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Verantwortlich für diese Ausgabe:

S. K. Berninghaus, L. R. Todorova and B. Vogt
Otto-von-Guericke-Universität Magdeburg
Fakultät für Wirtschaftswissenschaft
Postfach 4120
39016 Magdeburg
Germany

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How Sensitive is Strategy Selection in Coordination Games?

by Siegfried K. Berninghaus[1], Lora R. Todorova[2] and Bodo Vogt[3]

Abstract

This paper presents the results of an experiment designed to study the effect produced on strategy choices when a subject reports risk preferences on a risk scale before engaging in a 2×2 coordination game. The main finding is that the act of stating one's own risk preferences significantly alters strategic behavior. In particular, subjects tend to choose the risk dominant strategy more often when they have previously stated their attitudes to risk. 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 does not induce a change in subjects' beliefs. We argue that the behavioral arguments of strategy selection, such as focal points, framing and uncertain preferences can explain our results.

Keywords coordination game · questionnaire · risk scale · risk preferences · beliefs · focal points · framing · uncertain preferences

JEL Classification D81 · C91 · C72

[1] Karlsruhe Institute of Technology (KIT), Institute for Economic Theory and Statistics, P. O. Box 6980, D-76128 Karlsruhe, Germany. E-mail: siegfried.berninghaus@kit.edu (Corresponding author).
[2] Faculty of Economics and Management, Empirical Economics Research, Otto-von-Guericke University Magdeburg, P. O. Box 4120, D-39106 Magdeburg, Germany. E-mail: lora.todorova@ovgu.de.
[3] Faculty of Economics and Management, Empirical Economics Research, Otto-von-Guericke University Magdeburg, P. O. Box 4120, D-39106 Magdeburg, Germany. E-mail: bodo.vogt@ovgu.de.

1. Introduction

Survey questions are often employed to collect information about people's risk preferences. This information is then used to either make predictions about behavioral choices in subsequent decision situations involving risk or uncertainty or, as is often done in consumer finance, to tailor investment advice to the client's level of risk tolerance. Elicitation of risk preferences by means of survey questions is attractive because of its simplicity and low administration costs. There are, however, at least two problems associated with the use of survey questions. First, it is questionable whether they provide a good method for measuring risk preferences. One major concern is that survey questions are incentive-incompatible. Furthermore, MacCrimmon and Wehrung (1986) argue that one-dimensional risk questions (e.g. "How risk tolerant are you?") measure only a small part of the multidimensional nature of risk and that most people overestimate their preference for risk in these situations. Second, survey research implicitly assumes that the act of answering questions does not influence people's personal characteristics or their behavior in later decision situations. In light of empirical evidence from psychological studies, however, this assumption is not easy to justify. For example, Morwitz, Johnson and Schmittlein (1993) showed that asking a simple question about purchase intent increased the actual rates of automobile purchase in the subsequent six months by more than 35 percent. They labeled this phenomenon the mere-measurement effect. For a review of studies replicating this effect and a discussion of possible explanations see e.g., Levav and Fitzsimons (2006).

In this study we are concerned with the effect that risk questions produce on behavioral choices. While research on the mere-measurement effect shows that the likelihood of engaging in certain behavior (e.g., voting, smoking, buying etc.) is not independent of answering questions of intent, we are interested in investigating whether the question-behavior link observed by Morwitz, Johnson and Schmittlein (1993) applies equally to other than intent questions and to decision situations other than one explicitly linked to the questions asked. A frequently used type of survey questions asks people to assess (usually on a scale) their own attitudes. For example, one question in the German Socio-Economic Panel Survey (SOEP) asks subjects to assess their general risk preferences on a scale of 0 (not at all willing to take risks) to 10 (very willing to take risks).

We aim to achieve two goals. The first is to examine whether asking subjects to assess and state their own risk preferences influences behavior in a subsequently played economic game. Specifically, we study whether strategy choices in a one-shot 2×2 coordination game are altered by the act of reporting one's attitude toward risk. We stress the point that we seek to examine the link between the risk questions and behavior, and we do not claim that the survey questions we use provide a reliable measure of risk preferences. The second goal is to gain valuable insights into whether strategy selection in coordination games is consistent with deductive analysis. Both of these objectives are addressed through a single laboratory experiment whose results are then interpreted accordingly.

Much research, both theoretical and experimental, has been dedicated to studying the equilibrium selection problem in coordination games (e.g., Harsanyi and Selten 1988, Carlsson and van Damme 1993, Van Huyck et al. 1990, Cooper et al. 1992, Berninghaus et al., 2002). The majority of existing research, however, relies heavily on deductive analysis, and inductive methods of equilibrium choice are hardly considered. Deductive equilibrium analysis prescribes what strategy choices rational players will make, under the assumption of common knowledge of rationality, if they use only the information provided by the game, i.e., strategy space and payoff structure. In other words, subjects' strategy choices are assumed to be independent of historical accidents and dynamic processes. Whether this assumption is a good proxy of the real decision making process is an empirical question. Van Huyck et al. (1990), for example, report experimental results from repeated-period coordination games that show little evidence of decision making based on deductive methods. In this study, we investigate whether a simple non-strategic decision situation (i.e., assessing and stating one's own risk preferences) unrelated to the coordination game systematically alters strategic behavior in coordination games, and with this we hope to provide another piece of evidence showing the ability of deductive analysis to explain actual choices.

