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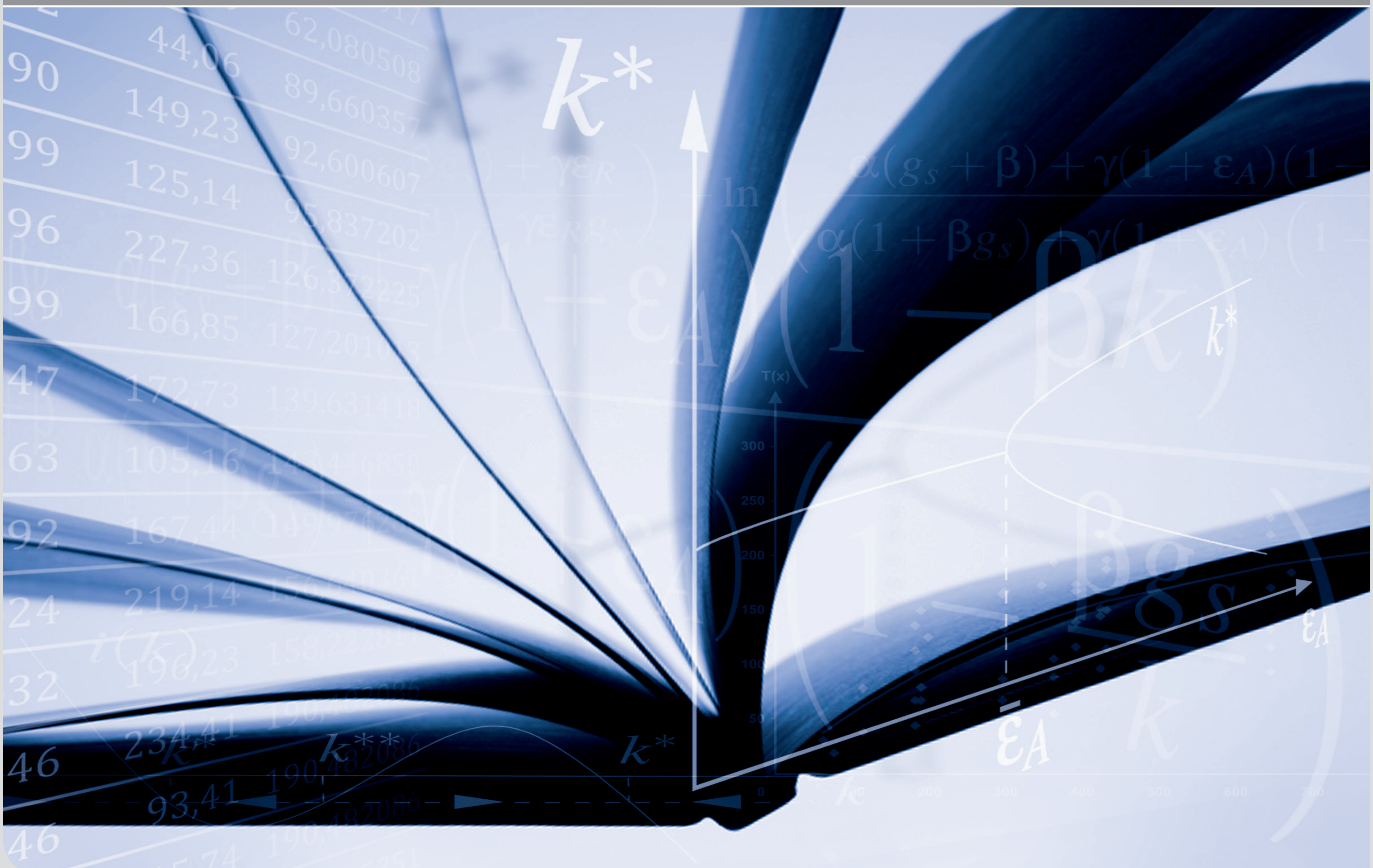

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A Simple Questionnaire Can Change Everything – Are Strategy Choices in Coordination Games Stable?

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Abstract

This paper presents results from an experiment designed to study the effect of self reporting risk preferences on strategy choices made in a subsequently played 2×2 coordination game. The main finding is that the act of answering a questionnaire about one's own risk preferences significantly alters strategic behavior. Within a best response correspondence framework, this result can be explained by a change in either risk preferences or beliefs. We find that self reporting risk preferences induces an increase in subjects' risk aversion while keeping their beliefs unchanged. Our findings raise some questions about the stability of strategy choices in coordination games.

JEL-classification: D 81, C 91, C 72

Keywords: coordination game, questionnaire, risk preferences, beliefs, best response correspondence

1. Introduction

The difficulty to predict strategy choices in games with multiple equilibria is a central feature of coordination games. Both the theoretical and the experimental literature is organized around the idea of determining which, if any, equilibrium point will be expected under different specifications of the game, such as complete vs. incomplete information games (Harsanyi and Selten (1988), Carlsson and van Damme (1993)), games with a larger number of players vs. games with a smaller number of players (Van Huyck et al. (1990)), games with preplay communication vs. games without preplay communication (Cooper et al. (1992)), games with local interaction vs. games without local interaction (Berninghaus et al. (2002)).

