Bonn Econ Discussion Papers

Discussion Paper 15/2008

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by

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July 2008

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July 25, 2008

Abstract:
Psychological game theory can help provide a rational choice explanation of framing effects; frames influence beliefs, beliefs influence motivations. We explain this theoretically, and explore the empirical relevance experimentally. In a 2×2 design of one-shot public good games we show that frames affect subject's first- and second-order beliefs, and contributions. From a psychological game-theoretic framework we derive two mutually compatible hypotheses about guilt aversion and reciprocity under which contributions are related to second- and first-order beliefs, respectively. Our results are consistent with either.

Keywords: Framing; psychological games; guilt aversion; reciprocity; public good games; voluntary cooperation

JEL codes: C91, C72, D64, Z13.

Acknowledgments: This paper is part of the MacArthur Foundation Network on Economic Environments and the Evolution of Individual Preferences and Social Norms. Support from the EU-TMR Research Network ENDEAR (FMRX-CT98-0238) and the University of St. Gallen Grundlagenforschungsfonds is gratefully acknowledged. Part of the research was done when Martin Dufwenberg visited Bonn University on a F. W. Bessel Research Award from the Alexander-von-Humboldt Foundation, and parts while he visited University of Gothenburg. We thank Christian Thöni for very helpful research assistance. We are also grateful for comments from Paolo Battigalli, Colin Camerer, Gary Charness, Glenn Harrison, Eva Poen, Lisa Rutström, Arthur Schram, Martin Sefton, Jean-Robert Tyran, Manuela Vieth, and many seminar participants.

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1. INTRODUCTION

Experiments in psychology and economics have shown that the framing of decisions may matter to preferences and choice (cf. Pruitt 1967; Selten & Berg 1970). This may reflect a failure by decision makers to exhibit "elementary requirements of consistency and coherence", as found by Tversky & Kahneman (1981) in a classic paper. Our main objective is to theoretically articulate, and experimentally illustrate, a further reason why framing may matter. We shall make no reference to irrationality, and the sort of framing effect we highlight comes from an interaction of frames and players' motivation. Framing may influence strategic behavior in games by influencing motivation that depends on beliefs, about choices and beliefs, in subtle ways.

Our message partly echoes the insight that focal points may influence coordination, as first noted by Schelling (1960) and investigated experimentally by Mehta, Starmer & Sugden (1994). The idea here is that a description of a strategic situation may possess cues that serve to coordinate choice behavior. This entails that descriptions influence *beliefs about others' choices*, which in turn may have bearing on a person's rational choice. However, we push beyond this observation as follows: We argue that if players are emotional or care for the intentions and desires of others, then framing may influence behavior independently of how beliefs about others' choices change. Frames may influence *beliefs about others' beliefs*, which in itself may influence a person's choice even if his or her belief about others' actions is given. The reason is that if players are emotional or care for the intentions and desires of others, then motivations may depend on beliefs directly.

The upshot is that framing may play a very special role in *psychological games*, as defined by Geanakoplos, Pearce & Stacchetti (1989). These structures differ from standard games in that the domain of a payoff function includes beliefs, not just strategy profiles. A body of recent work (cited in more detail below) in experimental economics and behavioral theory argues that psychological games are needed to capture some important 'social' preferences, like reciprocity or guilt aversion (a desire not to let others down).

In psychological games, motivation depends on beliefs (about choices and about beliefs) directly, so if beliefs are changed motivation may flip too. The key contribution of this paper is to tie this observation in with framing effects: frames may influence beliefs, which, as we just said, spells action in psychological games. Effectively, what we propose is an explanation why frames may matter when decision-makers interact strategically.

We are concerned with how frames affect choices and propose to understand this as a two-part process: (i) frames move beliefs, and (ii) beliefs shape motivation and choice. The hypotheses we will derive based on psychological game theory entail specific statements about (ii). As regards (i) no comprehensive theory exists yet. We will discuss some relevant conjectures based on what has been reported in the economic and psychological literature but leave a thorough theory development for future research.

There seems to be almost no prior theoretical work which attempts to explain framing effects. One shining exception is "variable frame theory" (VFT) (Bacharach 1993, Bacharach & Bernasconi 1997), which describes how players in a game conceptualize strategies and how this mental process affects play. This is different from our perspective; VFT deals with how players create frames while we look at how given frames affect choices and beliefs. As explained in the previous paragraph, we propose to understand framing as a two-step chain. If we were to factor in VFT we would have to add a step (o), to precede even step (i).[1] We have made no attempt to link the approaches here, but future research may have such a goal in mind.

[1] To get a perspective on (o) versus (i) & (ii), consider the following quote from Kahneman (2000, p. xiv) (about him, Tversky and framing): "A significant and perhaps unfortunate early decision concerned the naming of the new concept. For reasons of conceptual and terminological economy we chose to apply the label 'frame' to descriptions of decision problems at two levels: the formulation to which decision makers are exposed is called a frame and so is

In Section 2, we provide a theoretical elucidation regarding the *potential* relevance of our new approach to framing effects. In Section 3, we report the results of an experiment designed to explore the *empirical* relevance of the idea. We choose a simple public good game as our workhorse, and derive and test predictions based on two psychological-game based models. Our findings may be of independent interest to the experimental literature on framing in public goods (and social dilemma) games; in Section 4 we discuss and compare results. Section 5 concludes.

2. FRAMING EFFECTS IN PSYCHOLOGICAL GAMES

The key idea of this paper is that frames may shape players' beliefs in games, which may in turn influence strategic choices. Part of this message is reflected in the literature on focal points, which goes back to Schelling. He noted that in many games certain choices are 'focal', which may facilitate coordination. A classic example involves two persons meeting in New York City: going to Grand Central Station may be a focal choice.

Schelling's NYC example involves focal points created by properties possessed by a particular strategy, but one can easily imagine how focal points are similarly created by the framing of a game. Consider the two following games, which differ only by name:

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the interpretation that they construct for themselves. Thus, framing is a common label for two very different things: an experimental manipulation and a constituent activity of decision making. Our terminological parsimony was helpful in securing the acceptance of the concept of framing, but it also had its costs. The use of a single term blurred the important distinction between what decision makers do and what is done to them: the activities of editing and mental accounting on the one hand and the susceptibility to framing effects on the other."

The let's get 7 game:

	a	***b***
a	(9, 9)	(0, 8)
b	(8, 0)	(7, 7)

The let's get 9 game:

	a	***b***
a	(9, 9)	(0, 8)
b	(8, 0)	(7, 7)

Are these games the same? They have player sets, strategy sets, and payoff functions in common. However, the games' names differ, and different names may trigger different beliefs in the players' minds. They may, for example, coordinate on different equilibria in the two cases: Imagine that each player chooses ***b*** in the first game, while each player chooses ***a*** in the second game. This illustrates how frames could, in principle, shape play.[2]

In the preceding example, frames shape beliefs and beliefs influence behavior, ultimately because of what beliefs tell a player about a co-player's choices. So far so good, but nothing in this is really original. The new thing in this paper is instead to point out that the link from frames to beliefs to actions does not necessarily rely on perceptions of others' behavior. To make this point as clear as possible, consider the following example. The example will exhibit how a frame may influence a player's beliefs which influence the player's behavior, and yet it is from the outset inconceivable that any other player's behavior could change.

The example is a dictator game.[3] The first player, the *dictator*, chooses how to divide a sum of money, say $1000, between the two players. The second player, the *recipient*, has no real choice – she has to simply *accept* the dictator's decision. Now assume that the dictator does not

[2] The let's get 7 and let's get 9 games are so-called stag-hunt games, amply discussed for the intriguing coordination problem embodied. This matters e.g. to theories of equilibrium selection (e.g. Harsany & Selten 1988; Carlsson & van Damme 1993), examinations of the impact of communication (e.g. Aumann 1990; Charness 2000, Clark, Kay & Sefton 2001), and the impact of learning (e.g. Crawford 1995). We thus add framing to this list of topics.

[3] Forsythe, Horowitz, Savin & Sefton (1994) were among the first to study the dictator game, which has subsequently been used in many experimental studies.

like to let others down; he suffers from guilt (an emotional response) if he gives others less than he believes they expect. We will say that the dictator is *guilt averse*.[4]

Now imagine that one ran an experiment on this game, with the twist of calling it by different names in different treatments. Say that the game was referred to as either

- *The let's split a grand game*, or
- *The German tipping game*.

Imagine that most subjects make the equal split in the first case, that most subjects give away just small change in the second case, and that all of this happens because the dictator subjects hold vastly different beliefs about what recipients expect to get in the two cases. Under the first frame, dictators choose the equal split because that is what they expect recipients to expect them to do, and dictators would feel exceedingly guilty unless they lived up to these expectations. Under the second frame, they give away peanuts because this is all they expect the recipient to expect. This illustrates how a frame could, in principle, influence a dictator's beliefs, which influence his motivation, which influences his behavior, despite there being no strategic uncertainty whatsoever about what other players do.