To study the link between reporting one's own risk preferences and strategy choices in coordination games, we use a two-conditions, between-subject design. In one condition, we ask participants to answer a short questionnaire about their risk preferences and immediately after this we have them play a 2×2 coordination game characterized by two Pareto-ranked pure-strategy Nash equilibria. The questionnaire consists of three questions, all of which are derived from the general risk question in the SOEP survey. The questions were carefully formulated so that they did not suggest any level of risk tolerance—risk loving, risk neutral or risk averse. In the other condition, subjects played the coordination game right away.

Our experimental results reveal significant evidence that completing 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 played the coordination game without having previously completed the questionnaire chose the Pareto dominant strategy in the game. Once we had subjects answer the questionnaire before they played the game, this proportion was reduced to one half. We also report results from an additional condition in which there was a time gap of one week between filling out the questionnaire and playing the coordination game and show that the effect that the act of stating one's own risk preferences produces on strategy choices is not ephemeral but rather endures for a rather long period of time.

Our results suggest an additional research question: If subjects do play best responses, could the change in strategic behavior induced by completing the questionnaire be explained by a change in the subjects' risk preferences or a change in their beliefs? With the help of two additional conditions in which the subjects' first-order beliefs were elicited, we addressed this research question and found little support for the idea that the act of completing the questionnaire changes beliefs. This result implies that, within a best-response correspondence framework, the systematic change in strategy choices after completing the questionnaire is induced by a change in subjects' risk preferences. In particular, after completing the questionnaire about their own risk preferences, the subjects become on average more risk averse.

The result that the act of reporting one's own risk preferences alters strategy choices in a subsequently played coordination game is unexpected in light of standard economic theories. We find evidence that people systematically violate the requirement of consistency, which stipulates that in theoretically equivalent situations one will always choose the same alternative. Furthermore, our results challenge the idea that people make strategy choices based on deductive analysis. We attempt to explain our findings by means of focal points, framing and uncertain preferences.

The paper proceeds as follows. The next section introduces the experimental design and procedure. Section 3 presents the research hypotheses and experimental results. In Section 4, we offer a short discussion aiming to provide some explanations of our findings. Section 5 concludes.

2. Experimental Design and Procedure

2.1. Experimental Design

In all the experiments we report in this paper, we use a two-conditions (in one condition subjects answer a questionnaire about their risk preferences and in the other they do not) between-subjects design. In total, we present and discuss the results from five conditions: 1) subjects played a 2×2 coordination game (Condition C); 2) subjects first completed a questionnaire about their own risk preferences and immediately after this they played a 2×2 coordination game (Condition Q_C); 3) subjects first completed a questionnaire about their own risk preferences and one week later they played a 2×2 coordination game (Condition Q_1W_C); 4) subjects stated their first-order beliefs and then played a 2×2 coordination game (Condition B_C); 5) Subjects first completed a questionnaire about their own risk preferences, then stated their first-order beliefs and finally played a 2×2 coordination game (Condition Q_B_C). Conditions C and B_C are our control conditions and conditions Q_C, Q_1W_C and Q_B_C are our treatment conditions. The dependent measure that we study by means of the first three conditions is the frequency with which each of the two strategies in the 2×2 coordination game is chosen. The last two conditions are used to examine the distribution of subjects' beliefs about others' choices in the coordination game.

In all conditions, except condition Q_1W_C, consisting of more than one task, subjects performed the individual tasks one after the other, the only waiting time being associated with the time needed to collect the answer sheets from the first task and distribute the instructions and the answer sheets for the second (and third) task(s). In all conditions involving first completing the questionnaire and then performing additional tasks, subjects knew from the very beginning of the experiment that the experiment consisted of several parts but they did not have any further information about the second (and third) part.

The questionnaire consisted of three questions. All three questions were adapted from the general risk question used in the German Socio-Economic Panel Survey (SOEP).[4]

In Question 1, subjects were asked whether they liked taking risks; In Question 2, whether they always tried to avoid risks. Admissible answers were “Agree,” “Disagree”, and “Neither agree nor disagree.” In the third question, subjects were asked to determine their risk preference with greater precision by positioning it on a scale of 0 (most risk loving) to 100 (most risk averse). The question that was most important for this study was the last one. The first two questions were added with the intention of making subjects take the time to carefully assess their attitudes to risk.

We define the baseline game as a 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). The entries of the payoff matrix are expressed in experimental currency units. The following exchange rate was used to convert them into euros: 25 ECU = 1 euro. The players had complete information about the strategy space and the payoff function. Each subject played the game against an anonymous other participant.

