

Ambiguity when Playing Coordination Games Across Cultures

Joanne Peryman*
Behavioural Business Lab, RMIT University

David Kelsey
Nottingham University Business School
and
University of Exeter Business School

7 February 2020

Abstract: Cultural differences can be a source of ambiguity in coordination games. As players are likely to experience more ambiguity when playing a different culture, we expect players to choose safer strategies. We run experiments with a stag hunt and bargaining coordination game. Using a between-subjects design, we vary the identity of the opponent between someone of the same culture or a different culture. We compare the responses of British and East Asian students at the University of Exeter and show the cultural identity of the opponent by physical appearance. While we find no significant differences between treatments for East Asians, the British choose the safer option in the stag hunt and demand more of the pie in the bargaining game when faced with an opponent from a different culture.

*Corresponding author, email: jo.peryman@rmit.edu.au

Acknowledgments: We are grateful to Miguel Fonseca, Brit Grosskopf, Simon Gächter, Jürgen Eichberger, Jörg Oechssler, and two anonymous referees for their valuable suggestions and feedback. We are also grateful to seminar participants at the University of Exeter, the FUR Conference, and the ESA World Meetings for their helpful comments. We also thank Anna Morozova and Bing Chao for assistance in running the experiment. Finally, we thank the University of Exeter's Behaviour, Decisions and Markets research centre for funding our experiment.

1. Introduction

Coordination is important for many economic decisions, such as firms deciding on output and pricing decisions without knowing the decisions of their competitors, or Governments setting trade policy without knowing the strategies of other countries. People from different backgrounds may use different heuristics when trying to coordinate with others. Knowing how culture affects the ability to coordinate will be useful for those engaging in trade or competition with people from other countries.

People from the same culture are likely to share similar norms and perhaps find it easier to predict the behaviour of their opponent, thus improving coordination. On the other hand, when playing against someone from a different culture, the players may be unfamiliar with each other's norms and need to rely on cultural stereotypes to try and predict the opponent's behaviour. We expected players to experience more ambiguity when playing against someone from a different culture and therefore choose safer strategies in coordination games.

We ran two types of coordination games – a stag hunt and a bargaining game. While we did not find East Asian students to differentiate between a British or East Asian opponent, the British students tended to act very differently against an East Asian opponent compared to a British opponent. In a stag hunt game, the British students played the safer strategy more often against an East Asian opponent, while in a bargaining game they demanded more of the pie. We also collected data on expectations, which showed that British students expected East Asians to choose safer strategies compared to other British.

One possible reason for our results could be that the British were basing their behaviour on a cultural stereotype that East Asians are cautious. However, our results show that this stereotype is misleading. This interpretation is in-line with previous research by Hsee and Weber (1999), who found that both Americans and Chinese predicted Chinese to be more risk averse than Americans, even though experimental results showed the opposite.

2. Background Literature

2.1 Social Norms and Group Identity

Previous literature has demonstrated the importance of social norms (e.g. Singh, 2012) and group identity (e.g. Benjamin *et al*, 2010; Chen and Chen, 2011; Chen *et al*, 2014) for coordination game outcomes. As culture is one aspect of identity, we can expect a group identity to be stronger when players are from the same cultural background. Chen and Chen (2011) show that a salient group identity increases coordination on Pareto superior outcomes in the minimum effort coordination game (Huyck *et al*, 1990). As Chen and Chen impose only minimal group identities in the lab¹, we can expect natural group identities such as culture to have an even stronger effect.

Similarly, social norms are culture specific, and norms of sharing and cooperation within a community are likely to increase efficiency in coordination games. Singh (2012) considers how norms of trust within a society will affect behaviour in the stag hunt game. Payoffs for a typical two-player stag hunt game are illustrated in Table 1. The story goes as follows. Players must choose whether to hunt a stag or a hare when out hunting. Capturing a stag is more valuable than a hare but requires the help of both

¹ Minimal groups are where participants are randomly allocated to groups and given an arbitrary label such as the “blue” or “yellow” group.

players. Therefore, if a player hunts a stag without the assistance of the other player, he will receive a payoff of zero. Capturing a hare is easier and guarantees a small but sure payoff. We assume that players are separated and cannot communicate while on the hunt, thus coordination is important for reaching an equilibrium.

Table 1: Stag Hunt Game

		Player 2	
		Stag	Hare
Player 1	Stag	3, 3	0, 2
	Hare	2, 0	2, 2

There are two pure strategy Nash equilibria in this game. The payoff dominant equilibrium is where all players help in hunting a stag and obtain maximum payoffs. However, there is also a risk dominant equilibrium, where each player guarantees him or herself a sure payoff from hunting a hare. When there is uncertainty about the opponent's action, such as under ambiguity, a choice of hare yields a higher expected payoff and drives players towards the risk dominant equilibrium. There is also a mixed strategy equilibrium, where each player hunts stag with a $2/3$ probability.