We have two more comments about this example. First, it makes reference to a non-standard form of motivation which is non-standard, in the sense that it cannot be modeled using traditional game theory. To see this, note that in traditional (normal form) games player *i* has a utility of the form

$$u_i: A \to \mathbb{R}, \qquad (1)$$

[4] Charness & Dufwenberg (2006) introduced the term guilt aversion and Battigalli & Dufwenberg (2007) develop a general theory. Dufwenberg & Gneezy (2000) report experimental dictator game evidence in line with guilt aversion, although they do not consider framing effects.

where A is the set of strategy profiles of the game. Applied to the dictator game, $A = A_{dictator} \times A_{recipient} = [\$0, \$1000] \times \{accept\}$, where $A_{dictator}$ and $A_{recipient}$ are the players' respective strategy sets (the elements of the former specifying how much the dictator gives away). Such a formulation, whether used to model selfishness or some kind of other-regarding motivation (like altruism, or inequity aversion) predicts a uniquely defined set of best responses for *i*.[5] By contrast, in the example, the guilt averse dictator's set of best responses depends on his beliefs about the recipient's beliefs. Hence (1) cannot describe those preferences; hence traditional game theory is not a rich enough toolbox to handle this case.

To model belief-dependent preferences, such as the dictator's guilt aversion in the example, one must move to utilities of the following form:

$$u_i: A \times M_i \to \mathbb{R}, \qquad (2)$$

where M_i is *i*'s beliefs (about choices and beliefs), somehow described. Thus we need to move from standard games to so-called psychological games, as introduced by Geanakoplos *et al*.[6]

Our second comment relates to (2) and the extent to which that utility specification is actually more general than is borne out by the example involving the guilt averse dictator. That example showed how a frame may influence a player's beliefs, which influence his motivation, which influences his behavior, despite there being no strategic uncertainty whatsoever about what other players do. The formulation (2), however, is by no means limited to that case; (2) allows that, as frames change, so do beliefs of any order, including beliefs about others' strategies. What comes out of this may be framing effects that have a hybrid quality to them: frames may

[5] Examples: If the dictator is selfish, then his set of best responses is {\$0}; if his objective is to minimize the difference between his payoff and the recipient's, then his set of best responses is {\$500}; if his objective is to maximize the maximum payoff to one of the players, then his set of best responses is {\$0, \$1000}.

[6] Cf. also Battigalli & Dufwenberg (2008) who generalize Geanakoplos *et al*'s framework in several directions (including allowing updated beliefs to influence utility and having incomplete information; such extensions are important in many applications, but do not concern us here, however).

influence a player's beliefs, which influence his motivation directly *as well as* his perception of others' choices, and all of this influences his behavior. In other words, beliefs about anything in the domain of the utility in (2) may move behavior, and the domain includes *both* others' choices and others' beliefs. All those, potentially complex, links from frames to beliefs to actions are what we have in mind when we talk about our new approach to framing effects.

3. FRAMING & FREE-RIDING: AN EXPERIMENT

In this section we report the results of an experiment, designed to examine the empirical relevance of the ideas introduced in Section 2. The subsections that follow will in turn:

A. introduce, and motivate the choice of, our vehicle of research: a public good game,
B. discuss framing issues,
C. incorporate guilt aversion and reciprocity using psychological game theory,
D. derive testable predictions for the thus derived psychological public good games,
E. present the experimental design and procedures,
F. report the results.

3.A *The public good game*

As a vehicle of investigation we wish to select a game for which framing effects have already been documented, so that we can relate to and help further understand previous work. A linear public good game is our choice. Numerous experiments have shown the existence of framing effects (cf. Section 3.B), and since public good games represent many economically important situations that require the agents' voluntary cooperation it is important to understand how frames affect voluntary cooperation.

Linear public good games have the advantage of being simple, which makes a psychological game-theoretic analysis tractable (cf. Sections 3.C-D). The simplicity is due to the fact that selfish players have a dominant strategy to free ride, *i.e.*, subjects' optimal behavior is independent of others' behavior. Yet, numerous experiments have shown that many people do not play accordingly (Ledyard 1995). In particular, although previous work has not made connection to psychological games, there is evidence that subjects' choices may depend on their beliefs.[7] Thus, since our argument is that frames may influence beliefs and beliefs may affect motivations and thereby behavior, public good experiments are well-suited for our purposes.

We consider a public good game with the following structure: Each of three players simultaneously chooses how to allocate twenty monetary units between a 'private' and a 'public' account. The sum of what the players contribute to the public account is multiplied by 1.5, to determine its total value. A player's earnings is the sum of whatever he or she puts in the private account, plus one third of the total value of the public account.

The situation can be represented as a normal form game $G=(A_i, \pi_i)_{i\in N}$ such that $N=\{1,2,3\}$ is the player set, $A_i = \{0,1,\ldots,20\}$ is the strategy set of player i, and $\pi_i\colon \times_{j\in N} A_j \rightarrow \mathbb{R}$ is i's monetary payoff function defined by

$$\begin{aligned} \pi_i(a_1, a_2, a_3) &= 20 - a_i + (1/3)\cdot(3/2)\cdot(a_1 + a_2 + a_3) = \\ &= 20 - a_i + \tfrac{1}{2}\cdot(a_1 + a_2 + a_3). \qquad (3) \end{aligned}$$

All experimental treatments are set up to implement that structure. The treatments differ only in the frames used (cf. Sections 3.B & 3.E).

[7] For instance, Croson (2007) and Fischbacher & Gächter (2006) have shown that a subject's contribution is often highly positively correlated with the subject's beliefs about others' contributions. This result is anticipatory of one of our hypotheses (H_2) below.

3.B *Framing*

In selecting the frames to be examined, we take inspiration from some previous work on framing in the context of social dilemma-type games. A common distinction concerns whether a frame changes a reference point or whether it just consists of different wordings. We refer to these as *valence framing* and *label framing*.

Valence framing concerns whether the same essential information is put in a positive or a negative light (Levin, Schneider & Gaeth 1998). Several studies have looked at valence framings in public good provision. In the standard public good experiment subjects are endowed with some money, which they can keep for themselves or contribute to public good. Call this situation a *give treatment*. Thus, any contribution to the public good is a positive externality for all other players by definition of a public good. Another framing is to endow the group with the resources and to allow the group members to withdraw resources; call this a *take treatment*. A common result is that in the give treatment contributions to a repeatedly played public good are higher than in the take treatment (cf. Fleishman 1988; Andreoni 1995; Sonnemans, Schram & Offerman 1998; Willinger & Ziegelmeyer 1999; Cookson 2000; Park 2000).[8]

Label framing is involved if subjects are confronted with alternative, but objectively equivalent problem wordings (see, e.g., Elliott, Hayward & Canon 1998 who call this a "pure framing effect"). Ross & Ward (1996) and Liberman, Samuels & Ross (2004) report one of the best-known labeling effects. In their experiments a simple prisoners' dilemma game was either called the "Community Game", or the "Wall Street Game". Otherwise, the game and the

[8] Results are not altogether uniform though; see also the one-shot public good games in Brandts & Schwieren (2007), Cubitt, Drouvelis & Gächter (2008) and Walkowitz & Goerg (2007/Isreali treatment) who basically do not find a framing effect.

instructions were identical. Cooperation rates were significantly lower under the "Wall Street" frame than under the "Community Game" frame.[9]

Previous studies have either looked at valence framing or at label framing, but we study both simultaneously. As we explain further in Section 3.E, we develop a 2×2 design that varies both the label (community versus neutral treatments) and the valence (give versus take treatments). Thus, our factorial design allows us to assess the relative importance of these different versions of framing effects.

Our main contribution, however, is to move beyond the existing literature on framing by eliciting first- and second-order beliefs. This will help us testing hypotheses based on psychological game theory which can embrace framing effects. We discuss this latter topic next.

3.C *Guilt aversion and reciprocity*

Most of economic theory depicts decision makers as 'selfish', in the sense that they care only about their own monetary payoffs. In the context of the public good game we consider, this would correspond to assuming that (3) (or a similar formulation modified to control for risk-aversion) can describe players' preferences. By contrast, a rich body of experimental evidence suggests that decision makers often have more complex objectives, and in particular that they somehow care about what others get or do or hope to achieve. Some theoretical models have been proposed, with the objective to model such social preferences, and some such models build on

[9] Rege & Telle (2004) similarly played a one-shot public goods experiment and found higher contributions under a "community" frame than under a neutral frame. Further studies on label frame effects comprise Pillutla & Chen (1999), Burnham, McCabe, & Smith (2000), Abbink & Hennig-Schmidt (2006). See Gächter, Orzen, Renner & Starmer (2007) for a natural field experiment on label framing.

psychological game theory.[10] We focus on two of these – guilt aversion and reciprocity – and use them to derive testable implications that we subsequently address in the experiment.