[4] The general risk question in the SOEP survey is as follows: „How do you see yourself: are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please tick a box on the scale, where the value 0 means: not at all willing to take risks, and the value 10 means: very willing to takes risks.”

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

FIGURE 1. —The baseline game

We used the quadratic scoring rule (Murphy and Winkler 1970) to elicit subjects' first-order beliefs. 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. Selten 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 consideration the remark of Kahneman and Tversky (1973) that even if subjects can quantify their beliefs they might find some forms of quantitative beliefs processing more meaningful than others, and following Biel (2009), we elicit beliefs by asking about the number of players (out of 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, whether subjects would be paid for the beliefs elicitation part or for the coordination game part was determined by a flip of a fair coin at the end of the experiment.

2.2. Experimental Procedure

The experiment was carried out at MaXLab, the experimental laboratory of the University of Magdeburg between March and November 2010. Participants were recruited using ORSEE software (Greiner 2004) from a pool consisting primarily of students from various faculties. We imposed only one restriction on the recruitment process: no economics or management students were invited to our experiment. The rationale for 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 rather than on other considerations, such as which strategy was the optimal one according to their game theory classes. None of the invited participants had any previous experience with coordination games. No subject participated in more than one session. 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 our experiments—56 in condition C, 54 in condition Q_C, 35 in condition Q_1W_C, 24 in condition B_C and 23 in condition Q_B_C.

Upon arrival at the laboratory, subjects were seated in a single-person cabin with arrangements made 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 condition, two parts for the subjects in the second, third and fourth conditions, and three parts for the subjects in the fifth condition. These were as detailed in the previous section. Depending on the treatment, the duration of the whole experiment took between 20 and 40 minutes.

No remuneration was provided for completing the questionnaire. However, subjects were instructed that their answers would 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 participants were made row players. They were also 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 had completed their strategy choices. The matching procedure involved drawing a numbered ball from an urn containing n balls (with n being the number of subjects in a given session) and writing down, in a special field on their answer sheets, the number 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. All subjects were informed about the matching procedure.

The payoff matrix presented in Figure 1 and the exchange rate of 25 ECU = 1 euro were used to determine the remuneration for each subject, depending on 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 euros and the minimum payoff was 0 euros. The payoffs depended on the strategies that subjects and their randomly matched partners had chosen in the 2×2 coordination game, where Strategy A was the risky strategy, resulting in either the maximum possible payoff of 8 euros or the minimum possible payoff of 0 euros and Strategy B was the riskless strategy resulting in a payoff of at least 5 euros and at most 6 euros.

In the beliefs elicitation part of the experiment, subjects were asked to imagine that 100 individuals played the coordination game presented in Figure 1. They were then asked to write down the number of people from 100 (denoted as p) whom they believed would play strategy A. Subjects' payoff for this part of the experiment was then determined depending on one of the following states of the world: If their randomly assigned partner in the coordination game had chosen Strategy A, the euro payoff was calculated with the help of formula (1), otherwise the euro payoff was calculated with the help of formula (2).

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

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

Participants were told that their payoff would be maximized if they reported 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 depending on p (payoffs were calculated in increments of 5). The maximum payoff subjects could earn for stating their beliefs was 15 euros and the minimum payoff was 0 euros. The exact payoff depended on p and on the state of the world. The average payoff subjects received for this part was around 10 euros. The beliefs elicitation part was always followed by the coordination game and subjects were instructed that at the end of the experiment they would be paid either for the beliefs elicitation part or for the coordination game part, with the decision being taken on the basis of a fair coin flip.

3. Hypotheses and Results

We present in this section our research hypotheses and experimental results. We first discuss our main hypothesis regarding the relationship between the act of stating one' own risk preferences and strategy choices in a subsequently played coordination game. To gain additional insights into the motivational bases of subjects in the coordination game, we address also the question whether beliefs elicitation influences choices in the coordination game. Furthermore, we present the distributions of self-reported beliefs and risk preferences and discuss how they relate to actions in the coordination game.

One assumption of standard economic theory is the so-called internal consistency of preferences, which states that in theoretically equivalent situations people will always choose the same alternative. A common feature of all theories of equilibrium selection in coordination games is their reliance on deductive analysis. Deductive equilibrium analysis prescribes what strategy choices rational players should make under the assumption of common knowledge of rationality, if they use only the information provided by the game, i.e., strategy space and payoff structure.

In other words, subjects' strategy choices are assumed to be independent of historical accidents and dynamic processes. The following hypotheses should find support, if the participants in our experiment behave according to either of these two normative principles.

Hypothesis 1: The act of stating one's own risk preferences does not have any impact on the behavioral choices made in the subsequently played 2×2 coordination game.

Hypothesis 2: The act of stating one's own first-order beliefs does not have any impact on the behavioral choices made in the subsequently played 2×2 coordination game.

The hypothesis of key interest for this study is the first one, but as we have two conditions in which we elicit subjects' first-order beliefs, it is important to control for any effects that the act of stating one's beliefs may exert on strategy choices made in the coordination game.