Despite the profusion of research on coordination games, however, there are important aspects of decision making analysis which are left intact by both the theoretical and the experimental literature. Namely, inductive methods of equilibrium choice are hardly considered in the theories on equilibrium selection in coordination games which are all based on the assumption that subjects' decision making process is based on some sort of deductive analysis. Deductive equilibrium analysis prescribes what strategy choices rational players should made under the assumption of common knowledge of rationality if they utilize solely the information provided by the game, i.e. strategy space and payoff structure. In other words, subjects' strategy choices are assumed to be independent from historical accidents and from dynamic processes. Whether this assumption is a good proxy of real decision making process is an empirical question. Van Huyck et al. (1990), for example, report experimental results that are not consistent with the predictions of deductive methods. To our knowledge, no experimental research effort has yet been dedicated on the question of whether strategic behavior is influenced by factors external to the coordination game and not related to it in any obvious way. A common feature of previous experimental studies is that they analyze the effect of different specifications of the game on strategy choices but none of them even touches on the topic whether unrelated to the coordination game specifications could also exert influence on subjects' strategic behavior. For example, it is found that the majority of subjects tend to coordinate on the Pareto superior or Pareto inferior equilibrium in dependence of the number of players (Van Huyck et al. (1990), (1991), (1993)) and number of iterations (Berninghaus and Ehrhart (1998)). Moreover, preplay commitment (Van Huyck et al. (1992), Cooper et al. (1992), Clark and Sefton (2001)), recommendation (Brandts and MacLeod (1995), Croson and Marks (1996)), optimization premium (Battalio et al. (2001)), loss avoidance principles (Cachon and Camerer (1996)), salience (Metha et al. (1994)), and local interaction (Berninghaus et al. (2002)) are reported to exert influence on subjects' decision choices.

In this paper we aim at achieving two goals. The first one is to fill the above-mentioned gap by providing an experimental evidence of how nonstrategic decision situations encountered by subjects before playing a one-shot 2×2 coordination game and not related to the coordination game systematically change strategic behavior. Inferences are drawn on whether the observed in the laboratory behavior is consistent with decision making based on deductive analysis. The second one is to provide evidence on whether neutrally framed nonstrategic decision situations change subjects' preferences. Both of these objectives are addressed by conducting a single laboratory experiment whose results are then interpreted accordingly.

We focus on the question whether the act of answering a short neutrally framed questionnaire about one's own risk preferences systematically changes strategic behavior in a subsequently played 2×2 coordination game. The questionnaire consists of three questions in which subjects are asked to self-report their risk preferences. The questions are carefully chosen so that they do not make any suggestions about a certain level of risk tolerance – risk loving, risk neutral or risk averse. Immediately after the completion of the questionnaire, the subjects in a test group were asked to make a strategy choice in a 2×2 coordination game characterized by two Pareto-ranked pure strategy Nash equilibria. The strategy choices made by the test group participants were then compared to the strategy choices made by control group participants who were asked to play only the coordination game.

Our experimental results reveal significant evidence that answering the questionnaire about one's own risk preferences systematically changes strategy choices made in the subsequently played 2×2 coordination game. Around two thirds of the subjects who directly played the coordination game chose the Pareto dominant strategy in the game. Once we let subjects first answer the questionnaire and then play the game, this proportion was reduced to one half. Furthermore, we find that consistent with the best response correspondence framework, both risk preferences and beliefs are important for the determination of strategy choices. In particular, there is significant evidence that subjects who play the risk dominant strategy are on average more risk averse and hold less optimistic beliefs about the proportion of people who would play the risk dominated strategy than subjects who choose the risk dominated strategy.

Our results suggest an additional research question. Namely, if subjects do play best responses, could the change in strategic behavior induced by answering the questionnaire be explained by a change in subjects' risk preferences or a change in subjects' beliefs? With the help of specially designed treatments in which subjects' first order beliefs are elicited, we address this research question and find little support for the idea that the act of answering the questionnaire changes beliefs. This result implies that the systematic change of strategy choices after answering the questionnaire should have been induced by a change in subjects' risk preferences. In particular, after answering the questionnaire about one's own risk preferences, subjects should have become on average more risk averse. This latter result raises some questions about the stability of preferences assumption of standard economic theory.

Our observations are related to the psychological literature on priming but there exist important differences between the two. The term priming is used to describe how a first stimulus activates parts of a particular representation or association in memory before carrying out an action and explains that this activation influences the behavior in the subsequently completed task. Bargh et al. (1996) and Bargh (2007) report interesting experimental results. In one experiments, subjects were asked to construct a grammatically correct four words sentences from a set containing five words. Ten five words sets were given. In one condition, many of the given words referred to being old. In another condition, many of the given words referred to being young. The effect of this simple language task was that subjects from the "old" condition walked significantly slower out of the office than subjects in the "young" condition. In a similar way, in another experiment, Dijksterhuis and van Knippenberg (1998) primed the participants in one condition with the stereotype of a professor (or the trait intelligent) and in another condition with the stereotype of soccer hooligans (or the trait stupid) and then observed that the participants from the "professor" condition performed significantly better in a general knowledge test than the participants in the "soccer hooligans" condition.