Guilt aversion is dislike of the guilt felt if one chooses so as to give others less than one expects them to expect. Battigalli & Dufwenberg (2007) develop a general theory; we draw on their notion of "simple guilt:"[11] Let b_{ij} denote i's 'first-order belief' about j's choice (i,j=1,2,3; $i \neq j$); b_{ij} is the mean of a probability distribution i has over A_j. Let c_{iji} denote i's 'second-order belief' about b_{ji}; c_{iji} is the mean of a probability measure i has over the possible values of b_{ji}. One way to model guilt aversion is to assume that i suffers from guilt to the extent that he puts less in the public account than the average of what he believes his two co-players believe he puts in the public account. Formally, his utility function u_i^* can be defined by

$$u_i^*(a_1, a_2, a_3, c_{iji}, c_{iki}) = 20 - a_i + ½ \cdot (a_1 + a_2 + a_3) - \gamma_i \cdot \max\{0, (c_{iji} + c_{iki})/2 - a_i\} \qquad (4)$$

where i, j, k = 1, 2, 3; $i \neq j \neq k \neq i$, and where $\gamma_i \geq 0$ is a parameter measuring i's degree of guilt aversion. If $\gamma_i = 0$, (4) has the same RHS as (3) and $a_i = 0$ is a dominant strategy. If $0 < \gamma_i < ½$, the RHS of (4) changes, but $a_i = 0$ is still a dominant strategy. However, if $\gamma_i > ½$ very different possibilities come alive, as i's best response will be $a_i = (c_{iji} + c_{iki})/2$. In this case i's best response is belief dependent.

With reference to (1) and (2) in Section 2, note that (4) has the form $u_i: A \times M_i \rightarrow \mathbb{R}$ rather than $u_i: A \rightarrow \mathbb{R}$, since (4) includes beliefs in its domain. $G^* = (A_i, u_i^*)_{i \in N}$ is a psychological game.

[10] For discussions of the experimental evidence as well as of many models, see Fehr & Gächter (2000), Camerer (2003, Ch. 2), and Sobel (2005). Battigalli & Dufwenberg (2005) survey models that use psychological game theory.

[11] Huang & Wu (1994), Dufwenberg & Gneezy (2000), Dufwenberg (2002), Charness & Dufwenberg (2006), and Bacharach, Guerra & Zizzo (2007) consider similar sentiments in trust games. In motivating their concept, Battigalli & Dufwenberg cite work in social psychology by Baumeister, Stillwell & Heatherton (1994) and Tangney (1995).

Reciprocity is a desire to get even, to respond to perceived wrongdoings with revenge and to reward perceived kindness. Rabin (1993) developed a theory of reciprocity, which made the meaning of words like "kindness" precise. Rabin argues that kindness depends on what a player believes about others' choices, as this can capture a player's 'intentions'. Moreover, reciprocal motivation depends in general on beliefs about kindness, and hence on beliefs about beliefs since kindness depends on beliefs. Psychological game theory is again called for.

Rabin's objective is to call attention to two central qualitative aspects of reciprocity, and he restricts attention to two-player normal form games. Dufwenberg & Kirchsteiger (2004) and Falk & Fischbacher (2006) provide extensions that allow for more players (and which also consider extensive games). The following draws on the former model.

Applied to our game, the utility of player i is given by u_i** defined by

$$u_i^{**}(a_1, a_2, a_3, b_{ij}, b_{ik}) = 20 - a_i + \tfrac{1}{2}\cdot(a_1 + a_2 + a_3) + Y_i\cdot(\kappa_{ij}\cdot\lambda_{iji} + \kappa_{ik}\cdot\lambda_{iki}) \quad (5)$$

where again i, j, k = 1, 2, 3; $i \neq j \neq k \neq i$, and where the last term is in special need of further explanation. All but the last terms in (5) capture how the agent cares for own income (cf. (3) and (4)). The last term captures how he is motivated by reciprocity: $Y_i \geq 0$ is a constant measuring i's sensitivity to reciprocity; κ_{ij}, κ_{ik}, λ_{iji}, and λ_{iki} depend on i's choice or beliefs: κ_{ij} represents i's kindness to j – it is positive (negative) if i is kind (unkind); λ_{iji} represents i's belief about how kind j is to i – it is positive (negative) if i believes that j is kind (unkind). κ_{ik} and λ_{iki} have analogous interpretations. Equation (5) captures reciprocity by making it in i's interest to match the signs of κ_{ij} and λ_{iji}, and of κ_{ik} and λ_{iki}, *ceteris paribus.*

We need to calculate κ_{ij}, λ_{iji}, κ_{ik}, and λ_{iki}. This turns out to be (more) straightforward (than analogous calculations in many other games). Although in general games kindness depends on beliefs this is not the case in the public good game because there is a one-to-one link between a player's choice and his kindness. This is because, independently of the co-players' choices, there is a one-to-one link between a player's choice and his impact on the other players' monetary payoffs. Player *i*'s kindness to *j* [or *k*] is the difference between what *i* actually gives to *j* [or *k*] and the average of the maximum (=20) and minimum (=0) that *i* could give to *j* [or *k*]. We get $\kappa_{ij} = \kappa_{ik} = a_i - 10$. To get λ_{iji}, note first that this is *i*'s belief about $\kappa_{ji} = a_j - 10$, so just replace a_j by b_{ij} in the RHS of that expression; instead of $\kappa_{ij} = a_i - 10$ we get $\lambda_{iji} = b_{ij} - 10$. Similarly, we get $\lambda_{iki} = b_{ik} - 10$. All in all, we can re-write the RHS of (5) to get (5'):

$$\begin{aligned} &20 - a_i + \tfrac{1}{2}\cdot(a_1 + a_2 + a_3) + Y_i\cdot[(a_i - 10)\cdot(b_{ij} - 10) + (a_i - 10)(b_{ik} - 10)] = \\ &= 20 - a_i + \tfrac{1}{2}\cdot(a_1 + a_2 + a_3) + Y_i\cdot[(a_i - 10)\cdot(b_{ij} + b_{ik} - 20)]. \end{aligned} \tag{5'}$$

If $b_{ij}+b_{ik}-20 \leq 0$ (5') is maximized by $a_i=0$ regardless of Y_i. The interpretation is that *i* does not consider *j* and *k* to be, on average, kind, so there is no reason for *i* to sacrifice payoff to help *j* and *k*. If $b_{ij}+b_{ik}-20 > 0$, then (5') is maximized by $a_i = 20$ if Y_i is large enough and by $a_i = 0$ if Y_i is small enough. (Besides these cases there are additional combinations of b_{ij}, b_{ik}, and Y_i that make *i* indifferent between all his strategies.) The formulation joins the above one on guilt aversion in that what is a best response depends on *i*'s beliefs, although different beliefs matter this time.

With reference to (1) and (2) in Section 2, note that (5) (based on (5')) has the form u_i: $A \times M_i \to \mathbb{R}$ rather than u_i: $A \to \mathbb{R}$, since the utility function defined in (5) (based on (5')) includes beliefs in its domain. Hence $G^{**}=(A_i, u_i^{**})_{i \in N}$ is a psychological game.

3.D *Hypotheses*

Our experiment is set up to test the two theories presented in Section 3.C, as well as to check if/how framing matters. Since the utility functions (4) and (5) (based on (5')) include beliefs in their domains, the theories can be directly tested if one observes beliefs. Our design allows us to elicit some beliefs that are relevant to this task.[12] We describe the procedure for belief elicitation in detail in Section 3.E.

We formulate our hypotheses with reference to the choices and beliefs of individual players, rather than in terms of some equilibrium that would give predictions for all players jointly. If we focused on equilibria, we would run the risk of incorrectly rejecting a valid insight about motivation only because people did not coordinate well. Our approach is consistent with the theory in Section 3.C, where we merely discussed properties of an individual player's best responses rather than equilibrium.[13]

Hypothesis H_1 concerns guilt aversion. Recall that if $\gamma_i < ½$ then i's best response is $a_i = 0$ even if $(c_{iji} + c_{iki})/2 > 0$; if $\gamma_i > ½$ then i's best response is to match his or her second-order beliefs: $a_i = (c_{iji} + c_{iki})/2$.[14] Our design allows us to measure and observe the second-order beliefs $(c_{iji} + c_{iki})/2$, but γ_i is not observed. We rely on our choice and belief data to get a testable prediction. The theory, as described, implies that $a_i \in \{0, (c_{iji} + c_{iki})/2\}$ with $a_i = (c_{iji} + c_{iki})/2$ whenever $a_i > 0$.

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[12] Dufwenberg & Gneezy (2000), Bhatt & Camerer (2005), Charness & Dufwenberg (2006), Bacharach, Guerra & Zizzo (2007), Ellingsen, Johannesson, Tjøtta & Torsvik (2008) and Vanberg (2008) also measure beliefs in experiments with the purpose of connecting to psychological game theory (in the Bhatt & Camerer case the purpose is mainly broader). It is furthermore interesting to note that Ross & Ward (1996, p 108), who conducted the framing study we discussed in section 3.B, made some remarks which may be taken to indicate their interest in our approach. They call for further research on how a label influences the way subjects feel they ought to play and how a label changes their expectations about how the other player would choose to play. The authors conjecture that a frame may even alter subjects' beliefs about how the other player would expect them to play.

[13] Moreover, since the experiment involves a *one-shot* game, with no chance for learning, it would seem extreme to assume that people would be able to make correct prediction about one another.