The summary data of the distributions of choices in the coordination game from conditions C, Q_C, Q_1W_C and B_C are given in Table 1. We performed one-tailed Z-test for the significance of the difference between two proportions for each of the following sample pairs—C vs. Q_C, C vs. Q_1W_C and C vs. B_C. The corresponding z-statistics and p-values are reported in the last two rows of Table 1.

Table 1

Distribution of strategy choices in the coordination game

	C	Q_C	Q_1W_C	B_C
Number of participants	56	54	35	24
Strategy A chosen	37 (66 %)	27 (50%)	19 (54%)	15 (63 %)
Strategy B chosen	19 (34 %)	27 (50%)	16 (46%)	9 (37 %)
z-statistics	-	1.7083	1.1243	-0.3069
p-value	-	0.0438**	0.1305	0.3795

** Significant at the 10 percent level*
*** Significant at the 5 percent level*
**** Significant at the 1 percent level*

Looking first at the data from condition C and Q_C, we observe that approximately one third of the subjects in condition C played strategy B in the coordination game, while this strategy was chosen by as much as one half of all subjects in condition Q_C. The p-value of 0.0438 indicates that the difference between the proportion of subjects playing the risk dominant strategy B in condition C and Q_C is significant at the 5 percent level. That is, subjects who first reported their own risk preferences and then played the coordination game, chose strategy B more often than subjects who played the game right away.

This result is unexpected in light of the assumption of the internal consistency of preferences in standard economic theory. It is inconsistent also with the assumption of strategy selection based on deductive analysis. Subjects in both conditions C and Q_C played exactly the same coordination game under exactly the same conditions (i.e., recruiting process, matching procedure). The only difference between the two groups is the fact that subjects from condition Q_C first stated their own risk preference in a short questionnaire and then played the game, while subjects in condition C started by playing the game. Our experimental data provide significant evidence that the distribution of strategy choices in the coordination game changes depending on whether subjects were asked to assess and state their risk preferences. Based on this evidence, we reject Hypothesis 1.

It is interesting to examine whether the effect which the act of stating one's own risk preference produces on strategy choice in the coordination game is ephemeral or lasts for some time. In condition Q_C, the coordination game was played immediately after completing the questionnaire. In contrast, in condition Q_1W_C, subjects completed the questionnaire one week before they played the coordination game. Looking at the third column in Table 1, we observe that the proportion of subjects who played strategy B is higher by 11 percent in condition Q_1W_C than in condition C. The p-value of 0.1305 indicates that this difference is not statistically significant. However, it is relatively large and it is in the same direction as the difference between condition C and Q_C. This observation provides some evidence about the robustness of the result that the risk dominant strategy B is more often played after reporting one's own risk preferences. It also indicates that the effect of completing the questionnaire is not ephemeral but rather endures for some time.

In the last column of Table 1, we report the distribution of choices in the coordination game made in condition B_C, in which we first asked subjects to state their first order beliefs and then let them play the game. The proportions of subjects choosing each of the strategies in the game in that condition are almost identical to the proportions in condition C. This impression is confirmed also by the insignificant p-value of 0.3795. Based on this result, we cannot reject Hypothesis 2.

One approach to the strategy selection problem in the coordination game could be derived from the game's reaction correspondence (best response correspondence). Based on her best response correspondence, each player will choose to play A (B) if she believes that the other player in playing A with probability β larger (smaller) than $\bar{\beta}$, where the threshold value $\bar{\beta}$ corresponds to the mixed-strategies equilibrium. From this definition it follows that a strategy choice in the coordination game is a function of the subject's beliefs and risk preferences with the theoretical effect of beliefs optimism working opposite to the effect of risk aversion.

Table 2:

Summary statistics of self-reported beliefs and risk preferences

	B_C	Q_B_C	Q_C	Q_1W_C
Number of participants	24	23	54	35
Average	68	74	47	48
Median	70	85	42.5	55
p-value	0.192		0.883	

	Q_C		B_C & Q_B_C	
	A	B	A	B
Number of participants	27	27	33	14
Average	43	51.5	81	43
Median	40	55	85	42.5
p-value	0.087*		5.97E-7***	

** Significant at the 10 percent level*
*** Significant at the 5 percent level*
**** Significant at the 1 percent level*

We observed a change in strategic behavior after the act of completing the questionnaire. We will now examine whether this change in strategic behavior was triggered by a change in the distribution of the subjects' beliefs. Keeping everything else constant, subjects will play strategy B more often if they believe that it is less likely to encounter a partner who is playing strategy A (i.e., if they hold more pessimistic beliefs). The summary statistics of the distribution of beliefs from conditions B_C and Q_B_C are given in the first two columns of the upper panel of Table 2. The whole distributions of self-reported beliefs in these two treatments are depicted in panel a) of Figure 2. All p-values reported in Table 2 are calculated by means of a two-tailed Wilcoxon rank-sum test with the null hypothesis that Vectors x and y are independent samples from two continuous distributions with equal medians.