In our experiment, we observe a similar pattern – the completion of one task influences the behavior in a subsequent task. In contrast, to the priming literature, however, in the first task (the questionnaire) we do not prime any trait (risk loving, risk neutral or risk averse), rather we use a neutral framework. Consequently, the observation that the act of answering the questionnaire makes participants become on average more risk averse when playing the coordination game cannot be explained by priming.

The paper proceeds as follows. The next section introduces the baseline coordination game and discusses a framework of strategy choices based on the reaction correspondence structure of the game. Section II presents the research hypotheses. We then describe the experimental design and procedure and analyze the results. In section IV, a short discussion is included. Section V concludes.

I. A Pure Coordination Game – Reaction Correspondence Framework of Strategy Choices

We define the baseline game as one-shot symmetric 2×2 normal form coordination game with two Pareto-ranked pure strategies Nash equilibria ((A, A) and (B, B)) and one equilibrium in mixed strategies (Figure 1).

		Column Player: A	Column Player: B
Row Player	A	200, 200	0, 125
	B	125, 0	150, 150

FIGURE 1: The Baseline Game

The entries of the payoff matrix are expressed in experimental currency units. The players have complete information about the strategy space and the payoff function.

One approach to the strategy selection problem could be derived from the game's reaction correspondence (best response correspondence). Best response correspondences are drawn as a line for each player in a unit square strategy space. Figure 2 depicts the best response correspondence of the baseline game.

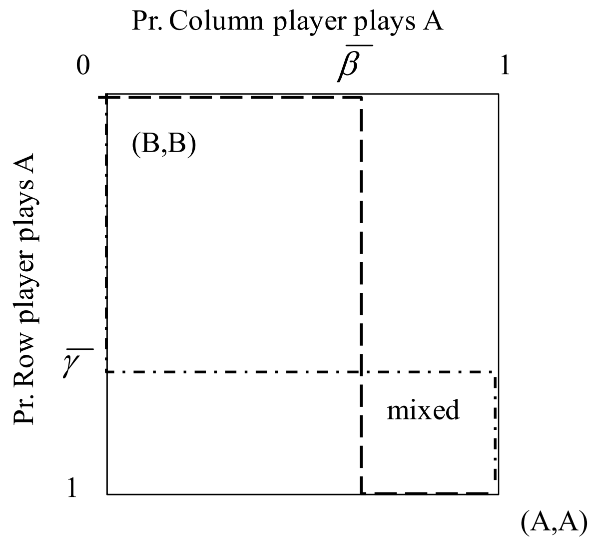

FIGURE 2: Best Response Correspondence

The long dash (dash dot) line represents the optimal probability with which the Row (Column) player plays A as a function of the probability with which the Column (Row) player plays A (because of the symmetry of the game, from now on we will concentrate our attention only on the Row player). Based on her best response correspondence, the Row player will choose to play A (B) if she believes that the Column player plays A with probability β larger (smaller) than $\overline{\beta}$, where the threshold value $\overline{\beta}$ corresponds to the mixed strategies equilibrium and is the solution of the following equation:

$$u(200)\beta + u(0)(1-\beta) \overset{!}{=} u(125)\beta + u(150)(1-\beta) \tag{1}$$

$$\overline{\beta} = \frac{u(150)}{u(200) + u(150) - u(125)} \tag{2}$$

with $u(x)$ being the Row player's utility function. Analogously, $\overline{\gamma}$ is the probability with which the Column player mixes her strategies in the mixed strategy equilibrium. We use different notation for each player in order to account for the fact that subjects might be characterized by different utility functions. By definition, $\overline{\beta}$ ($\overline{\gamma}$) is the probability with which players randomize between their strategies so that they are indifferent between choosing strategy A or strategy B. Each intersection of the two reaction correspondences represents an equilibrium point. From Figure 2, it could be easily seen that the baseline game has three equilibria $-(A,A)$, (B,B) and $(\bar{\beta},\bar{\gamma})$ with the latter being the mixed strategies equilibrium.

The definition of reaction correspondence implies that a player's strategy choice is determined by her beliefs and the threshold probability $\bar{\beta}$ ($\bar{\gamma}$) which depends on her utility function. That is, under the assumption of value maximizing subjects who play best responses, a strategy choice is a function of players' beliefs and risk preferences. A comparative static analysis shows that the theoretical effects of beliefs optimism work opposite to the effects of risk aversion. For example, a risk loving player could choose either strategy A or B in dependence of how optimistic (pessimistic) her beliefs are. The same holds for a risk averse player. This creates an identification problem – the independent effects of risk preferences and beliefs could not be distinguished by simply observing a strategy choice. Any complete analysis of strategic behavior should, therefore, explicitly address the interplay between risk preferences and beliefs. The importance of this point is well reflected in the work of Dickinson (2009) who contrary to previous bargaining research does not examine risk attitude and beliefs in isolation but rather considers their interplay.