According to Singh (2012), people from societies with a norm of high trust are more likely to coordinate on the payoff dominant outcome in a stag hunt, whereas people from societies with a norm of low trust will be driven towards the risk dominant equilibrium. We expect ambiguity to work in a similar way to the low trust norm. Where players are unfamiliar with their opponent's social norms, we believe they will prefer the safer strategy of hunting hare.

2.2 Expectations and Stereotypes

Bordalo *et al* (2016) build a model of stereotypes, which shows that stereotypes are created when a characteristic is more common in a social group compared to other social groups, even when the characteristic is not the most common within the social group. For example, most people in Florida are not elderly, but there are a greater proportion of elderly people in Florida compared to other states, giving rise to a stereotype of Floridians being elderly. Bordalo *et al* (2016) relate their findings to Kahneman and Tversky's (1972) representation heuristic, in that stereotypes work as a heuristic to simplify the representation of social groups.

Expectations of other peoples' behaviour sometimes rely on stereotypes, which do not necessarily represent the social norm². For example, Fershtman and Gneezy (2001) find that men of Eastern Jewish origin (Asian or African) in Israel are discriminated against in a trust game because they have an ethnic stereotype of being untrustworthy. However, the stereotype was found to be unjustified as Eastern Jewish participants did not send back significantly lower amounts than men of European or American Jewish origin. They also find men of Eastern Jewish origin to be allocated more money in an ultimatum game because they have a stereotype of reacting harshly to unfairness. Again, this stereotype was unfounded in actual rejection rates.

Similarly, Hsee and Weber (1999) find predictions of risk aversion in Chinese and American participants to be in contrast to actual behaviour. Participants apparently rely on a misleading cultural stereotype that Americans are more risk seeking than Chinese, probably because Americans are portrayed as risk seeking in movies. In fact,

² Stereotypes are often correlated with social norms, as people gain utility from belonging to a group and thus often prefer to conform to group stereotypes in order to reinforce their group membership (Geisinger, 2004; Shih *et al*, 1999).

the results showed the opposite, with Chinese being more risk seeking than Americans in financial lottery choice tasks. One caveat with Hsee and Weber's (1999) data is that participants received a flat fee, rather than being paid according to their decisions in the lottery choice and prediction tasks.

Participants in Hsee and Weber's (1999) study apparently relied even more on the misleading stereotype when trying to predict behaviour of those from a different culture. The Chinese participants expected Americans to be even more risk seeking than the American participants expected of each other. Similarly, the American participants expected the Chinese to be even more cautious than the Chinese expected of other Chinese. When trying to predict behaviour of people in other countries, participants have less scope to base their prediction on people they know, and thus rely more on stereotypes. This suggests that people will likely face more ambiguity when interacting with those from another culture.

2.3 Ambiguity and Coordination Games

Ambiguity refers to a situation where the relevant probabilities are unknown and cannot be estimated to a reasonable degree. Eichberger *et al* (2008) show that the identity of the opponent matters for ambiguity, with student participants experiencing more ambiguity when playing strategic games against a granny than a game theorist. Most students reported that the game theorist's behaviour was easier to guess than the granny and that they would prefer to play against the game theorist. As such, the students chose more ambiguity averse strategies against the granny than the game theorist. As people are less familiar with the social norms of other cultures, we expect they will experience more ambiguity when playing strategic games and therefore choose safer strategies.

A high degree of ambiguity can hinder coordination on the payoff dominant outcome in many coordination games. Eichberger and Kelsey (2002) consider a bargaining game where players can make claims on a total payoff, say 4, but if the claims exceed 4, everyone receives 0. As the players are not allowed to communicate, the game can be interpreted as a coordination game. Any outcome that exhausts the available surplus is a Nash equilibrium. However, with sufficient ambiguity, participants will prefer to claim lower amounts, leading to inefficient outcomes. The two-player version of this bargaining game where players can claim 1, 2, or 3 is illustrated in Table 2.

Table 2: Bargaining Coordination Game

		Player 2		
		3	2	1
Player 1	3	0, 0	0, 0	3, 1
	2	0, 0	2, 2	2, 1
	1	1, 3	1, 2	1, 1

The bargaining game discussed above differs from the stag hunt in that the bargaining game is a situation of strategic substitutes, whereas the stag hunt is a game with strategic complements. Strategic substitutes are where an increase in the opponent's action will decrease the marginal benefit of one's own action. For example, in the bargaining game above, a larger claim of the opponent decreases the marginal benefit of one's own claim. Strategic complements are the opposite: an increase in the opponent's action makes one's own action more beneficial, as in the stag hunt game. If the opponent switches from hunting hare to hunting stag, this increases the benefit of putting in the extra effort to hunt stag.