[14] If $\gamma=½$ then anything is a best response for i but we ignore this possibility.

We test a somewhat weaker prediction (involving positive correlation rather than equality between a_i and $(c_{iji}+c_{iki})/2$). If the prediction holds true this would support the idea that the guilt aversion theory is approximately (rather than exactly) correct. We separate subjects with $a_i = 0$ & $(c_{iji}+c_{iki})/2 > 0$, for whom we 'know' that $\gamma_i < ½$, and the others:

H_1: $a_i = 0$ & $(c_{iji}+c_{iki})/2 > 0$ ***or*** there is a positive correlation between a_i and $(c_{iji}+c_{iki})/2$.

H_1 predicts that for subjects that contribute non-zero amounts contributions and second-order beliefs are positively correlated. To determine if we can support H_1, we perform a one-sided test of the null hypothesis of zero correlation between a_i and $(c_{iji}+c_{iki})/2$ considering only those *i* for which it is *not* the case that $a_i = 0$ & $(c_{iji}+c_{iki})/2 > 0$.

Hypothesis H_2 concerns reciprocity. Our design allows us to measure and observe the first-order beliefs b_{ij} and b_{ik}. However, as was the case with γ_i for the case of guilt aversion, Y_i is unobservable so again we have to make a few assumptions to derive a testable prediction. Recall from Section 3.C that with reciprocal motivation the predicted choices are either 0 [implied when $(b_{ij} + b_{ik})/2 \leq 10$] or 20 [which would imply $(b_{ij} + b_{ik})/2 > 10$].[15] Again we test a somewhat weaker prediction (involving positive correlation rather than the bang-bang 0-20 split of a_i depending on $(b_{ij} + b_{ik})/2$). If the prediction holds true this would support the idea that the reciprocity theory is approximately (rather than exactly) correct. H_2 invokes one more proviso. Consider subjects who exhibit $a_i = 0$ and $(b_{ij} + b_{ik})/2 = 20$. We 'know' that Y_i is so low that they

[15] We here ignore the possibility that (for certain combinations of Y_i, b_{ij}, and b_{ik}) *i* may be indifferent between all his choices. This time the assumption may not be quite as innocuous as the analogous assumption in the case of guilt aversion (cf. footnote 14) since the indifferences would not solely depend on the exogenous parameter Y_i (in analogy to the γ=½ case) but also on the first-order beliefs b_{ij}, b_{ik} which would be endogenously determined if we applied some equilibrium concept. However, as explained in the text, we do not apply any equilibrium concept.

would never reciprocate kindness with kindness. The following hypothesis treats these subjects separately (cf. the "$a_i = 0$ & $(c_{iji}+c_{iki})/2 > 0$" part of H_1):

H_2: $a_i = 0$ & $(b_{ij}+b_{ik})/2 = 20$ ***or*** there is a positive correlation between a_i and $(b_{ij}+b_{ik})/2$.

To examine H_2, we perform a one-sided test of the null of zero correlation between a_i and $(b_{ij}+b_{ik})/2$ considering only those i for which it is *not* true that $a_i = 0$ & $(b_{ij}+b_{ik})/2 = 20$.

Note that hypotheses H_1 and H_2 differ with respect to the beliefs involved. Guilt-aversion operates via second-order beliefs whereas reciprocity works on first-order beliefs. Note also that our experiment is not set up to test guilt aversion against reciprocity; in our game the two theories do not necessarily imply mutually inconsistent testable predictions.

H_1 and H_2 represent directional research hypotheses derived from specific theories, and so will be submitted to one-sided tests. In addition to H_1 and H_2 we will examine framing effects, *i.e.* whether choices and first- and second-order beliefs differ by treatment. Here we have no preconceived theory to guide us, and hence we perform two-sided tests. Of course, it would not be unreasonable to expect certain patterns of framing effects based on previous experimental work (recall the discussion in Section 3.B) and scholarly discussions. We will discuss how our results compare to these earlier findings, in Section 4.

3.E *Experimental design*

The standard linear public good game (Ledyard 1995) as introduced in Section 3.A is our workhorse. The subjects are randomly assigned to groups of three people and each subject is endowed with 20 'Taler' (the experimental currency).

We employ a 2×2 factorial design, which consists of two label and two valence frames. The label frame involves a minimal change in wording, naming the game in two different ways. In the NEUTRAL labeling, whenever the instructions or the decision screens refer to the experiment we speak of "the experiment". In the COMMUNITY labeling, whenever we refer to the experiment we name it "the community experiment".[16]

The valence frame entails describing the game as a "give-some" or a "take-some" game. The GIVE frame corresponds to the standard public good setting given in equation (3). The instructions explain carefully that (i) the Talers the subject keeps for herself generate an "income from Taler kept"; (ii) the Talers the subject contributes to a project of her group create an "income from the project"; (iii) the subject's total income is the sum of both kinds of income.

In the TAKE frame, subjects can take Talers from a "project", the public good. The parameters were chosen to make the monetary payoff function in the TAKE frame equivalent to the GIVE situation. Therefore, the project consists of 60 Talers. Each subject i can take $t_i \in \{0,1,...,20\}$ Talers from the project and the payoff function under the TAKE frame is given by

$$\pi_i(t_1, t_2, t_3) \quad = t_i + ½\cdot(60 - (t_1 + t_2 + t_3)) \qquad (6)$$

Note that (6) describes the same monetary payoff function as (3), since $t_i = 20 - a_i$.

Table 1 summarizes our 2×2 design.

[16] The name of the game was changed at four place in the instructions, once on the decision screen for contributing to (taking from) the project, twice on each of the decision screens for first and second order belief elicitation.

Table 1: *Our* 2×2-*design – experimental treatments*

Treatment name	Valence frame	Label Frame	Independent observations
GIVE-NEUTRAL	GIVE	NEUTRAL	66
GIVE-COMMUNITY	GIVE	COMMUNITY	51
TAKE-NEUTRAL	TAKE	NEUTRAL	72
TAKE-COMMUNITY	TAKE	COMMUNITY	66

We ran the experiments in the Bonn Laboratory of Experimental Economics. All sessions were computerized, using the software z-Tree (Fischbacher 2007). In total, 255 people participated, almost all undergraduate students from Bonn University majoring in law, economics and other disciplines. We conducted 15 sessions (four in each of GIVE-NEUTRAL, TAKE-NEUTRAL and GIVE-COMMUNITY and three in TAKE-COMMUNITY) with 18 or 15 participants, respectively.

The above public good problem was explained to the subjects in the instructions (see Appendix A). We took great care to ensure that subjects understood the game and the incentives. After subjects had read the instructions, for which they had plenty of time, they had to answer ten control questions that tested their understanding of the decision situation in the different treatment conditions. We did not proceed until all subjects had answered all questions correctly.

After subjects had answered the control questions, they had to make their contribution or take decision. We then asked them to guess, on the one hand, the sum of their co-players' contributions, and, on the other hand, the sum of their co-players' guesses. For each of these guesses subjects were paid €20 each if their guesses were exactly correct, and nothing otherwise. These guesses form the basis of our measurement of $(b_{ij} + b_{ik})/2$ and $(c_{iji} + c_{iki})/2$.[17] When subjects

[17] The incentives provided do not exactly provide incentives for means-revelation, as would seem relevant to the theory in section 3.C. A quadratic-scoring rule would theoretically provide such incentives but is also more difficult for subjects to comprehend. We chose our belief-elicitation protocol because it is simple and easy to explain. Our idea is to get a rough-but-meaningful estimate of the participants' first- and second-order beliefs. We refer to

made their contribution or take decisions they did not know about the subsequent estimation tasks. We decided on this timing of events because we did not want subjects' choices of contributions to be influenced by what choice they thought might facilitate correct subsequent guesswork. Subjects played the game only *once* without being informed about their income before the end of the experiment. Thus, all decisions are strictly independent.

We recruited subjects by campus advertisements that promised a monetary reward for participation in a decision-making task. In each session, subjects were randomly allocated to the cubicles, where they took their decisions in complete anonymity from the other participants. All participants were informed fully on all features of the design and the procedures. Sessions lasted about 1 hour. On average subjects earned €15.20 (roughly $15 at the time of the experiment).

3.F *Results*

Our analysis in this section will consist of two parts. First, we investigate how our frames affect beliefs and contributions. We then turn to our main focus: the test of guilt aversion and reciprocity (H_1 and H_2) as explanations for the observed contribution behavior. To make the data analysis between our TAKE and GIVE treatments comparable we express everything in the size of the public good (*i.e.*, what people contribute to the public good in the GIVE treatments, or what subjects leave in the public good in the TAKE treatments).