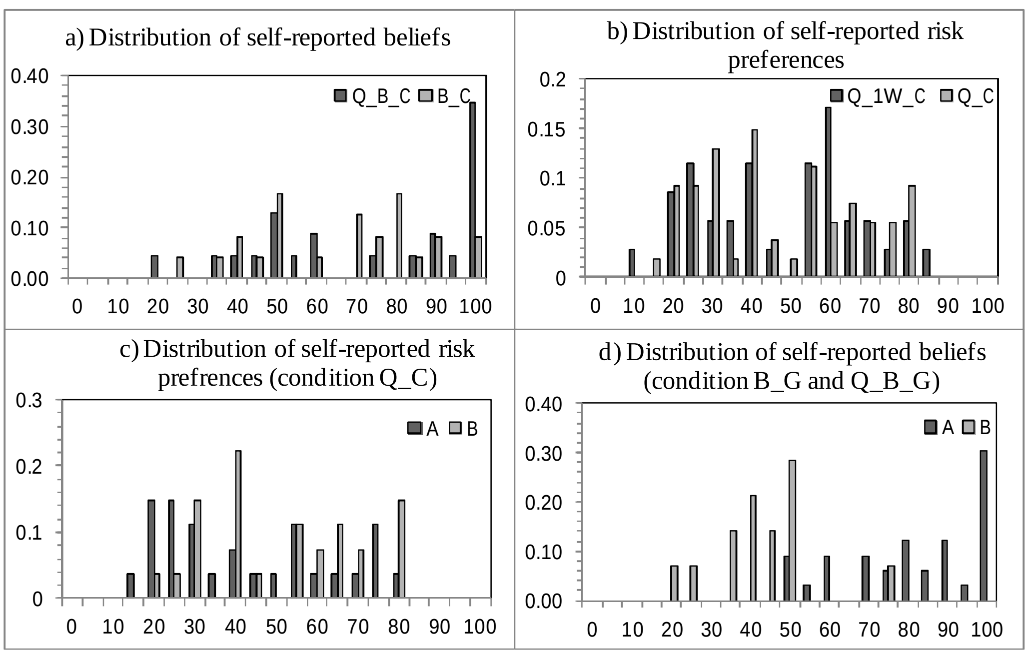

FIGURE 2.—Distributions of self-reported beliefs and risk preferences

Our "belief measure" corresponds to the number of people out of 100 which our participants believed would play strategy A on the coordination game. We observe from Table 1 that the median belief was higher in condition Q_B_C than in condition B_C. This difference, however, is not only insignificant but it is also in the opposite direction from what we would have expected was a change in beliefs responsible for the change in strategy choices in the coordination game. Panel a) of Figure 2 also does not depict any pronounced difference between the distribution of beliefs in the two treatments. From these results we conclude that the act of reporting ones' own risk preferences does not change the distribution of first-order beliefs.

We have not yet discussed the answers given in the questionnaire. The main reason to postpone the discussion about the distribution of risk preferences was that we wanted to stress the point that the act of self-assessing and stating one's own risk preferences changes strategic behavior in the subsequently played coordination game and that the precise answers given in the questionnaire are not important for the observed shift in behavior. We also argued that it is not clear whether one-dimensional incentive-incompatible risk questions are a good method for measuring risk preferences. However, for the sake of completeness, in the last two columns of the upper panel of Table 2 we present the summary statistics of the self-reported risk preferences on Question 3 from condition Q_C and Q_1W_G (we do not report the exact answers from the first two questions because they were very general and subjects often answered them inconsistently or by "neither agree nor disagree"). The distribution patterns from these two treatments are depicted in panel b) of Figure 2. Subjects from the two conditions did not report statistically different risk preferences. We also observe that approximately half of the subjects said that they were risk loving and half said that they were risk averse.

From the first two columns of the lower panel of Table 2 and panel c) of Figure 2, we observe that subjects who played strategy B in the coordination game reported that they were on average slightly more risk averse than subjects who played strategy A. This difference is significant only at the 10 percent level and does not provide strong evidence that subjects playing the risk dominant strategy have different risk preferences from the subjects that play the payoff dominant strategy in the coordination game.

In contrast to self-reported risk preferences, self-reported beliefs have strong predictive power for the strategy choices in the coordination game. In the last two columns of the lower panel of Table 2 we present the summary statistics of beliefs held by subjects who played each of the two strategies in the coordination game. (To obtain a larger sample size we pooled the data from conditions Q_B_C and B_C. This is possible, because as we showed above the act of completing the questionnaire does not change the distribution of beliefs.) The median belief of subjects who played A is twice as high as the median belief of subjects who played B. The difference between the two distributions is significant at the 1 percent level. In panel d) of Figure 2 it is also clear that subjects who played Strategy A held more optimistic beliefs than subjects who played Strategy B.