Existing literature on coordination games has dedicated little effort to decompose the effects of risk preferences and beliefs. The theoretical research avoids dealing with the identification problem by considering payoff matrices given in terms of utilities rather than in monetary units (e.g. Nash (1951), Harsanyi and Selten (1988), Carlsson and van Damme (1993), Selten (1995)). The advantage of this approach is that one needs not know players' risk preferences. Therefore, beliefs receive the major attention in the further mathematical modeling. The experimental studies are often designed to test the predictions of certain theoretical models. However, in experimental laboratory settings the use of utilities in the payoff matrix is impossible and the fact that the theoretical analysis is based on utilities and the actual experiment on monetary units is often not accounted for (e.g. Batalio, Samuelson and Van Huyck (2001), Nyarko and Schotter (2002)). Other researchers report that the risk neutrality assumption holds for the average participant in their experiments and again avoid explicitly dealing with the identification problem (e.g. Biel (2009)). The overlooked effect of the interplay between risk preferences and beliefs in coordination game might create several problems that could eventually invalidate experimental results. Among these are incorrect estimation of the mixed strategy, Pareto dominant and risk dominant equilibria, incorrect conclusions about whether players best respond to stated beliefs, and lack of understanding about the reasons why subjects choose different strategies in theoretically equivalent situations. The focus of the current research is on the latter problem.

II. Research Hypotheses

The aim of this paper is to understand in what way a neutrally framed questionnaire about one's own risk preferences influences strategy choices in subsequently played one-shot coordination game. The internal consistency of preferences assumption of standard economic theory postulates that in theoretically equivalent situations people should always choose the same alternative. In addition, equilibrium selection principles based on deductive analysis prescribe that strategy choices are independent from historical accidents and dynamic processes. The implications of these two normative theories lead us to our first research hypothesis.

Hypothesis 1: The act of answering a questionnaire about one's own risk preferences does not change strategic behavior in a subsequently played 2×2 *coordination game.*

In the best response correspondence framework, discussed in the previous section, it was argued that both risk preferences and beliefs are important for the determination of strategy choices. In dependence of the individual distribution of beliefs, both strategies might be chosen by players characterized by any risk attitude. Following the insights of previous research (e.g. Schmidt et al. (2003), Heinemann et al. (2009) and Goeree et al. (2003)) that strategic behavior in games is related to subjects' risk preferences, we derive our second research hypothesis.

Hypothesis 2: The players' risk preferences determine strategy choices in the 2×2 *coordination game.*

Analogously, from the reaction correspondence framework, we would expect the same causality to apply also to subjects' beliefs. Confirmation of the intuition about the importance of beliefs in the determination of strategic behavior has already been reported in the literature (e. g. Nyarko and Schotter (2002) and Costa-Gomes and Weizsäcker (2008)).

Hypothesis 3: The players' beliefs determine strategy choices in the 2×2 *coordination game.*

Our results reveal significant evidence that the act of answering the questionnaire does indeed induce a change in strategic behavior in the subsequently played 2×2 coordination game. This leads us to ask and investigate an additional research question about the mechanism behind the observed results. Referring again to the reaction correspondence framework presented in section I, we know that a strategy choice is a function of risk preferences and beliefs. In addition, our experimental data proved to be consistent with the second and the and third research hypotheses. Our presumption, therefore, is that any change in strategic behavior should have been induced by a change in either risk preferences or beliefs.

Hypothesis 4: The act of answering the questionnaire about one's own risk preferences changes subjects' beliefs.

Hypothesis 5: The act of answering the questionnaire about one's own risk preferences changes subjects' risk preferences.

III. The Experiment

a. Experimental Design

We designed an experiment consisting of five treatments. In the first treatment (treatment Q), subjects were asked to fill out a short questionnaire about their own risk preferences. In the second treatment (treatment G) subjects were asked to select a strategy in the 2×2 coordination game presented in Figure 1. Subjects from treatment three (treatment Q_G) were instructed to first fill out the questionnaire about their own risk preferences and then play the 2×2 coordination game. In the fourth treatment (treatment B_G), subjects were asked to state their first order beliefs and then play the 2×2 coordination game. Finally, subjects from the fifth treatment (Q_B_G) first answered the questionnaire, then stated their first order beliefs and subsequently played the 2×2 coordination game.

In all treatments consisting of more than one task, subjects performed the individual tasks one after the other with the only waiting time in between being associated with the time needed to collect the answer sheets from the first tasks and distribute the instructions and the answer sheets for the second (and third) tasks. Table 1 summarizes the decision situations involved in all five treatments as well as their sequence.

	Questionnaire			Beliefs			Coordination Game		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Treatment 1	✓								
Treatment 2							✓		
Treatment 3	✓							✓	
Treatment 4				✓				✓	
Treatment 5	✓				✓				✓

TABLE 1: Treatments and Tasks

In all treatments involving first answering the questionnaire and then performing additional tasks, subjects knew from the very beginning of the experiment that the experiment consists of several parts but they did not have any further information about the second (and third) part.

The questionnaire consisted of three questions. In the first two questions, subjects were asked whether they like taking risks and whether they always try to avoid risks, respectively. Admissible answers were "Agree", "Disagree" or "Neither agree nor disagree". In the third question, subjects were asked to determine their risk tolerance with a greater precision by positioning themselves on a scale between 0 (maximal risk loving preferences) and 100 (maximal risk averse preferences) with 50 being chosen as the point corresponding to the risk neutrality case. The important for the current study question was the last one, where subjects had to estimate and report their degree of risk aversion. The first two questions were added with the intention to make subjects take the time and carefully assess their risk attitude.