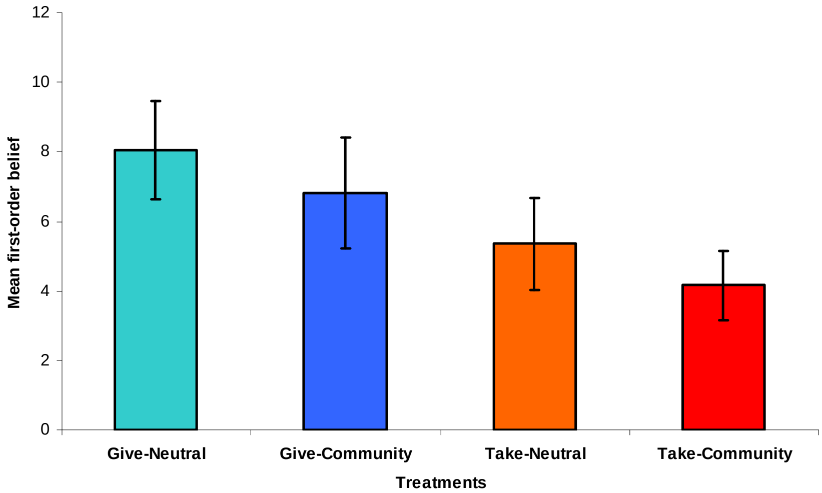
Result 1 concerns how our frames have affected beliefs.

Result 1: *The frames strongly affected first- and second-order beliefs.*

Andersen, Fountain, Harrison & Rutström (2007) for a penetrating discussion about the pros and cons of various belief elicitation methods.

Support: Figures 1 and 2 provide the main support for Result 1. Figure 1 shows the mean first-order beliefs (*i.e.*, $(b_{ij}+ b_{ik})/2$) and the confidence bounds.

Figure 1: *Mean first-order beliefs (and confidence intervals) for each treatment*

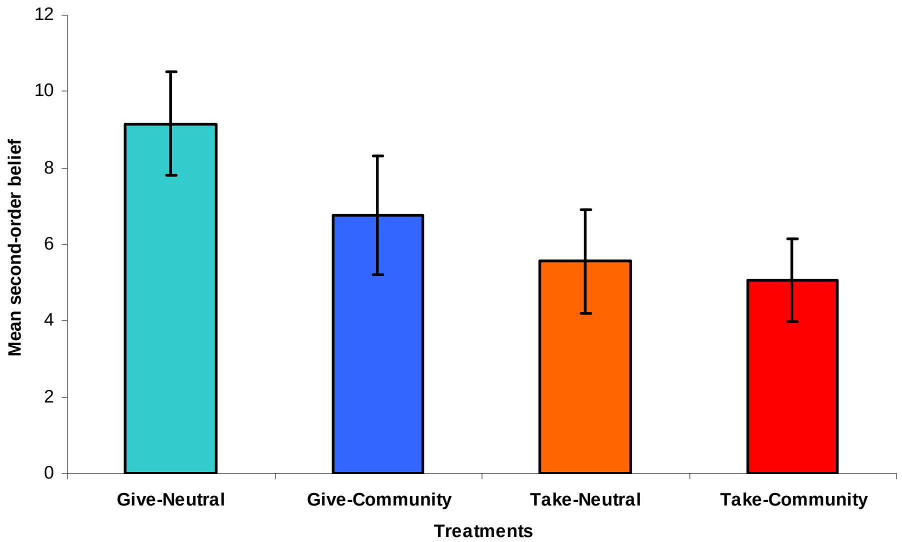


We find that first-order beliefs vary between 8 tokens in GIVE-NEUTRAL and 4.2 tokens in TAKE-COMMUNITY.[18] A non-parametric Kruskal-Wallis test strongly rejects the null hypothesis that the first-order beliefs from our four treatments stem from the same distribution ($\chi^2(3)$ = 18.28, p=0.0004). A parametric analysis of variance (ANOVA) comes to the same conclusion (F=6.63; p=0.0003). The analysis of variance with respect to the factors "valence" and "label" shows that the factor "valence" is highly significant (F=15.81; p=0.0001); "label" is marginally significant (F=3.26; p=0.0722). The interaction variable "label×valence" is insignificant (F=0.00, p=0.9783). We conclude that both the context and in particular the valence framing affect the first-order beliefs. Most importantly, subjects in the TAKE treatments hold lower beliefs that others contribute than subjects in the GIVE treatments.

[18] The medians (standard deviations) of first-order beliefs are as follows. GIVE-NEUTRAL: 7.5 (5.8); GIVE-COMMUNITY: 6.0 (6.8); TAKE-NEUTRAL: 5.0 (4.1); TAKE-COMMUNITY: 3.0 (4.1). See Appendix B for a histogram of first-order beliefs.

Figure 2 depicts the means and confidence bounds of the *second-order beliefs* (*i.e.*, (c_{iji}+ c_{iki})/2).[19] We find that the distributions of second-order beliefs are as well strongly and highly significantly affected by the frames (Kruskal-Wallis test, $\chi^2(3) = 21.97$, p = 0.0001). Again, an ANOVA supports this finding (F=8.11; p=0.0000): the factor "valence" is highly significant (F=16.00; p=0.0001); "label" is significant at the five-percent level (F=4.75; p=0.0303); and the interaction variable "label×valence" is insignificant (F=2.08; p=0.1506). In other words, subjects in the TAKE treatments believe that the other group members expect them to contribute less than subjects in the GIVE treatments. Similarly, subjects believe that others expect them to contribute less in the COMMUNITY treatments than in the NEUTRAL treatments.

Figure 2: *Mean second-order beliefs* (*and confidence intervals*) *for each treatment*



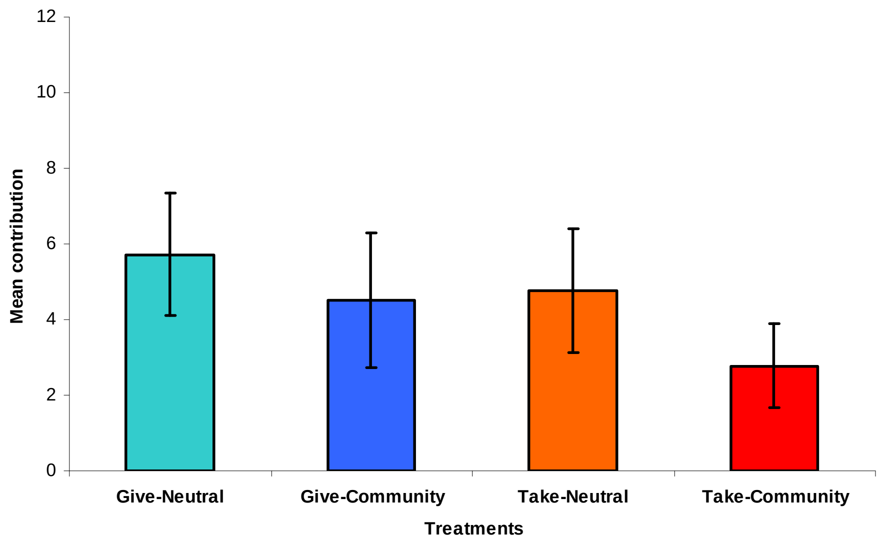
[19] The medians (standard deviations) of second-order beliefs are as follows. GIVE-NEUTRAL: 9.5 (5.5); GIVE-COMMUNITY: 6.25 (5.5); TAKE-NEUTRAL: 5.0 (5.5); TAKE-COMMUNITY: 5.0 (4.4). See Appendix B for a histogram of second-order beliefs.

We now turn to contributions. Before we investigate how beliefs have affected choices, we look at contributions under the different frames. Result 2 records our findings.

Result 2: *The frames affected contributions but less strongly than beliefs.*

Support: Figure 3 provides the support for Result 2. Mean contributions are highest under GIVE-NEUTRAL and lowest under TAKE-COMMUNITY.[20] A Kruskal-Wallis test suggests weakly significant differences between treatments ($\chi^2(3)=6.66$, p=0.0837). An ANOVA shows weakly significant treatment differences (F=2.63; p=0.0508) as well: the factor "label" is significant (F=4.23; p=0.0408); "valence" is marginally significant (F=2.99; p=0.0850); and the interaction variable "label×valence" is insignificant (F=0.26; p=0.6119).[21]

Figure 3: *Mean contributions (and confidence intervals) for each treatment*



[20] The median contributions (standard deviations) are as follows. GIVE-NEUTRAL: 4.5 (6.6); GIVE-COMMUNITY: 0.0 (6.4); TAKE-NEUTRAL: 0.0 (.69); TAKE-COMMUNITY: 0.0 (4.5). See Appendix B for a histogram of contributions.

[21] If we drop this insignificant interaction variable, the model becomes significant (F=3.83; p=0.0231).

It is potentially surprising that the COMMUNITY frame has lowered beliefs and contributions relative to the NEUTRAL frame. We will comment on this finding in Section 4.

We will now turn our attention to the behavioral link between beliefs – which we have shown to be strongly affected by the frames – and behavior. Specifically, we will test our two main hypotheses H_1 and H_2, on guilt aversion and reciprocity, respectively.

Result 3 records the result concerning guilt aversion.

Result 3: *The data support the guilt aversion hypothesis* H_1.