Eichberger and Kelsey (2002) show that ambiguity will have opposite effects in games with strategic complements and substitutes. In the bargaining game we have strategic substitutes and negative aggregate externalities, because an increase in demands of the opponent lowers payoffs. In this case an increase in ambiguity will lower equilibrium actions. Ambiguity aversion will cause a given player to overweight bad outcomes. With negative externalities, a bad outcome would be the opponent choosing a high strategy. With strategic substitutes this will reduce a given player's perceived marginal benefit of increasing his/her action. Since both players think this way the equilibrium actions will be lower with ambiguity.

The opposite result holds under positive externalities. With strategic complements, an increase in ambiguity will increase equilibrium actions under negative externalities but decrease equilibrium actions under positive externalities. The stag hunt game has positive externalities, i.e. a higher action by the opponent is beneficial, which means that ambiguity should lower equilibrium actions in the game, leading to the inefficient outcome where all players hunt hare. Therefore, an increase in ambiguity, perhaps by playing someone from a different culture, has undesirable implications for both the stag hunt and bargaining coordination games.

2.4 Previous Experimental Results

Kelsey and le Roux (2016) compare the level of ambiguity when playing against a local or a foreign opponent in coordination games with multiple equilibria. Their participant pool consists of students at the University of Exeter in the UK and St. Stephen's College in New Delhi, India. They firstly run the experiment in India and then match the students in Exeter with both another Exeter student and a foreign opponent from the Indian sample. Students in the Exeter experiment are explicitly told that they

are playing against students in India and are given some background information on the Indian students, e.g. that they are studying at a prestigious institution.

Kelsey and le Roux (2016) find no difference in the level of ambiguity when playing a local or foreign opponent. They offer the following reasons for this. Firstly, part of the experiment uses a within-subjects design where players face both a local and foreign opponent. Participants may have simply wanted to appear consistent in their choices against different opponents. In addition, some students were worried about appearing racist if they changed their behaviour towards the foreign opponents. We can tackle this first point by using a between-subjects design so that students are faced with *either* an opponent from their own culture or a different culture, but not both.

However, Kelsey and le Roux (2016) also point out that participants may have found it easy to conceptualise the foreign students and thought they were the same as any other students due to increasing globalisation. As universities in the UK have become very international, students are used to mingling with people from many different cultures and probably see more similarities than differences with their fellow students. This point is difficult to control for and can only be dealt with by extending the sample to non-students who perhaps have less interaction with others from abroad. Such an extension is a promising avenue for future work.

3. Experimental Design

We tested whether players from the same cultural background coordinated better when playing a stag hunt or a bargaining game. Players may view non-cooperative games as ambiguous if they find their opponent's behaviour difficult to predict (Eichberger *et al*, 2008; Eichberger and Kelsey, 2000). Cultural differences may

make it harder to predict people's behaviour. This is because players are less familiar with the social norms that drive behaviour in different cultures. As such, we predicted that players from different cultures will prefer safer strategies and therefore choose less efficient outcomes in coordination games.

We ran a between-subjects design where players faced either someone from their own culture or someone from a different culture, but not both. This was to remove the confound of participants wanting to appear consistent against different opponents, as noted by Kelsey and le Roux (2016). All participants played either a one-shot stag hunt game or a one-shot bargaining game. The reason we chose one-shot games was to make the decisions highly salient for the participants and avoid wealth effects in future rounds. We also wanted to avoid participants hedging risk between the two games, which is why each participant only played either the stag hunt or bargaining game, not both.

We recruited East Asian and British students to the Finance and Economics Experimental Laboratory (FEELE) at the University of Exeter. Using ORSEE (Greiner, 2004), we recruited participants based on surnames, with a mixture of East Asian and English surnames invited to sessions. We verified that all participants identified with the appropriate cultures by checking their responses to a follow-up questionnaire. A small number of participants with English surnames came from other individualistic English-speaking countries such as Australia and the United States. All of the participants with East Asian surnames were in fact from East (or South East) Asian

backgrounds, with the vast majority coming from China and a small number from Vietnam, Thailand, and Hong Kong³.

We ran two different treatments, which are summarised below:

Treatment One: The opponent was from the same culture, which was achieved by inviting either all East Asian or all British participants to sessions.

