



## Framing prisoners and chickens: Valence effects in the prisoner's dilemma and the chicken game

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### ABSTRACT

In an experimental study, we investigated how decisions in social dilemmas are affected by the valence of outcomes that are at stake. Prospect theory states that individuals are risk-averse when outcomes are framed as gains, and risk-seeking when outcomes are framed as losses. On the basis of this framework, previous research on social dilemmas has addressed the question of whether people are more cooperative in the negative domain than in the positive domain, but this research has led to inconsistent results. A possible explanation for this is that in many social dilemmas it is unclear whether cooperation or defection is the risky choice. In the current paper, we compare the well-studied prisoner's dilemma with the less studied chicken game. Whereas in the prisoner's dilemma it is unclear what constitutes the risky option, in the chicken game the risky option is quite clear. Consistent with predictions, we found in the chicken game more defection in the loss frame than in the gain frame, but no difference between the gain and loss frame in the prisoner's dilemma. Moreover, choices were predicted by risk attitude in the chicken game, but not in the prisoner's dilemma.

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### Introduction

As social beings, we frequently encounter situations where our own interests conflict with the interests of others. Social dilemmas are situations in which personal and collective interests are at odds (for overviews, see e.g. Komorita & Parks, 1995; Kopelman, Weber, & Messick, 2002; Messick & Brewer, 1983). In the current article, we argue that how people deal with such dilemmas depends on (a) the valence of outcomes that are at stake, and (b) the type of dilemma people face.

Sometimes the conflict between personal and collective interests concentrates on negative outcomes. For example, in the original description of the prisoner's dilemma, two prisoners have to make a decision that determines for how many years they will be sentenced. On other occasions, the outcomes may be positive, for example, when fishermen have the choice between harvesting more or less fish from a sea in danger of over-fishing. Are people more cooperative when the social dilemma is about negative rather than positive outcomes? In the present study we argue that the effect of valence on cooperation is dependent on the structural characteristics of the dilemma. Following prospect theory (Kahneman & Tversky, 1979, 1984) we will argue that the effect of va-

lence will be most pronounced when the dilemma involves a clear choice between a risky and a non-risky decision. To demonstrate this, we compare behavior in two types of dilemmas: the prisoner's dilemma and the chicken game.

#### Prisoner's dilemma and chicken game

In the *prisoner's dilemma*, two persons have to choose independently from each other between cooperation (C) and defection (D). If both players choose C, they both get the reward payoff (R), which is better than the punishment payoff (P) for mutual defection, so for both players mutual cooperation is better than mutual defection. However, in a one-sided defection the temptation payoff (T) for the defector is even better than the mutual cooperation payoff, while the sucker payoff (S) for the cooperator in this exchange is even worse than the mutual defection payoff. In brief, a prisoner's dilemma is defined by the payoff structure  $T > R > P > S$  (Fig. 1). Because of this payoff structure, for each individual defection always pays better than cooperation, regardless of whether the other chooses cooperation (since  $T > R$ ) or defection (since  $P > S$ ). However, if both players follow their self-interest, both will be worse off than if they both had chosen to cooperate (since  $P < R$ ). Real-life examples of prisoner's dilemmas are two gas stations deciding whether or not to start a price war (Murnighan, 1991), or World War I soldiers in the trenches choosing whether or not to open serious fire at the enemy (Axelrod, 1984).

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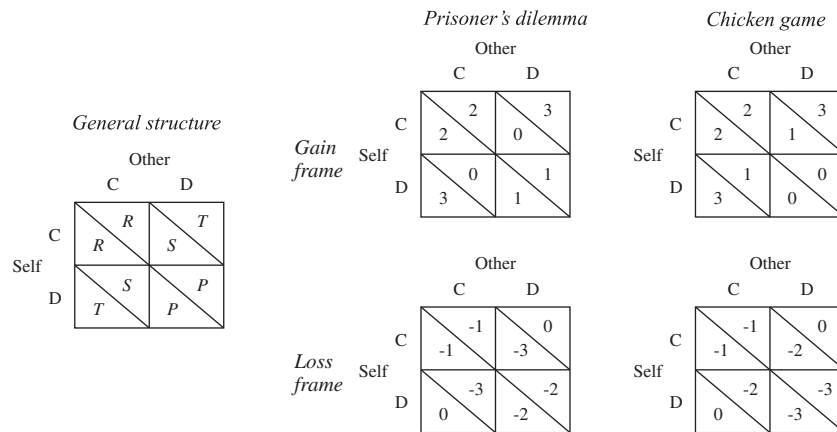


Fig. 1. Gain-framed and loss-framed payoff structures for the prisoner's dilemma and the chicken game.