4. Discussion

Our main result, that the act of reporting one's own risk preferences alters strategy choices in a subsequently played coordination game, is not predicted by standard economic theories. Our experimental data show that people systematically violate the requirement of consistency. Furthermore, it turns out to be difficult to justify the finding that the change in strategic behavior in the coordination game (after completing the questionnaire) is not triggered by a change in beliefs. This is because, under the assumption that subjects' behavioral choices can be readily analyzed within the reaction-correspondence framework of the coordination game, the result of no change in beliefs after completing the questionnaire implies that the change in strategic behavior is triggered by an increase in subjects' risk aversion. This argument, however, is at odds with the assumption of stable risk preferences. The results we report in this paper also challenge the idea that players choose strategy choices based on deductive analysis. We now present several arguments from behavioral economics and quantum game theory which might be used to explain our findings.

4.1. Focal Points

One behavioral approach to strategy selection in coordination games rests on the idea of focal points. Schelling's (1960) seminal experiments show that people are sometimes able to successfully coordinate their actions by drawing on a shared perception of "prominence" or "salience." In one experiment, for example, Schelling

(1960) reports that, when asked to choose between heads and tails in a coin flipping 2×2 game paying one unit of payoff, if both players choose the same strategy and zero otherwise, 86 percent of his American subjects chose heads. This result was replicated for subjects in England by Mehta et al. (1994a, 1994b), who found that an almost identical 87 percent of the participants chose heads. Schelling's (1960) concept of salience is based on the idea that people in coordination games are looking for strategies that "suggest themselves" and are obvious or natural.

Many researchers argue that the Pareto-dominant equilibrium is a natural focal point in (symmetric) coordination games (see e.g., Schelling 1960, Harsanyi and Selten 1988). Colman (1997) provides a psychological justification, the so called Stackelberg heuristic, of focusing on and therefore selecting the Pareto-dominant equilibrium. Our experimental data, do indeed show that in condition C, in which subjects play only the coordination games, approximately two thirds of the participants chose the Pareto-dominant strategy A. If people choose strategies based on silence, the distribution of choices in the coordination game in condition Q_C, could then be explained by a change in subjects' perception of which strategy is more salient after answering the questionnaire. After reporting their own risk preferences, subjects start to explicitly think about risk and probably recognize that their partners also explicitly think about risk. As a result, it might appear to some of them that the risk dominant strategy B is the more natural choice.

4.2. Framing

A concept closely related to the phenomenon of focal points is framing. For example, the salience of strategies might be varied by varying their labels, which are part of the way in which a decisions problem is framed. Tversky and Kahneman (1981) define a decision frame as the "decision-maker's conception of the acts, outcomes, and contingencies associated with a particular choice." They further argue that the "frame that a decision maker adopts is controlled partly by the formulation of the problem and partly by the norms, habits and personal characteristics of the decision-maker." It is often possible to frame the same decision problem in several different ways.[5] Tversky and Kahneman (1981) also show that framing a decision problem in terms of gains induces risk-averse behavior, while framing it in terms of losses induces risk-loving behavior.

The effect of different specifications of the decision problem on strategy selection in coordination games was extensively studied (e.g., 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]). Decision frames, however, according to the definition of Tversky and Kahneman (1981) are determined not only by the external structure of the game but also by the personal characteristics of the decision-maker. Bacharach and Bernasconi (1997) also stress the importance of the subjective perception of the game influenced by subjects' personal characteristics. They define a decision frame as the set of variables subjects use to conceptualize the game. They further note that frames may vary both across players and from occasion to occasion.

In our experiments, subjects in all conditions played the same coordination game. Thus, the difference in the distributions of choices between conditions C and Q_C cannot be explained by the external structure of the game. It is possible, however, that subjects who reported their risk preferences perceived the decision problem they were faced with in the coordination game differently from subjects

[5] In a famous experiment Tversky and Kahneman (1981), demonstrated the power of frames to influence decision choices, as follows. Subjects were told to imagine that the US was preparing for the outbreak of a disease, which was expected to kill 600 people. To combat the disease two programs had been proposed, whose consequences were known. Subjects in problem 1 were asked to choose between program A and B. Subjects in problem 2 were asked to choose between program C and D. The number in the brackets after each program shows what percentage of the participants chose the given program.

Program A: If program A is adopted, 200 people will be saved. [72 percent]

Program B: If program B is adopted, there is one third probability that 600 people will be saved, and two thirds probability that no people will be saved. [28 percent]

Program C: If problem C is adopted, 400 people will die. [22 percent]

Program D: If program D is adopted, there is one third probability that nobody will die, and two thirds probability that 600 people will die. [78 percent]

Problem 1 and 2 are effectively identical but the preferences over the different alternatives in the two problems are very different. The results of this experiment show that people are risk-averse for gains and risk-loving for losses.

who had not completed the questionnaire. Depending on their reference point for example, the choice between the two strategies in the coordination game can be represented as a choice between lotteries framed in terms of gains (if the reference point is one of the payoffs [or some combination of them] that are associated with the risk dominant strategy) or in terms of losses (if the reference point is the highest attainable payoff associated with the equilibrium point [A, A]). According to the specific frame subjects adopt in describing the coordination game to themselves, some subjects will try to avoid taking risks and opt for the risk dominant strategy B, while others will seek out risk and opt for the Pareto-dominant strategy A. Following this argumentation, we can argue that, in our experiment, in condition Q_C more subjects perceived the decision problem in the coordination game as a choice between lotteries formulated in terms of gains than in condition C, and as a consequence more subjects in the condition with the questionnaire opted for the risk dominant strategy.