Treatment Two: The opponent was from a different culture. Here, we invited a mixture of East Asian and British participants and matched them against each other.

Table 3 shows the number of participants per treatment per culture.

Table 3: Number of Participants per Treatment per Culture

	East Asian	British
<u>Treatment One</u> : Same Culture	32	28
<u>Treatment Two</u> : Different Culture	32	32

The main reasons for choosing East Asians and British were that the two cultures have very different social norms and that they have obvious differences in physical appearance. To avoid experimenter demand effects⁴, we used physical appearance to subtly show the cultural identity of the participants. When participants arrived at the lab, they were greeted by an assistant who checked their names and then showed them

³ We understand that there are vast differences within both East Asian and Western cultures. However, the countries we classed as either East Asian or British all rank very similarly on Hofstede's cultural dimensions (1980). For example, on individualism, China, Vietnam, and Thailand all score 20 while Hong Kong scores 25. This compares to the UK's 89, Australia's 90, and the United States' 91.

⁴ Brislin and Lonner (1973, p. 70) note that experimenter demand effects, or "courtesy bias", are particularly prevalent in Eastern cultures, where participants like to please the experimenter.

to their seats. Seating was randomised in Treatment One, while East Asian and British students were seated on opposite sides of the room in Treatment Two⁵. The experiment instructions informed participants that they were randomly matched with another player who was seated on the other side of the room. However, to preserve anonymity we did not reveal who on the other side of the room they were matched with.

Given the large number of East Asian and British students studying at the university and small capacity of the lab (16 participants), we did not believe that having only East Asian or British students in a session or on one side of the room would feel unusual for the participants. However, we tested for experimenter demand effects by asking participants what they thought the experiment was about in a follow-up questionnaire, in the spirit of Benjamin *et al* (2010).

The experiment consisted of three stages: priming, stag hunt game or bargaining game, and follow-up questionnaire. All of the stages were run on computer terminals using z-Tree (Fischbacher, 2007). Full instructions for the experiment are available in Appendix One. Participants were given each set of instructions separately for each stage of the experiment.

3.1 Priming

Players were primed before taking part in the game, in order to make their cultural identities salient. We used a questionnaire to subtly get participants thinking about their own culture (Shih *et al*, 1999). This type of priming avoids inducing any particular stereotype which may affect behaviour. For example, showing American participants the Statue of Liberty may induce a feeling of freedom. Inducing stereotypes

⁵ We ran two sessions here to swap which side of the room the East Asians and British were seated on, in case this had any effect on their behaviour. There were no significant differences in behaviour between these sessions.

is dangerous as stereotypes can sometimes be misleading (Fershtman and Gneezy, 2001; Hsee and Weber, 1999). Instead, by completing a questionnaire, participants think about the people they know and social norms of their culture rather than stereotypes. The questions we used in the priming stage were intended to get participants thinking of their friends and family back home, and were as follows:

What year of study are you in at Exeter?

How many full years have you lived in the UK?

How often do you talk to people from your home country here in Exeter?

Do you live with your family during term time?

If you answered "no" above, how many trips do you make to visit your family each year?

3.2 Stag Hunt Game

Our simple 2-player stag hunt game is illustrated in Table 4. Players had two strategies to choose from, which we label as “1” and “2”. We kept the labels neutral, rather than calling the strategies “hunt hare” or “hunt stag”. This is because the descriptive labels may be interpreted in a very different way by people from different cultures. The payoffs in Table 4 are given in Experimental Currency Units (ECU), which were converted into pounds after the experiment.

Table 4: Stag Hunt Game

		Other Player's Choice	
		2	1
Your Choice	2	60, 60	0, 40
	1	40, 0	40, 40

3.3 Bargaining Game

The bargaining game involved a surplus of 40 ECU to be shared between each pair of participants. Each participant needed to decide how much of the 40 ECU to demand for themselves before knowing the decision of their opponent. If the total demands exceeded 40, both players received zero. If the total demands were less than or equal to 40, each player received the amount they demanded. However, participants had only four options in the amount they could demand, and there was no obvious focal point. This means that social norms become important in trying to determine what the opponent will choose. The bargaining game is illustrated in Table 5.

