilibria are reasonably robust.\(^3\)

\(^3\)I have not searched for any mixed Nash equilibria.
3 Discussion

Yet pure self-interest is far from a complete description of human motivation, and realism suggests that economists should move away from the presumption that people are solely self-interested.

*Rabin [4, p.16]*

Here we have discussed one model for how generalise the analysis of human behaviour by positing a complex interplay of motivation and reward internal to each person. This is a type of multiple-self model of human behaviour.

The proposed model of people composed of multiple independent selves also suggests a rationale for framing effects, described as:

two logically equivalent (but not *transparently* equivalent) statements of a problem lead decision makers to choose different options. *Rabin [4, p.36]*

The many Nash equilibria that potentially exist in a game by people with multiple selves make it quite likely that different statements of a situation will lead to different Nash equilibria being realised. Recall that the extensive form of a game often favours one Nash equilibria over another [3, §6.2], even when the two Nash equilibria are equally valid in the strategic form of the game; sub-game perfect equilibria are the rational solutions in an extensive game. Problem statements which present equivalent information in a different sequential order lead to the playing of different extensive games even though the corresponding strategic games are
equivalent. Thus the framing of a game problem possibly explores independent players within a person.

A different multiple-self model has been proposed to explain time varying preferences:

a person is modeled as a separate “agent” who chooses her current behavior to maximize her current long-run preferences, whereas each of her future selves, with her own preferences, will choose her future behaviour to maximize her preferences. Rabin [4, p.39]

The difference is that here we posited multiple selves to co-exist simultaneously within each person. Such a multiple-self model could explain the richness of human behaviour much better than one simple utility.

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References

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