The *chicken game*, also known as hawk-and-dove (Maynard Smith & Price, 1973), resembles the prisoner's dilemma in many respects. Again players have to choose between cooperation and defection. The payoff structure of the chicken game,  $T > R > S > P$ , is like the prisoner's dilemma in the sense that the best and second-best payoff are  $T$  (for one-sided defection) and  $R$  (for mutual cooperation) respectively. The difference is in the ranking of  $P$  and  $S$ . In chicken games the mutual defection payoff ( $P$ ) is worse than the payoff for one-sided cooperation ( $S$ ), so if the other defects, cooperation pays better than defection. Many social situations have the payoff structure of a chicken game. For example, if both parties in marital conflict choose escalation to full conflict in order to get their way (mutual defection), this may be very harmful to both, so trying to reach a compromise (mutual cooperation) is usually preferable over mutual defection. However, one-sided defection can be a very effective power tactic, at least in the short run, if the partner prefers giving in to full conflict. Nations using the threat of nuclear war, management and unions heading for a strike, children doing dangerous things in order to show their toughness, chicken games can be seen everywhere. Although it is our impression (admittedly hard to prove) that the chicken game is more ubiquitous in social life than the prisoner's dilemma, it has received much less attention in psychology and other social sciences. Searching for "prisoner's dilemma" or "chicken game" (or "chicken dilemma", or "game of chicken") in the Psycinfo database on February 19, 2010, led to 1133 hits for the prisoner's dilemma, against 49 for the chicken game.

The relatively small difference between the chicken game and the prisoner's dilemma ( $S > P$  versus  $P > S$ ) leads to strongly divergent strategic possibilities. The payoff structure of the prisoner's dilemma, at least in the one-shot version, works strongly in favor of mutual defection. If both you and your opponent always get more after choosing  $D$  than after  $C$ , both fear (for the worst outcome  $S$ ) and greed (for the best outcome  $T$ ) lead to defection. In the language of game theory, defection is the dominant choice in the (one-shot) prisoner's dilemma, because self-interested players will always choose defection. In the chicken game, conditions are more favorable for cooperation. Greed may still lead to defection, but fear no longer does, because in chicken the safe choice (which avoids the worst possible outcome) is cooperation. In agreement with this analysis, higher cooperation rates have been reported for the chicken game than for the prisoner's dilemma, both in two-person (Rapoport & Chammah, 1969) and in  $N$ -person (Liebrand, Wilke, Vogel, & Wolters, 1986; Wit & Wilke, 1992) situations.

#### Valence effects

So how will the valence of outcomes affect decisions in prisoner's dilemmas and chicken games? According to *prospect theory*

(Kahneman & Tversky, 1979, 1984), people are risk-seeking in the negative domain and risk-averse in the positive domain. To predict the effects of valence on cooperation one therefore first of all needs to identify risk-seeking and risk averse behavior.

In this respect, we will briefly discuss previous social dilemma research, in which prospect theory was primarily invoked to understand differences between public good and resource dilemmas. In *resource dilemmas* (or take-some dilemmas), people can increase their outcomes by harvesting from a common pool, whereas in *public good dilemmas* (or give-some dilemmas) they decide how many from their own resources they contribute to a common pool (e.g., van Dijk & Wilke, 1995). Both games share a similar conflict between personal and collective interest. If too much is taken from, or not enough is given to the common pool, all will be worse off than when they had shown more restraint or generosity. The games are different, however, in presentation of the outcome structure. The resource dilemma is characterized by a positive frame, the public good dilemma by a negative frame.

So what is the risky option in these dilemmas? Brewer and Kramer (1986) reasoned that in both types of social dilemmas defection (i.e., taking much or giving little) is the more risky choice, because it makes the worst possible collective outcome more likely. Subsequent theorizing, however, questioned this conclusion, by reasoning that one could also conclude that cooperation is more risky. For example, in a public good dilemma, contributing could be seen as risky because one's contributions will be wasted if the public good is not provided. Based on these considerations, some researchers concluded that it is very difficult or even impossible to generate predictions from prospect theory (e.g. van Dijk & Wilke, 1995). In line with this reservation, empirical research has shown very inconsistent findings. Whereas some studies (e.g. Brewer & Kramer, 1986; McCusker & Carnevale, 1995) found that participants were less cooperative in public good dilemmas than in resource dilemmas, other studies found no difference (e.g. Rutte, Wilke, & Messick, 1987) or even a difference in the opposite direction (e.g. Komorita & Carnevale, 1992, Experiment 3). In a large meta-analysis on framing effects, Kühberger (1998) concluded that game theory designs, as he called the kind of studies described above, do not produce a framing effect at all.

Despite these objections, we will argue that it is possible to apply prospect theory if we are more specific about what constitutes risky behavior in social dilemmas. In contrast to previous research on differences between public good and resource dilemmas, we do not define risk in terms of the chances of creating the worst possible collective outcome (cf. Brewer & Kramer, 1986). Instead, we define risk in terms of variance, following other research on valence effects (Kühberger, 1998), in which risky decision making involves a choice between at least two options. The *safe option* has one or

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