Table 5: Bargaining Game

		Other Player's Choice			
		30	25	15	10
Your Choice	30	0, 0	0, 0	0, 0	30, 10
	25	0, 0	0, 0	25, 15	25, 10
	15	0, 0	15, 25	15, 15	15, 10
	10	10, 30	10, 25	10, 15	10, 10

3.4 Follow-up Questionnaire

Once the game was complete, the participants were shown the decisions of their opponent and their total payoff from the experiment. After payoffs were revealed, the experiment was concluded with a demographic questionnaire, to control for other factors that could be driving behaviour. The questionnaire included a few questions about cultural background to verify where the participants were born and raised. In order to exclude participants from immigrant families with East Asian surnames, we asked participants how many years they had lived in the UK. Similarly, we ensured that

no participants were from mixed cultures, by asking for the nationalities of both parents⁶. We also asked participants for their predictions about their opponent's behaviour when playing the game. This was to see whether there was a difference in expectations when playing someone from another culture. The entire set of questions in the follow-up questionnaire can be found in Appendix Two⁷.

4. Results

Table 6 shows some summary statistics of our sample. While age was quite similar across cultures, the East Asian sample contained a higher proportion of females than the British sample. The East Asian sample also contained a slightly higher proportion of business majors. On average, East Asian students had lived in the UK for 3.30 years, compared to an average of 17.43 for the British students, most of whom had lived in Britain for their entire lives. This indicates that the East Asian students were indeed exposed to a different cultural upbringing than the British. We controlled for all of these demographic variables in our regression analysis.

Table 6: Summary Statistics

Averages	East Asian	British
Age (years)	21.06	19.73
Percentage of Females	79.69%	33.33%
Percentage of Business Majors	82.54%	75.00%
Years in the UK	3.30	17.43

⁶ According to our follow-up questionnaire, no participants were from mixed culture or immigrant families.

⁷ We did not include a measure of risk aversion, as previous research shows that beliefs about the opponent's actions are more important than risk attitudes in determining choices in strategic games (e.g. Berninghaus, 2013; Neumann and Vogt, 2009).

4.1 Stag Hunt Game

Coordination levels and average earnings for the stag hunt are displayed in Table 7. As expected, participants in Treatment One (same culture) achieved more coordination on the payoff dominant outcome than participants in Treatment Two (different culture), with 43% coordination compared to 19%. This difference is significant ($p = 0.022$ using a one-sided Z-test for equality of proportions⁸). Participants in Treatment Two were slightly more likely to coordinate on the risk dominant outcome, but the difference is not significant. The difference in overall coordination levels between Treatment One and Treatment Two is also not significant. Average earnings were higher in Treatment One than in Treatment Two, but the difference is not quite significant ($p = 0.102$ using a one-sided t -test). Overall, these results support our hypothesis that players face more ambiguity when interacting with others from different cultures and therefore choose safer strategies in coordination games.

Table 7: Stag Hunt Outcomes

	Coordinating on Payoff Dominant Outcome	Coordinating on Risk Dominant Outcome	No Coordination	Average Earnings ⁹
Overall	30%	20%	50%	£1.80
<u>Treatment One:</u> Same Culture	43%	14%	43%	£2.00
<u>Treatment Two:</u> Different Culture	19%	25%	56%	£1.63

⁸ We chose a one-sided test as our hypothesis that participants would choose safer strategies when faced with an opponent from a different culture is directional.

⁹ Participants earned a £2 show-up fee in addition to their stag hunt payoff. Although the amounts seem low, the experiment only took 10-15 minutes, which means the payoffs are in-line with the usual hourly rate for lab experiments in Exeter.

The results from the stag hunt game broken down by treatment and culture are reported in Figures 1 and 2. Here we not only see a difference between the same culture and mixed culture treatments, but we find a difference in behaviour between cultures. When the British students were faced with an East Asian opponent, they were less likely to go for the payoff dominant outcome than when faced with a British opponent ($p = 0.081$ using a one-sided Fisher's exact test). However, the East Asian students were no less likely to choose the payoff dominant outcome when faced with a British opponent compared to an East Asian opponent. In fact, the proportion of East Asians choosing each option was exactly the same in each treatment.

We also checked the expectations data from our follow-up questionnaire. While the East Asian students did not differentiate between the same culture and mixed culture treatments, the British students were less likely to expect East Asian students to choose the payoff dominant outcome compared to other British. However, the difference is not quite significant ($p = 0.102$ using a one-sided t -test). Nonetheless, this data supports the idea that the British may have been relying on a cultural stereotype of East Asians being cautious (Hsee and Weber, 1999).