There is a discussion in the literature whether survey questions are a good method for measuring risk tolerance with the major concern of many economists being that questionnaires are not incentive compatible. Considerable research effort has been dedicated to the analysis of the stability of risk preferences across elicitation methods (e. g. Grable and Lytton (2001), Kruse and Thompson (2003), Anderson and Mellor (2009), Dhomen et al. (2009)). Despite methodological differences, all these studies report consistency of risk preferences elicited with the help of surveys and economics experiments at least at the aggregate level or at least for some of the subjects. The use of a questionnaire in the current study is justified by a twofold argument. First, we are interested in finding out whether a neutrally framed non-strategic decision situation (the questionnaire) unrelated to the subsequently played coordination game influences strategic behavior (Hypothesis 1). That is, we study the effect of the act of answering the questionnaire on subsequent strategic behavior and for addressing this research hypothesis the exact answers given on the questionnaire are of little importance. Second, the design of the experiment allows us to draw some conclusions about the behavioral meaningfulness of self-reported personal risk attitudes and thus contribute to the discussion of whether survey questions are a good method for measuring risk attitude. In addressing our second research hypothesis, we rely on the answers given to the questionnaire under the implicit assumption that they provide a good proxy of subjects' risk tolerance. Our findings about the validity of the hypothesis could then be compared to the findings of other studies which use similar experimental settings but different risk elicitation procedures (i. e. Neumann and Vogt (2009)). Significant experimental evidence favoring the use of questionnaires for the elicitation of risk preferences could be found in Dohmen et al. (2009) who show that an incentive incompatible question asking individuals to make a global assessment of their willingness to take risks on a scale from 0 to 10 generates a meaningful measure of risk attitudes, which maps into actual choices in lotteries with real monetary consequences.

In treatment four and five, beliefs are elicited using one of the scoring rules reported in Murphy and Winkler (1970) – the quadratic scoring rule. Murphy and Winkler (1970) discuss two problems related to the suggested scoring rules – flatness and risk neutrality which raise some questions about whether quadratic scoring rules provide an incentive compatible mechanism to elicit beliefs in real experimental settings. McKelvey and Page (1990) suggest an experimental design that deals with these problems. First, to relax the assumption of risk neutrality they use a lottery version of the scoring rule. Second, to sharpen the incentives of the scoring rule, instead of paying a fixed amount for each lottery won, they pay according to a sliding scale. Seletn et al. (1999) report, however, that even though money does not induce risk neutral behavior, binary lotteries are found to do even worse. That is why, we decided to stick to the original version of the quadratic scoring rule and not to the one suggested by McKelvey and Page (1990).

Taking into considerations the remark of Kahneman and Tversky (1973) that even if subjects can quantify their beliefs, they might find some form of processing quantitative beliefs more meaningful than others and following Biel (2009) we elicit beliefs by asking about the number of players (from 100) who are believed to choose strategy A rather than about the probability with which a single opponent is believed to play a single action. Finally, to sharpen the incentives to report one's true beliefs we set the maximal potential reward for the beliefs elicitation part considerably higher than the maximal remuneration that could be achieved in the coordination game part. To avoid any portfolio or hedging effects, it was determined by a flip of a fair coin at the end of the experiment whether subjects would be paid for the beliefs elicitation part or for the coordination game part.

The payoff matrix of the 2×2 coordination game (Figure 1) was presented to the subjects in experimental currency units (ECU) where the following exchange rate was used to convert them into Euro:

(3) $$25ECU = 1Euro\,.$$

b. Procedure

The experiment was carried out in MaXLab, the experimental laboratory at the University of Magdeburg between March and November 2010. Participants were recruited using ORSEE software (Greiner (2004)) from a pool of mostly students from various faculties. We imposed only one restriction on the recruitment process – namely, no economics or management students were invited for our experiment. The rational of this restriction is that we wanted our subjects to make their choices in the 2×2 coordination game based on their real risk preferences and beliefs and not on some other considerations, such as which strategy is the optimal one according to their game theory classes. None of the invited participants had any previous experience with coordination games. Due to the simplicity of the experiment, it was carried out on a sheet of paper. All instructions were provided in German. In total, 192 subjects participated in the experiment – 35 in the first treatment, 56 in the second treatment, 54 in the third treatment, 24 in the fourth treatment and 23 in the fifth treatment. All five treatments of the experiment were run in different sessions.

Upon arrival at the laboratory, subjects were seated in a single cabin with arrangements to ensure their privacy. During the experiment, no communication was allowed among the participants. The written instructions were explained to the subjects also orally and they were instructed to raise their hands if they had questions which were then answered individually. The experiment consisted of one part for the subjects in the first and second treatments, of two parts for the subjects in the third and fourth treatments and of three parts for the subjects in the fifth treatment which were as explained in the previous section. In dependence of the treatment, the duration of the whole experiment varied between 20 minutes and 40 minutes.

For filling out the questionnaire, no remuneration was provided. Yet, subjects were instructed that their answers will be used for a research project and they were asked to try to be as accurate in their answers as possible.