Support: Figure 4 and Table 2 contain the evidence in favor of Result 3. Figure 4 provides a graphical illustration of the guilt aversion hypothesis. In this figure we depict contributions as a function of the second-order beliefs (*i.e.*, $(c_{iji}+ c_{iki})/2$). The symbols represent combinations of contributions and second-order beliefs per treatment. The size of symbols is proportional to the underlying number of observations. Our hypothesis is that for subjects who contribute non-zero amounts contributions and second-order beliefs are positively correlated. We therefore distinguish in Figure 4 between zero contributions for positive second-order beliefs (indicated as filled circles on the *x*-axes) and the other contributions (indicated as triangles). The bold line is the trend line of the relationship between contributions and second-order beliefs (excluding the observations a_i=0&$(c_{iji}+ c_{iki})/2>0$).

Figure 4: *Contributions and second-order beliefs for each treatment*

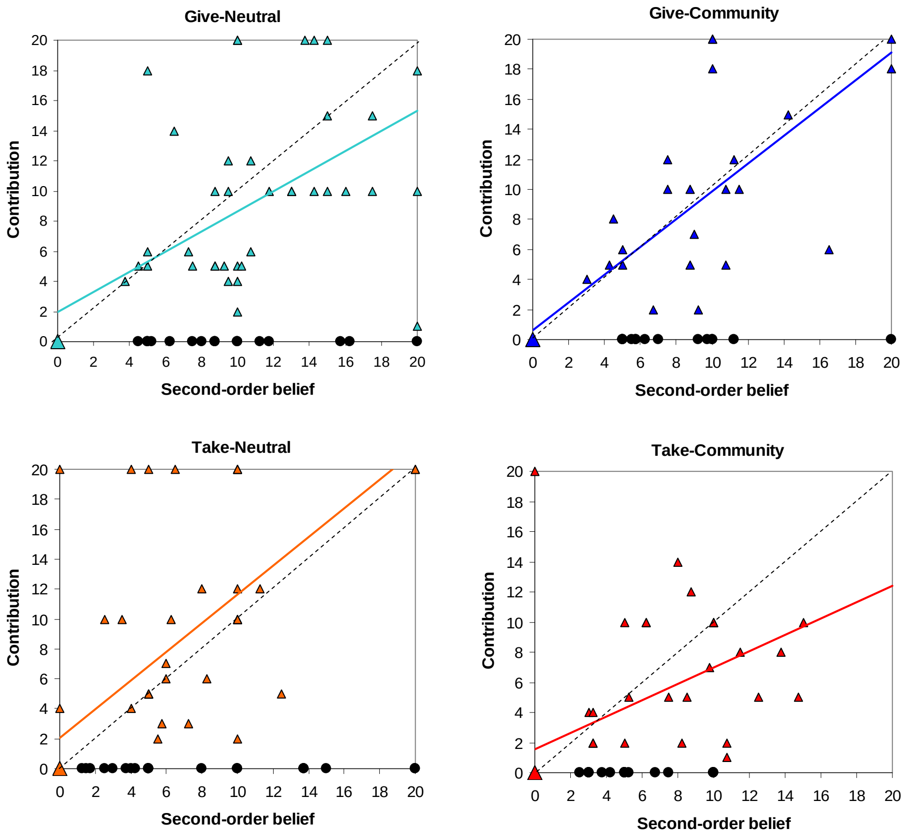


Figure 4 shows, first, that many subjects chose zero contributions even if they reported positive second-order beliefs: The fraction of subjects with positive second-order beliefs and zero contributions is very similar across all treatments ($\chi^2(3)=0.29$, $p=0.96$) and ranges from 27.8 percent in TAKE-NEUTRAL to 31.8 percent in TAKE-COMMUNITY. Second, contributions and second-order beliefs of subjects other than those who have a zero contribution despite a positive second-order belief are positively correlated in all four treatments.[22] Table 3 corroborates this finding econometrically. Contributions and second-order beliefs are highly significantly

[22] This result can be compared to findings in Dufwenberg & Gneezy (2000), Bhatt & Camerer (2005), Charness & Dufwenberg (2006), and Bacharach, Guerra & Zizzo (2007), concerning similar choice – second-order belief correlation in other games.

positively correlated (t-values > 4.5).[23] Yet, the explained variance differs between treatments as the figure shows and as the regressions show formally. In GIVE-COMMUNITY, for instance, R^2 = 0.66, whereas in TAKE-COMMUNITY R^2 = 0.31.

Table 2: *Testing the guilt aversion hypothesis*

	Dependent variable: Contributions			
	GIVE-NEUTRAL	GIVE-COMMUNITY	TAKE-NEUTRAL	TAKE-COMMUNITY
Second-order beliefs	0.669	0.922	0.959	0.544
	(0.130)***	(0.105)***	(0.118)***	(0.119)***
Constant	1.957	0.644	2.035	1.527
	(1.069)*	(0.404)	(0.896)**	(0.876)*
Observations	47	36	52	45
R-squared	0.38	0.66	0.45	0.31

Notes: 1. OLS-regression; Robust standard errors in parentheses.
2. * significant at 10%; ** significant at 5%; *** significant at 1%.
3. Zero contributions for positive second-order beliefs are excluded.

When we test whether the regression coefficients are significantly different across treatments, we find that the constants are the same across treatments (F(3,172) = 1.08; p = 0.359). The slopes, however, differ significantly across treatments (F(3,172) = 2.94, p = 0.0349), which implies that the frame affects the relationship between second-order beliefs and contributions.

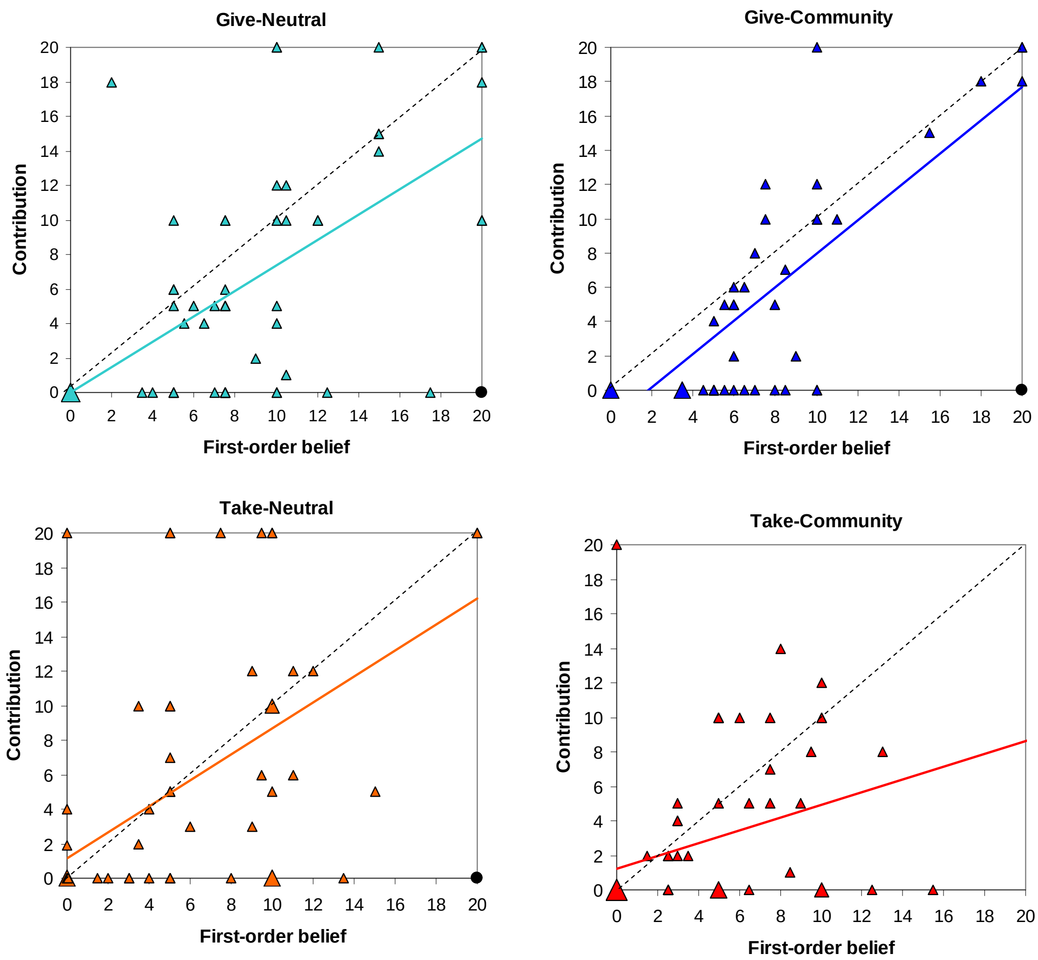
We turn now to reciprocity and H_2, which concerns the relation between a subject's contribution and his or her *first-order beliefs*. Figure 5 provides a graphical illustration. We distinguish between subjects who contribute nothing despite a first-order belief $(b_{ij}+ b_{ik})/2 = 20$; (indicated by filled circles on the *x*-axes), and the others (indicated by triangles). The size of symbols is proportional to the number of observations. The bold line is again the trend line (excluding observations $a_i=0 \& (b_{ij}+ b_{ik})/2 = 20$).