Figure 1: Proportion of British and East Asian students choosing stag or hare when faced with an opponent from the same culture

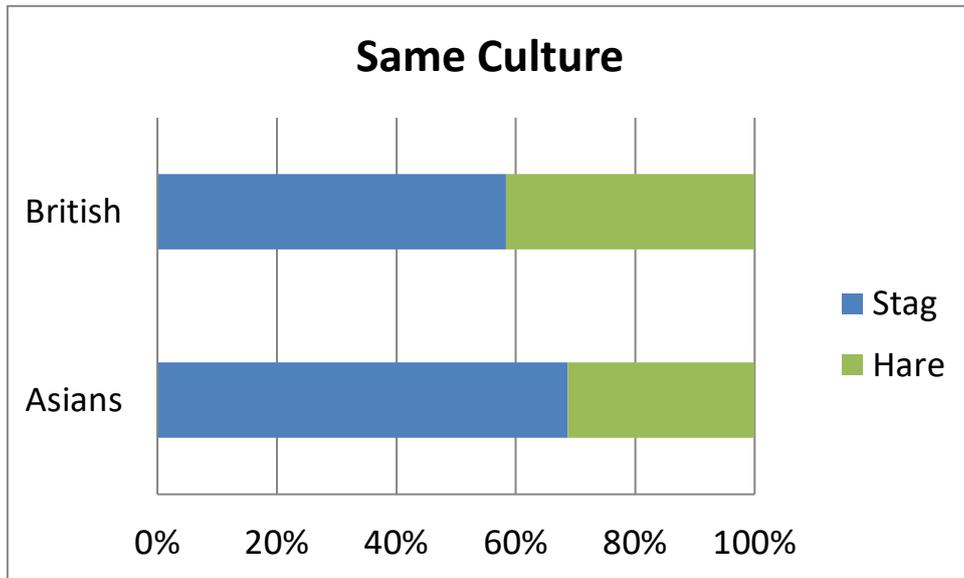
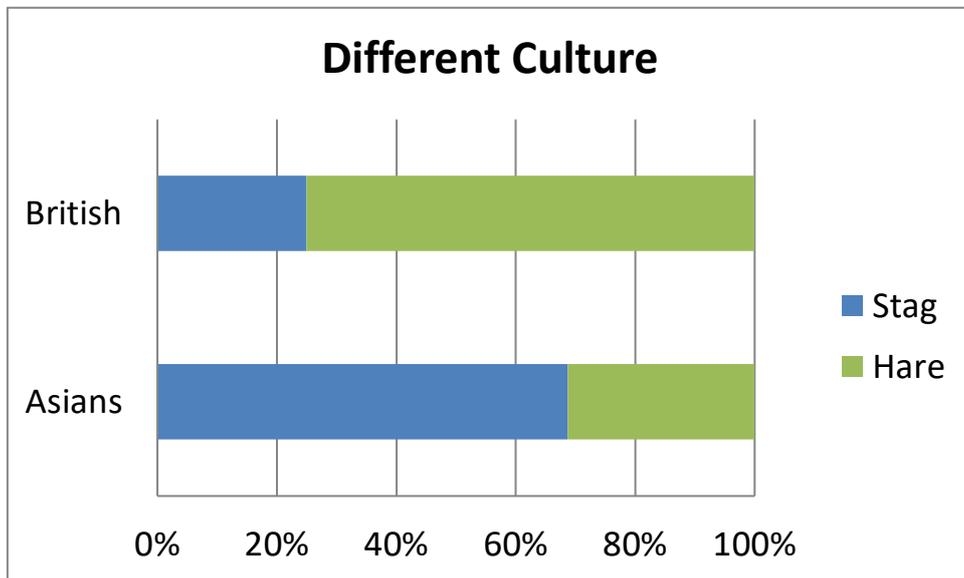


Figure 2: Proportion of British and East Asian students choosing stag or hare when faced with an opponent from a different culture



4.2 Stag Hunt Game: Regression Analysis

In order to control for demographic variables that may have influenced our results, we ran a probit regression on whether or not the participants chose to hunt stag. Our dependent variable was binary, hunting stag = 1 and hunting hare = 0. We controlled for the following variables: culture (East Asian = 1, British = 0), age in years, gender (female = 1, male = 0), subject major (business major = 1, otherwise = 0), years in the UK, an interaction term for culture and gender (East Asian female = 1, otherwise = 0), and treatment (same culture = 1, different culture = 0). The coefficients from this regression are presented in Table 8.

Table 8: Coefficients from Probit Regression on Hunting Stag¹⁰

Coefficients	Overall (n = 60) (Pseudo R² = 0.194)	British (n = 28) (Pseudo R² = 0.175)	East Asians (n = 32) (Pseudo R² = 0.186)
East Asian	0.581 (0.932)	N/A	N/A
Age	0.410** (0.177)	0.235 (0.168)	0.590** (0.284)
Female	0.183 (0.536)	0.139 (0.547)	-0.849 (0.919)
Business Major	-0.513 (0.527)	-0.646 (0.629)	-0.070 (1.125)
Years in UK	-0.003 (0.045)	0.006 (0.047)	-0.107 (0.223)
East Asian Female	-0.653 (0.903)	N/A	N/A
Same Culture	0.601 (0.368)	0.928* (0.530)	0.554 (0.626)
Constant	-8.290** (3.699)	-5.031 (3.432)	-11.289 (6.258)

¹⁰ Robust standard errors are given in parentheses. Significance at the 90%, 95%, and 99% level of confidence is indicated with *, **, and ***, respectively.