In the coordination game part, subjects were individually instructed whether they were row or column players and were asked to choose either strategy A or strategy B. To avoid any artifacts, all subjects were assigned to be row players. They were further told that their payoff depended on the combination of their own strategy and the strategy played by a hidden player with whom they were going to be randomly matched once all players completed their strategy choices. The matching procedure involved drawing a ball from an urn containing n balls (with n being the number of subjects in a given treatment) and writing down in a special field on their answer sheets the number which was written on the ball. The balls in the urn were numbered consecutively from 1 to $n/2$ and there were two balls with the same number. In this way, we matched subjects who had drawn a ball labeled with the same number.

The payoff matrix presented in Figure 1 and the exchange rate in (3) were used to determine the remuneration for each subject in dependence of her own strategy choice and that of her randomly matched partner. The maximum payoff subjects could earn during the coordination game part of the experiment was 8 Euro and the minimum payoff was 0 Euro. The payoffs depended on the strategies subjects and their randomly matched partner had chosen in the 2×2 coordination game, where strategy A was the risky strategy either resulting in the maximum possible payoff of 8 Euro or the minimum possible payoff of 0 Euro and strategy B was the riskless strategy resulting in a payoff of at least 5 Euro and at most 6 Euro.

In the beliefs elicitation part of the experiment, subjects were asked to imagine that 100 individuals play the coordination game presented in Figure 1. They were then asked to write down the number of people from 100 (denoted as p) which they believed would play strategy A. Subjects' payoff for this part of the experiment was then determined in dependence of one of the following states of the world. If their randomly assigned partner in the coordination game (partner matching was as explained above) had chosen strategy A (B), the Euro payoff was calculated with the help of formula (4) ((5)).

(4) $$15-15\left(1-\frac{p}{100}\right)^2$$

(5) $$15-15\left(\frac{p}{100}\right)^2.$$

Subjects were told that their payoff will be maximized if they report their true beliefs. In addition, for $p \in [0,100]$ and each state of the world, subjects were shown tables in which their payoff was calculated in dependence of p (payoff were calculated for increments of 5). The maximum payoff subjects could earn for stating their beliefs was 15 Euro and the minimum payoff was 0 Euro. The exact payoff depended on p and on the state of the world. The average payoff subjects received for this part was around 10 Euro. The beliefs elicitation part was always followed by playing the coordination game and subjects were instructed that at the end of the experiment they will be paid for either the beliefs elicitation part or for the coordination game part, with the decision being taken on the basis of a fair coin flip.

c. Experimental Results

The analysis of our experimental data involves intergroup comparisons. The crucial assumption that allows us drawing valid conclusions on the basis of comparisons between treatments is that all groups are identical with identical being used in the sense that all groups are characterized by the same initial distribution of risk preferences. In the general case and for limited sample sizes this assumption is not necessarily fulfilled. We, therefore, directly test whether our sampling procedure results in samples characterized by the same initial distribution of risk preferences. For this purpose we compare the medians of the answers of question three on the questionnaire given by subjects in treatment Q (median = 55) and in treatment Q_G (median = 42.5). Using a two-tailed Wilcoxon rank-sum test we cannot reject the null hypothesis that the two samples are independent and are drawn from identical continuous distributions with equal medians (p-value: 0.88).

Result 1: Our sampling procedure generates samples characterized by identical initial distribution of risk preferences.

Based on Result 1 we aggregate the data from treatment Q and treatment Q_G and calculate the cumulative distribution function of self-reported risk preferences. Furthermore, we characterize the subjects as either risk loving or risk averse according to the following rule: if a subject scored on the scale a number between 0 and 50, she is characterized as risk loving, and if she scored a number between 50 and 100 she is characterized as risk averse. Interestingly, only 1 out of the 89 subjects scored exactly 50 on the scale between 0 and 100.

Result 2: 53 percent of the subjects reported that they are risk loving and 47 percent reported that they are risk averse.

Similarly, aggregating the data from the beliefs elicitation parts of treatment B_G and treatment Q_B_G (it will be later explained why drawing an inference from the aggregate data is meaningful) we calculate the sample distribution of beliefs.

Result 3: 66 percent of the subjects believe that more than 50 out of 100 people will choose alternative A on the 2×2 *coordination game, and 34 percent believe that less than 50 out of 100 people will chose strategy A.*

In treatment B_G and Q_B_G, directly before playing the coordination game, subjects were asked to state their first order beliefs. There is a discussion in the literature whether beliefs elicitation alters strategic actions. For example, Costa-Gomes and Weizsäcker (2008) and Biel (2009) report only minor effect of stating one's own beliefs on strategic behavior, while Rutström and Wilcox (2009) find significant evidence that beliefs elicitation influences strategic behavior. However, the result of Rutström and Wilcox (2009) is found to be player specific. That is, only players with strong asymmetric payoff opportunities show the beliefs elicitation effect. Using the data from treatment G and treatment B_G, we test whether beliefs elicitation alters players' strategy choices. Table 2 reports the proportions of the subjects in treatment G and treatment B_G who chose strategy A and B, respectively.

	Treatment G	**Treatment B_G**
Number of participants	56	54
Strategy A chosen	37 (66%)	15 (63%)
Strategy B chosen	19 (34%)	9 (37%)

TABLE 2: Distribution of Strategy Choices in the Coordination Game (Treatment G and Treatment B_G)

It could be easily seen from Table 2 that the distribution of strategy choices in both treatments is remarkably similar – in treatment G, 34 percent of the subjects chose strategy B and in treatment B_G, this proportion is equal to 37 percent. Performing a one-tailed Z-test for the significance of the difference between the two proportions ($H_0: p_1 - p_2 \leq 0$, with $p_1 = 0.37$ and $p_2 = 0.34$), we find that we cannot reject the null hypothesis at any usual level of significance (z-statistics: 0.30691; p-value: 0.37946).