4.3. Uncertain Preferences

In standard economic theory, the type of a player is deterministic. It is assumed that people have stable preferences which do not interact with or depend on the specific environment in which decisions are made. This view is very restrictive and leaves many behaviors that are observed in experiments or in real life unexplained. Lambert-Mogiliansky et al. (2009) introduce a model of uncertain preferences based on the mathematical formalism of quantum mechanics. In the quantum mechanical framework, the type of a player is not deterministic. Rather there is inherent indeterminacy of preferences. The main idea in the Lambert-Mogiliansky et al. (2009) framework is to view the type of a person as a quantum mechanical system. The following analogy is used to link quantum mechanics to uncertain preferences. Any decision situation is modeled as a measurement of a player's type. The result of this measurement is one element from the set of all possible actions in the given decision situations. Prior to the decision situation, every player is in a state that is a linear combination of all possible behaviors (that is, all possible elements in the set of actions) that can be adopted in the decision situation. When subjects are asked to make a decision, one of all possible behaviors is realized and translated into the specific actions subjects take.

One interesting property of a quantum system is that depending on whether two (or more) decision situations "do not commute" or "commute", an order effect will or will not be observed, respectively. In the case when the decisions situations "commute", the predictions of the quantum model of preferences coincide with the predictions of standard economic theory. But if the two decision situations "do not commute", people will make different choices depending on the order in which the decision situations have been encountered. An inconvenience associated with the quantum mechanical framework is that the only way to ascertain whether two decision situations commute is through experiments. Once this is done, however, many different behavioral phenomena can be easily explained by allowing that subjects possess uncertain preferences.

We considered the following decision situations: One decision situation was to assess and state one's own risk preferences and the other was to choose strategy A or B in the coordination game. We found that strategy choices made in the coordination game in the condition in which the subjects played the coordination game right away were different from strategy choices made in the condition in which subjects first reported their risk preferences. Based on this result and the quantum framework of risk preferences we can argue that the questionnaire and the coordination games are two decision situations which do not commute and that therefore the order in which they are played matters for the determination of actual choices.

5. Conclusion

This study reports experimental evidence that strategy choices in a one-shot symmetric 2×2 coordination game are systematically altered by the act of stating one's own risk preferences. To be precise, subjects who completed the questionnaire about their risk preferences more often chose the risk dominant strategy in the coordination game. This result contradicts the assumption of internal consistency of preferences. In addition, it implies that people rely on inductive rather than on deductive principles when making strategy choices. We also find that the change in behavioral choices in the coordination game played after completing the questionnaire was not induced by a change in beliefs. Within a best-response correspondence framework, these two results taken together imply that subjects should have become on average more risk averse after reporting their risk preferences. This argument raises questions about the stability of risk preferences. We argue that focal points, framing and uncertain preferences could be used to explain our results.

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Appendix Written Experimental Instructions

In this appendix, we include the written experimental instructions of Condition Q_B_C. The instructions of all other conditions can be replicated from the written experimental instructions of Condition Q_B_C. In particular: In Condition C, subjects were only asked to play the 2×2 coordination game; In Condition Q_C, subjects were instructed to first fill out the questionnaire about their own risk preferences and immediately after that to play the 2×2 coordination game; In Condition Q_1W_C, subjects first filled out the questionnaire about their own risk preferences and one week later they played the 2×2 coordination game; In Condition B_C, subjects were asked to state their first order beliefs and then play the 2×2 coordination game.

Condition Q_B_G

Welcome to our today's experiment! Below you will find the description of the experiment and then you will be asked to make a series of decisions. Please read the following information very carefully. If you have any questions, please ask before the experiment starts. Please note that during the whole experiment, communication with the other participants is not allowed. Thank you!

The Experiment

This is a hand-run experiment consisting of two parts. You get separate instructions for each part of the experiment. Please write a chosen from you pseudonym in the upper right blank on your decision sheets. Please read the complete instructions at first and ask any questions you may have. After that, please make your decisions.

At the end of the experiment you will be informed about your earnings and you will be privately paid.

Part 1

Pseudonym:

Instructions

In this part of the experiment you are asked to answer several questions about your personality. Please answer question 1 and question 2 with “Agree”, “Disagree” or “Neither agree nor disagree”. In question 3, you are asked to position yourself on a scale between 0 and 100 according to your risk preferences, where 0 indicates the maximal risk-loving behavior, 100 indicated the maximal risk-averse behavior. Please note that there are no “right” or “wrong” answers. The results are being used in scientific research, so please try to be as accurate as possible in answering the questions.