According to the overall regression results, culture (being East Asian or British) does not significantly influence the choice to hunt stag rather than hare. This is in contrast to the British student's predictions that East Asians would be less likely to choose stag. This supports the idea that a cultural stereotype of East Asians being cautious is misleading. In support of the non-parametric test, the binary variable for being in the same culture treatment is positive and marginally significant for the British students.

Age is the only significant demographic variable, with a positive effect on choosing stag. The significant effect of age comes from the East Asian sample. We had no *a priori* expectations for the effect of age. Age was included as a covariate as age is often correlated with risk attitudes, which we thought might affect behaviour in the stag hunt game. However, previous research shows that risk aversion *increases* with age (Dohmen *et al*, 2011), which suggests that older players should choose the safer option, i.e. hare. Therefore, the positive effect of age on choosing the riskier option in our stag hunt game is surprising.

4.3 Bargaining Game

Coordination levels and average earnings for the bargaining game are displayed in Table 9. In contrast to the stag hunt, participants in Treatment One (same culture) coordinated better than participants in Treatment Two (different culture), with 63% coordination compared to 50%. However, this difference is not significant. Participants were more likely to demand too little in Treatment One and too much in Treatment Two, but only the difference in demanding too much is significant ($p < 0.01$ using a two-

sided Z-test for equality of proportions¹¹). Choosing the riskier strategy of high demands in Treatment Two contrasts our hypothesis, which expected participants to face more ambiguity and choose safer strategies in the different culture treatment.

Table 9: Bargaining Game Outcomes

	Coordinating on an Equilibrium	Demanding too Much	Demanding too Little	Average Earnings ¹²
Overall	56%	19%	25%	£3.03
<u>Treatment One:</u> Same Culture	63%	6%	31%	£3.47
<u>Treatment Two:</u> Different Culture	50%	31%	19%	£2.59

To further investigate these results, we break down the bargaining game choices by treatment and culture in Figures 3 and 4. Similarly to the stag hunt results, we also obtain a cultural difference in the bargaining game. East Asians demanded slightly less of the pie when faced with a British opponent compared to the all-East Asian treatment, although this difference is not significant. On the other hand, British demanded *more* when faced with an East Asian opponent compared to the all-British treatment, which is a significant result ($p = 0.010$ using a one-sided Mann-Whitney U -test). The British also contrasted the theoretical prediction that people will choose safer options when faced with an opponent from a different culture.

¹¹ We used a two-sided test here as the result is opposite to our hypothesis.

¹² Participants earned a £2 show-up fee in addition to their bargaining game payoff. Although the amounts seem low, the experiment only took 10-15 minutes, which means the payoffs are in-line with the usual hourly rate for lab experiments in Exeter.

Figure 3: Proportion of British and East Asian students choosing each bargaining game option when faced with an opponent from the same culture