Result 4: Beliefs elicitation does not significantly alter strategic behavior in the subsequently played coordination game.

We now address our first research hypothesis. Namely, we are interested in finding out whether the act of answering the questionnaire about one's own risk preferences influences strategic behavior in the subsequently played 2×2 coordination game. This analysis involves comparison of the strategy choices made in the coordination game by subjects from treatment G and treatment Q_G. Table 3 reports what proportions of the subjects in treatment G and in treatment Q_G chose strategy A and B, respectively.

	Treatment G	**Treatment Q_G**
Number of participants	56	54
Strategy A chosen	37 (66%)	27 (50%)
Strategy B chosen	19 (34%)	27 (50%)

TABLE 3: Distribution of Strategy Choices in the Coordination Game (Treatment G and Treatment Q_G)

We observe that from the subjects (treatment G) who directly played the 2×2 coordination game, 34 percent chose the riskless strategy B, and from the subjects (treatment Q_G) who first answered the questionnaire and then played the game, 50 percent chose the riskless strategy B. Using a one-tailed Z-test, we test for the significance of the difference between the two proportions ($H_0: p_1 - p_2 \leq 0$, with $p_1 = 0.5$ and $p_2 = 0.34$). At the 5 percent level of significance we reject the null hypothesis (z-statistics: 1.7083; p-value: 0.04379).

Result 5: The act of answering the questionnaire about one's own risk preferences changes strategy choices made in the subsequently played coordination game. In particular, there is significant evidence that the proportion of subjects who choose the riskless strategy B increases after answering the questionnaire as compared to the case when the coordination game is directly played.

An interesting question is through what mechanism this change in strategic behavior is induced. Before we address this question, however, we will first investigate the second and the third research hypotheses. In section I, a framework for the analysis of strategy choices based on the best response correspondence of the game was discussed. We argued that a strategy choice in the coordination game is a function of risk preferences and beliefs. It is interesting, therefore, to examine whether risk preferences and beliefs might predict strategic behavior for the average player.

To address research hypothesis 2, we test whether subjects who choose strategy B have different distribution of risk preferences from subjects who choose strategy A. We use the data from treatment Q_G and perform test on the medians of the self-reported risk preferences on the third question of the questionnaire. The median of the self-reported risk preferences of the subjects who played strategy A is equal to 40, while it is equal to 55 for the subjects who played strategy B. Using a one-tailed Wilcoxon rank-sum test on the medians we find significant evidence at the 5 percent level that subjects choosing strategy B are on average more risk averse than subjects choosing strategy A (p-value: 0.0434).

Result 6: Subjects who choose strategy B are on average more risk averse than subjects who choose strategy A.

Similarly, we address research hypothesis 3 by comparing the medians of the elicited first order beliefs of subjects who played strategy A and strategy B, respectively. We used the aggregate data from treatment B_G and treatment Q_B_G. The median of the elicited beliefs of the subjects who played strategy A is equal to 85 and of the subjects who played strategy B is equal to 42.5. Performing a one-tailed Wilcoxon rank-sum test on the medians, we find significant evidence at the 1 percent level that subjects choosing strategy A are on average more optimistic than subjects choosing strategy B (p-value: ≈ 0).

Result 7: Subjects who choose strategy A hold on average more optimistic beliefs about the proportion of people who would play strategy A, than subjects who choose strategy B.

Results 6 and 7 indicate that both risk preference and beliefs could be used to predict behavior of the average player. The question, however, why after answering the questionnaire more subjects on average choose strategy B still remains. Based on the best response correspondence framework and on results 6 and 7, we know that both risk preferences and beliefs are important for the determination of strategy choices. Our presumption, therefore, is that the act of answering the questionnaire had changed either risk preferences or beliefs. It was already discussed that the theoretical effects of beliefs optimism work opposite to the effects of risk aversion. The increase of the proportion of subjects choosing strategy B after answering the questionnaire could, therefore, be induced by either an increase of subjects' risk aversion or a decrease in their optimism (i.e. a leftward shift of their beliefs' distributions). The subtle point in our analysis is that not all of the individuals are to change their strategy choices after answering the questionnaire. This is so, because it is unlikely that all players are characterized by the same coefficient of risk aversion and beliefs' distribution. The shift in either of these variables applies to all players but in dependence of the individual risk preferences and beliefs this shift will be large enough to evoke a change in strategy choices only for some of them.

The examination of research hypotheses 4 and 5 sheds more light on the exact reasons behind the observed change in strategic behavior. A two-tailed Wilcoxon rank-sum test on the medians of the elicited beliefs of subjects in treatment B_G (median = 70) and Q_B_G (median = 85) shows that we cannot reject the null hypothesis that the two samples are from identical continuous distribution with equal medians (p value = 0.1919). This result is the reason why we aggregated the data from treatment B_G and Q_B_G for the derivation of result 3 and 7.