The questionnaire

1. I like taking risks — o Agree o Disagree o Neither agree nor disagree
2. I always try to avoid situations involving risk — o Agree o Disagree o Neither agree nor disagree
3. Please position yourself on the following scale between 0 and 100 according to your risk preferences, where 0 indicates the maximal risk-loving behavior, 100 indicated the maximal risk-averse behavior.

0 10 20 30 40 **50** 60 70 80 90 **100**

risk-loving **risk-averse**

Part II

Instructions

The following game is played one time. You will be told whether you play as the "Row player" or as the "Column player". Your partner plays the other role. You will be randomly matched with your partner upon competition of your decision choice. The table bellow shows the game you play:

Column Player

Row Player

	A	B
A	(200,200)	(0,125)
B	(125,0)	(150,150)

You have to decide between the two possible strategies A and B. Your payoff depends on your decision as well as on the strategy selected by your partner. There are four possible strategy combinations (A, A), (A, B), (B, A), (B, B). In the table above, you can find the corresponding payoffs. The first number in a field represents the payoff of the row player and the second number represents the payoff of the column player. The payoffs are given in experimental currency units (ECU).

Payoff mechanism

Your payoff depends on the resulting strategy combination. Please note that the payoffs in the table are given in ECU. To convert the given payoffs in Euro please use the following exchange rate:

25 ECU = 1 Euro

Decision 1

Imagine that 100 subjects play this game.

Please write down how many subjects (a number p between 0 and 100) out of the 100 subjects you believe would play strategy A.

Payoff mechanism for decision 1

For the determination of your payoff, you will be randomly matched with a partner. Your payoff will be determined according to one of the following two cases:

Case 1: Your partner has chosen strategy A:

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

p = number of players (out of 100) whom you believe would play strategy A

Example for the amount of your payoff in Case 1 for different values of p :	
p = 0 → 0,00 euros	p = 55 → 11.96 euros
p = 5 → 1,46 euros	p = 60 → 12.60 euros
p = 10 → 2,85 euros	p = 65 → 13.16 euros
p = 15 → 4,16 euros	p = 70 → 13.65 euros
p = 20 → 5,40 euros	p = 75 → 14.06 euros
p = 25 → 6,56 euros	p = 80 → 14.40 euros
p = 30 → 7,65 euros	p = 85 → 14,66 euros
p = 35 → 8,66 euros	p = 90 → 14,85 euros
p = 40 → 9,60 euros	p = 95 → 14,96 euros
p = 45 → 10,46 euros	p = 100 →15,00 euros
p = 50 → 11.25 euros	

Case 2: Your partner has chosen strategy B:

$$Payoff = 15 - 15\left(\frac{p}{100}\right)^2$$

p = number of players (out of 100) whom you believe would play strategy A

Example for the amount of your payoff in Case 2 for different values of p :	
p = 0 → 15,00 euros	p = 55 → 10.46 euros
p = 5 → 14,96 euros	p = 60 → 9,60 euros
p = 10 → 14,85 euros	p = 65 → 8,66 euros
p = 15 → 14,66 euros	p = 70 → 7,65 euros
p = 20 → 14,40 euros	p = 75 → 6,56 euros
p = 25 → 14,06 euros	p = 80 → 5,40 euros
p = 30 → 13,65 euros	p = 85 → 4,16 euros
p= 35 → 13,16 euros	p = 90 → 2,85 euros
p = 40 → 12,60 euros	p = 95 → 1,46 euros
p = 45 →11,96 euros	p = 100 → 0,00 euros
p = 50 → 11,25 euros	

Please note

With the above-described payoff mechanism, your (expected) payoff will be maximized if you state your true beliefs.

Decision 2

You play the game with your randomly assigned partner from Decision 1.

Payoff mechanism for decision 2:

Your payoff is determined by the combination of your own strategy choice and that of your partner.

Please note

You will be remunerated for only one of the two decisions. The decision which will be paid out will be randomly determined (by a toss of a fair coin) at the end of the experiment. If “heads” falls, Decision 1 will be paid out. If “tails” falls, Decision 2 will be paid out.

Pseudonym:

Decision sheet

Decision 1

Please make your Decision 1 now.

p =

(p = number of players (out of 100) whom you believe will play strategy A)

Decision 2

You play as the "Row player". Please make your decision now.

Column Player

Row Player		A	B
	A	(200,200)	(0,125)
	B	(125,0)	(150,150)

Please indicate the strategy you choose to play in the field below.

Now you will be randomly assigned a participants number. Please record that number in the field bellow.

Otto von Guericke University Magdeburg
Faculty of Economics and Management
P.O. Box 4120 | 39016 Magdeburg | Germany

Tel.: +49 (0) 3 91 / 67-1 85 84
Fax: +49 (0) 3 91 / 67-1 21 20

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