[23] This is actually true whether or not we include those subjects *i* for which $a_i = 0$ & $(c_{iji}+c_{iki})/2 > 0$.

Result 4: *The data support the reciprocity hypothesis H_2.*

Support: Figure 5 and Table 3 provide the support for Result 4.

Figure 5: *Contributions and first order beliefs for each treatment*



First, across all treatments, four participants contributed nothing despite holding an average first-order belief = 20. Second, contributions and first-order beliefs of the remaining subjects are on average positively correlated. The trend line follows the diagonal quite closely in all treatments (except TAKE-COMMUNITY), which means that subjects matched their first-order belief on average, as predicted by our reciprocity hypothesis.

Table 3 corroborates these findings econometrically. We again confine our attention to subjects other than those who have a zero contribution despite an average first-order belief = 20. We find that all first-order belief coefficients are significantly positive (t-values vary between 14.4 in GIVE-COMMUNITY and 2.49 in TAKE-COMMUNITY).[24] Again, the explained variance differs between treatments. The R^2 is highest in GIVE-COMMUNITY (0.66) and lowest in TAKE-COMMUNITY (R^2 = 0.12). In other words, the link between first-order beliefs and contributions is tightest in GIVE-COMMUNITY and loosest in TAKE-COMMUNITY.

Table 3: *Testing the reciprocity hypothesis*

	Dependent variable: Contributions			
	GIVE-NEUTRAL	GIVE-COMMUNITY	TAKE-NEUTRAL	TAKE-COMMUNITY
First-order beliefs	0.735	0.973	0.752	0.371
	(0.115)***	(0.067)***	(0.128)***	(0.149)**
Constant	0.022	-1.771	1.187	1.23
	(0.895)	(0.503)***	(0.723)	(0.705)*
Observations	65	50	70	66
R-squared	0.40	0.66	0.31	0.12

Notes: 1. OLS-regression; Robust standard errors in parentheses.
2. * significant at 10%; ** significant at 5%; *** significant at 1%.
3. Zero contributions for average first-order beliefs = 20 are excluded.

When testing for the regression coefficients in Table 3 to be different from one another, we find the slopes to differ significantly between treatments (F(3,243) = 5.02; p = 0.0022). The constants are highly significantly different from one another (F(3,243) = 5.88; p = 0.0007) as well. Thus, frames shift both the level and the slope of the relationship of first-order beliefs and contributions.

[24] This is actually true whether or not we include those subjects *i* for which $a_i = 0$ & $(b_{ij}+b_{ik})/2 = 20$.

In summary, our results show that frames affect beliefs and beliefs affect contribution behavior. This finding can be embraced by psychological game theory, and indeed individual subject data on choices and beliefs exhibit support for psychological-game based theories of guilt aversion and reciprocity. This is the main finding of Section 3.F.

4. THE IMPACT OF OUR FRAMES – SOME DISCUSSION

We have documented systematic evidence regarding how frames move beliefs and behavior. First- and second-order beliefs (and contributions) are higher with a GIVE frame than with a TAKE frame, in line with previous findings quoted in Section 3.B. These and our own findings are consistent with ideas based on the concept of *decision-induced focusing* (van Dijk & Wilke 2000). This concept rests on the idea that subjects are focused on the decision they are explicitly asked to make (*contribute* under the GIVE frame and *take* under the TAKE frame). A decision induces an initial focus in the sense that participants having to decide on how much to give are more focused on the part of their endowment they contribute than on the part of their endowment they keep for themselves. The reverse holds for the take decision.

As to the label frame, first- and second-order beliefs (and contributions) are higher with a NEUTRAL than with a COMMUNITY frame, seemingly at odds with some previous findings (Ross & Ward; Liberman, Samuels & Ross and Rege & Telle who are closest to our design). At first sight, our result may seem implausible as the COMMUNITY frame is generally associated with positive connotation. Imagine, however, a student in a dorm (his "community") where others never voluntarily clean the common rooms like bathroom and kitchen and free ride at parties by hardly ever contributing drinks and snacks. This student may believe that others contribute nothing or only peanuts in an experiment presented under a COMMUNITY frame!

The general point is as follows. Since our experiments were one-shot games, subjects had no other possibility than to infer others' behavior and expectations from their life experiences. A frame may serve as a cue on comparable social situations and these cues may be subject-pool dependent. Thus, a community-frame may induce some subject pools to contribute less than under a neutral frame (and to hold respective first- and second-order beliefs) if for most subjects the community cue is associated with low cooperation; for others the opposite may hold.

We tested this idea by replicating our experiment in the GIVE-treatments with 48 subjects from the University of St. Gallen. St. Gallen is a small Swiss university with a strong corporate identity, where students from the very beginning are socialized into the "University of St. Gallen community". By contrast, the University of Bonn is a huge and much more anonymous university with no strong community-spirited corporate identity.[25] As hypothesized, we found no subject pool differences in the NEUTRAL frame. The COMMUNITY frame, however, induced significantly higher first-, second-order beliefs, and contributions of St. Gallen subjects compared to Bonn students.[26]

5. CONCLUDING REMARKS

Framing effects are a challenge to traditional rational choice models, which assume description invariance. In this paper we first argued that psychological-game theoretic models can accommodate framing effects without reference to bounded rationality or cognitive biases. We

[25] We used exactly the same protocol, instructions, software and incentives in both subject pools similarly composed as to students' majors.

[26] The detailed results in St. Gallen (Bonn) are as follows: (GIVE-)NEUTRAL – mean first-order beliefs: 8.9 (8.1); mean second-order beliefs: 8.1 (9.2); mean contributions: 6.8 (5.7); (GIVE-)COMMUNITY – mean first-order beliefs: 10.6 (6.8); mean second-order beliefs: 9.7 (6.8); mean contributions: 10.4 (4.5). Second-order beliefs are insignificantly higher under the COMMUNITY frame than under the NEUTRAL frame in St. Gallen. First- and second-order beliefs are marginally insignificantly higher in COMMUNITY than in NEUTRAL (Mann-Whitney tests, $p<0.1185$). In NEUTRAL, we find only marginally insignificant support for guilt aversion in St. Gallen. In COMMUNITY, the support for the guilt aversion and the reciprocity hypotheses is very similar in both subject pools.

then used public good experiments to examine the empirical relevance of this claim. We find support for two psychological-game based theories which can accommodate framing effects, namely guilt aversion and reciprocity.

All in all, we have proposed to understand framing as a two-part process where (i) frames move beliefs, and (ii) beliefs shape motivation and choice. Guilt aversion and reciprocity theory furnish specific statements about (ii), for which we have found empirical support. We have not proposed and tested any theory as regards (i), but our results contribute to understanding the subtle interplay between framing, beliefs and choices. A challenge for future work is to develop a theory of framing that can explain also (i).

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Appendix A

Note: Text in brackets denotes the [GIVE treatments].

Instructions to the (community) experiment

Welcome to the *(community)* experiment

General information on the *(community)* experiment

You are now participating in an economic experiment which is financed by the European Union. If you read the following explanations carefully, you'll be able to earn a considerable amount of money – depending on your decisions. Therefore it is important to actually read the instructions very carefully.

The instructions are for your private information only**. During the experiment it is not allowed to communicate with other participants in any way.** If you have questions, please consult us.

During the experiment, we will not talk about Euro, but about Taler. Your total income will first be calculated in Taler. The total amount of Taler that you have accumulated during the experiment will be converted into Euro at the end of the experiment at an exchange rate of

1 Taler = 0.50 Euros

At the end of the experiment, you will be paid the total amount of Taler earned during the experiment and converted into Euro **in cash**.

At the beginning of the experiment, all participants will be randomly divided into groups of three. Besides you, there will be two more members in your group. **You will neither learn before nor after the experiment, who the other persons in your group are**.

The experiment consists of only one task. You have to decide **how many Taler you take from [contribute to] a project of your group and how many Taler you leave in the project [keep for yourself].** On the following pages we will describe the exact course of the experiment. At the end of this introductory information we ask you to do several control exercises which are designed to familiarize you with the decision situation.

The decision in the (*community*) experiment

At the beginning of the first stage, there are **60 Taler** in a project of your group [every participant receives an "endowment" of **20 Taler]**. You then have to decide how many of these 60 Taler you take from the project for yourself or how many you leave in the project. [You then have to decide how many of these 20 Taler you contribute to the project or how many you keep for yourself.] Each participant can take up to **20 Taler** from the project [can contribute up to 20 Taler]. The two other members of your group have to make the same decision. They can also either take Taler from the project for themselves or leave Taler in the project. [They can also either contribute Taler to the project or keep Taler for themselves.] You and the other members of the group can choose any amount to be taken [contribution] between 0 and 20 Taler.

Every Taler that you take from the project for yourself [do not contribute to the project] automatically belongs to you and will be paid to you, converted by the exchange rate given above, at the end of the experiment.