Result 8: The act of answering the questionnaire about one's own risk preferences does not change beliefs.

Result 8 implies that the observed increase in the proportion of subjects choosing strategy B after answering the questionnaire should have been induced by an increase in subjects' risk aversion.

Conclusion: Subjects become on average more risk averse when playing the coordination game after answering the questionnaire about their own risk preferences.

IV. Discussion

The results reported in this paper provide several interesting insights which are not only novel with respect to the literature on coordination games but also impose a severe test on some of the assumptions of standard economic theory. It was already mentioned, that despite the profusion of experimental evidence on the equilibrium selection problem in coordination games, to our knowledge, no research effort has yet been dedicated to study whether nonstrategic decision situations encountered by subjects before playing a coordination game and not related to it in any obvious way could influence strategic behavior. In result 5, we report that a decision situation as simple as a neutrally framed questionnaire about one's own risk preferences does indeed alters subjects' strategy choices.

This result violates the internal consistency of preferences assumption of standard economic theory stipulating that in theoretically equivalent situations people should always choose the same alternative. Furthermore, result 5 challenges the idea that players choose strategy choices based on deductive analysis. When faced with the 2×2 coordination game, subjects from treatment Q_G have exactly the same information about the game as subjects from treatment G. In addition, the two samples are characterized by the same initial distribution of risk preferences (result 1) and no preplay communication takes place in any of the treatments. In other words, identical groups are faced with the same decision situation but contrary to the predictions of deductive principals their distributions of strategy choices differ. This result provides strong evidence that players apply some sort of inductive selection principles when playing the 2×2 coordination game. Van Huyck et al. (1990) report experimental results that in a repeated coordination game, subjects' strategy choices are influenced by the history of play. We find evidence that a nonstrategic decision situation (answering a questionnaire about one's own risk preferences) not related to the coordination game also influences strategic behavior.

The conclusion that subjects become on average more risk averse after answering the questionnaire about their own risk preferences provides a second challenge to standard economic theory which assumes that risk attitude are stable personality traits. There is a considerable amount of research addressing the stability of risk attitudes. The majority of it, however, investigates stability of risk preference either over time, across domains or across elicitation methods (e.g. Brunnermeier and Nagel (2008), Vlaev et al. (2009), Nosic and Weber (2008), Anderson and Mellor (2009), Dohmen et al. (2009)). In the current study, we show that a decision situation as simple as reporting one's own risk preferences in an incentive incompatible questionnaire makes people become on average more risk averse.

Our results contribute also to the discussion of whether incentive incompatible survey questions are a good method for measuring risk attitude. According to the best response correspondence framework, both risk preferences and beliefs are important for the determination of strategy choices. Our intuition, therefore, is that both risk preferences and beliefs could be used as predictors of strategic behavior for the average player. Based on the self reported risk preferences on question three of the questionnaire, we indeed find evidence that risk attitudes could predict strategic behavior (result 6). This result is different from the results of Neumann and Vogt (2009) who do not find significant evidence that risk attitudes determine the strategy selection in coordination games. The difference between the two studies is that Neumann and Vogt (2009) rely on a measure of risk attitudes based on the lottery approach suggested by Holt and Laury (2002), while we use data from a survey question. Result 6 provides evidence that an incentive incompatible survey question about one's own risk preferences is a good method for measuring risk attitude. In addition, the difference in our results and the results of Neumann and Vogt (2009) suggests that self reported risk preference might provide a superior measure of underlying risk preferences than risk preferences elicited with the help of lotteries.

V. Conclusion

This study reports an experiment where subjects are asked to play a one-shot symmetric 2×2 normal form coordination game characterized by two Pareto-ranked pure strategies Nash equilibria and one equilibrium in mixed strategies. The experiment is divided into five treatments. In dependence of the treatment, subjects are asked in addition of playing the 2×2 coordination game to answer a questionnaire about their own risk preferences or (and) state their first order beliefs.

We discuss a framework based on the best response correspondence of the coordination game, within which strategy choices and their determinants could be analyzed. The main implication of the best response correspondence framework is that strategy choices are a function of risk preferences and beliefs with the theoretical effects of these two working in opposite directions. The main conclusions from the experiment can be summarized as follows. Significant evidence is found that the act of answering the questionnaire about one's own risk preferences systematically changes strategic behavior in the subsequently played coordination game. This result contradicts the internal consistency of preferences assumption. In addition, it implies that subjects rely on inductive rather than on deductive principles when making strategy choices. As another result, we find that both risk preferences and beliefs could be used to predict strategic behavior in coordination games. Finally, our results provide evidence that the change in strategic behavior after answering the questionnaire is not induced by a change in subjects' beliefs. We, therefore, conclude that subjects become more risk averse after self reporting their risk preferences. This conclusion raises some questions about the assumed by standard theory stability of risk attitudes.

We demonstrate that strategy choices in coordination games are very sensitive not only to the exact game specifications but also to nonstrategic decision situations preceding the coordination game and not related to it in any way (such as answering a questionnaire about one's own risk preferences). These results raise some questions about the stability of strategy choices in coordination games. Furthermore, our experimental evidence is indicative that a non strategic neutrally framed decision situation as simple as stating one's own risk preferences might have crucial consequences for subjects' preferences and strategic behavior.

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