The following happens to the Taler that are not taken from [that are contributed to] the project: The project's value will be multiplied by 1.5 and this amount will be **divided equally among all three members of the group**. If for instance 1 Taler is not taken from [is contributed to] the project, the Taler's value increases to 1.5 Taler. This amount is divided equally among all three members of the group. Thus every group member receives 0.5 Taler.

Your income from the project rises by 0.5 Taler if you take one Taler less from [contribute one Taler more to] the project. At the same time, the income of the other two members of the group also rises by 0.5 Taler, because they receive the same income from the project as you do. Therefore, if you take one Taler less from [contribute one Taler more to] the project the income from the project with regard to the whole group increases by 1.5 Taler. It also holds that your income rises by 0.5 Taler if another group member takes one Taler less from [contributes one Taler more to] the project.

After all three members of the group have made their decisions about the amounts they take from [their contributions to] the project the total income achieved by each participant is determined.

How is your income calculated from your decision?

The income of every member of the group is calculated in the same way. The income consists of two parts:

(1) the Taler that somebody takes [keeps] for himself/herself **("income from Taler taken [kept]")**
(2) the **"income from the project"**. The income from the project is
1.5 × (60 - sum of all Taler taken from the project)/3 =
0.5 × (60 - sum of all Taler taken from the project)
[1.5 × (sum of all Taler contributed to the project)/3 =
0.5 × (sum of all Taler contributed to the project)].

Therefore your total income will be calculated by the following formula:

Your total income =

Income from Taler taken [kept] + Income from project =

(Taler taken by you) + 0.5 × (60 - sum of all Taler taken from project)

[(20 – Taler you contributed to project) + 0.5 × (sum of all Taler contributed to project)]

If you take all 20 Taler from [do not contribute anything to] the project, your "income from Taler taken [kept]" is 20. If you take [contribute] for instance 10 Taler from [to] the project, your "income from Taler taken [kept]" is 10. At the same time, the total sum of Taler left in [contributed to] the project decreases [increases] and so does your "income from the project".

In order to explain the income calculation we give some examples:

- If each of the three members of the group takes 20 Taler from [contributes 0 Taler to] the project, all three will receive an "income from Taler taken [kept]" of 20. Nobody receives anything from the project, because no one left [contributed] anything. Therefore, the total income of every member of the group is 20 Taler.
  *Calculation of the total income of every participant:(20) + 0.5 * (60-60) = 20*
  [*Calculation of the total income of every participant:(20 – 0) + 0.5 * (0) = 20*]
- If each of the three members of the group takes 0 [contributes 20] Taler there will a total of 60 Taler left in [contributed to] the project. The "income from Taler taken [kept]" is zero for everyone, but each member receives an income from the project of 0.5 * 60 = 30 Taler.
  *Calculation of the total income of every participant:(0) + 0.5 * (60-0) = 30*
  [*Calculation of the total income of every participant:(20 – 20) + 0.5 * (60) = 30*]
- If you take 0 [contribute 20] Taler, the second member 10 and the third member 20 [0] Taler, the following incomes are calculated.
  - Because the second and third member have together taken 30 Taler [you and the second member have together contributed 30 Taler], everyone will receive 0.5 * 30 = 15 Taler from the project.
  - You took 0 [contributed all your 20] Taler from [to] the project. You will therefore receive 15 Taler in total at the end of the experiment.
  - The second member of the group also receives 15 Taler from the project. In addition, he receives 10 Taler "income from Taler taken [kept]" because he took [contributed only] 10 Taler from [to] the project [Thus, 10 Taler remain for himself], and he receives 15 + 10 = 25 Taler altogether.
  - The third member of the group, who took all Taler [did not contribute anything], also receives the 15 Taler from the project and additionally the 20 Taler "income from Taler taken [kept]", which means 20 + 15 = 35 Taler altogether.

  *Calculation of your total income: (0) + 0.5 * (60-30) = 15*
  *Calculation of the total income of the 2nd group member: (10) + 0.5 * (60-30) = 25*
  *Calculation of the total income of the 3rd group member: (20) + 0.5 * (60-30) = 35*
  [*Calculation of your total income: (20 – 20) + 0.5 * (30) = 15*
  *Calculation of the total income of the 2nd group member: (20 – 10) + 0.5 * (30) = 25*
  *Calculation of the total income of the 3rd group member: (20 – 0) + 0.5 * (30) = 35*]
- The two other members of your group take 0 [contribute 20] Taler each from [to] the project. You take all Taler [do not contribute anything]. In this case the income will be calculated as follows:
  *Calculation of your total income (amount taken 20): (20) + 0.5 * (60-20) = 40*

Calculation of the total income of the 2nd and 3rd group member (amount taken 0):
*(0) + 0.5 * (60-20) = 20*
[*Calculation of your total income (contribution 0): (20 – 0) + 0.5 * (40) = 40*
Calculation of the total income of the 2nd and 3rd group member (contribution 20):
*(20 – 20) + 0.5 * (40) = 20*]

When making your decision you will see the following screen:

Please make the decision on the amount to be taken by you [your contribution] in the *(community)* experiment now.

In the project, there are [Your endowment] 60 [20]
The amount to be taken by you from [Your contribution to] the project…..

You will make your decision on a screen like the one above and enter into the blank space how many Taler you take from [contribute to] the project.

After you have made your decision please press the OK-button. As long as you did not press the button you can change your decision anytime.
The experiment will be carried out **once**.

First order belief statement (text of questions)

After you have taken your decision in the (*community*) experiment we would like to ask you for the following statement:

Please estimate how many Taler **the other two members of the group have taken from [contributed to] the project in total**.

If you estimated the correct amount you will be paid **20 EURO**.

Example 1:

You estimate that the other two members of the group took [contributed] 31 Taler from [to] the project. In fact, both members took [contributed] 19 and 12 Taler. Your estimation was correct and you will be paid **20 EURO**

Example 2:

You estimate that the other two members of the group took [contributed] 17 Taler from [to] the project. In fact, both members took [contributed] 12 and 6 Taler. Your estimation was wrong and you will be paid **0 EURO**

(Note that your estimation must be a number between 0 and 40 including these numbers.)

Estimated amount taken by [contribution of] the other two group members in the *(community)* experiment in total:

Second order belief statement (text of questions)

Each member in your group has estimated in the same way as you did how many Taler in total the other two members of the group took from [contributed to] the project.

Please estimate now the sum of amounts the other two group members **stated** as estimation in the (*community*) experiment.

If you estimated the correct amount you will be paid **20 EURO**.

Example 1:

You estimate that the other two members of the group stated an estimation of 57 Taler. In fact, the second member stated 31 and the third member stated 26 Taler as estimation.

Your estimation was correct and you will be paid **20 EURO**

Example 2:

You estimate that the other two members of the group stated an estimation of 42 Taler. In fact, the second member stated 17 and the third member stated 21 Taler as estimation.

Your estimation was wrong and you will be paid **0 EURO**

(Note that your estimation must be a number between 0 and 80 including these numbers.)

Estimated sum of amounts the other two group members stated as estimation in the *(community)* experiment:

Appendix B

Figure B1: *Histogram of the distribution of first-order beliefs:*

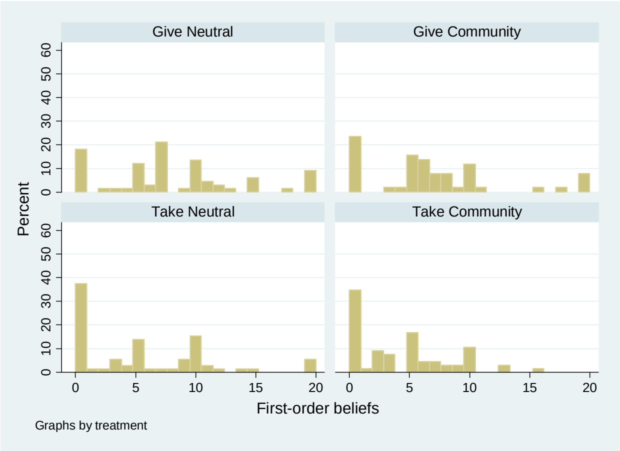

Figure B2: *Histogram of the distribution of second-order beliefs:*

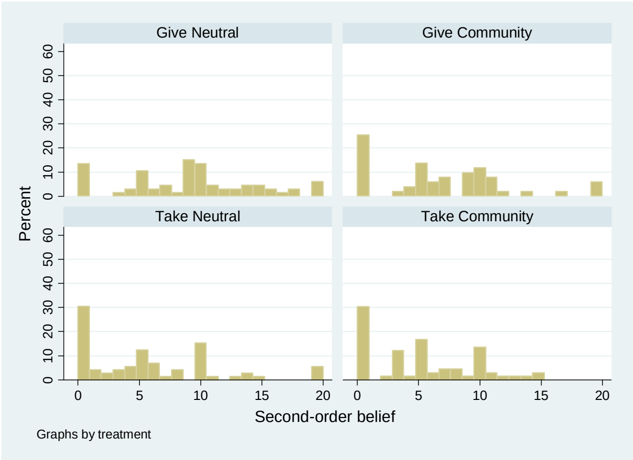

Figure B3: *Histogram of the distribution of contributions:*