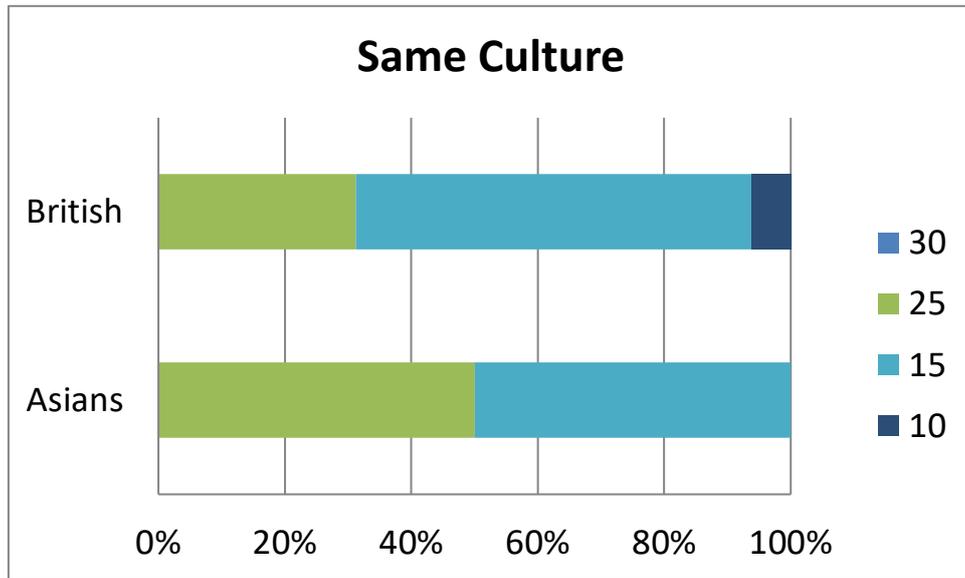
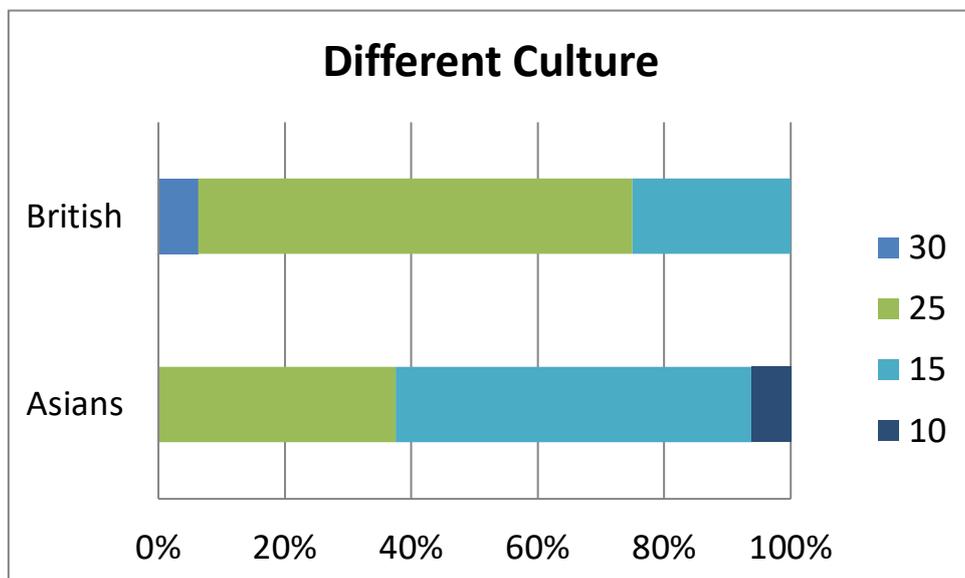


Figure 4: Proportion of British and East Asian students choosing each bargaining game option when faced with an opponent from a different culture



According to our expectations data from the follow-up questionnaire, the British students expected East Asian students to claim less of the pie than other British

students¹³. The difference is significant ($p < 0.01$ using a one-sided t -test). This supports the idea that the British may hold a stereotype of East Asians being cautious. There was no difference in expected demands between the same and different culture treatments for the East Asian students.

4.4 Bargaining Game: Regression Analysis

We ran an ordinary least squares regression on choices in the bargaining game. Our dependant variable was the choice of bargaining game demands (10, 15, 25, or 30). We controlled for the following variables: culture (East Asian = 1, British = 0), age in years, gender (female = 1, male = 0), subject major (business major = 1, otherwise = 0), years in the UK, an interaction term for culture and gender (East Asian female = 1, otherwise = 0), and treatment (same culture = 1, different culture = 0).

The coefficients from this regression are presented in Table 10. The results support the non-parametric test, with a significant negative effect of being in the same culture treatment on bargaining game demands for the British students. None of the demographic variables are significant in this regression. This is to be expected, as the variables were included as potential controls, rather than as hypotheses to be tested.

¹³ We averaged expected demands for each treatment. Several participants wrote “15 or 25” for the expected demands, in which case we took an average of 20.

Table 10: Coefficients from Ordinary Least Squares Regression on Bargaining Game

Choice¹⁴

Coefficients	Overall (n = 64) (R² = 0.090)	British (n = 32) (R² = 0.247)	East Asians (n = 32) (R² = 0.150)
East Asian	-3.771 (3.242)	N/A	N/A
Age	-0.142 (0.266)	0.727 (0.938)	-0.060 (0.278)
Female	0.931 (2.137)	1.282 (2.131)	4.055 (2.422)
Business Major	-1.119 (1.618)	0.882 (2.353)	-0.460 (2.294)
Years in UK	-0.060 (0.165)	-0.120 (0.254)	-0.146 (0.213)
East Asian Female	2.150 (3.274)	N/A	N/A
Same Culture	-1.779 (1.437)	-5.194** (2.010)	2.112 (2.203)
Constant	25.637 (6.644)	9.755 (19.750)	17.248** (7.490)

5. Discussion

5.1 Stereotypes

The British appear to be more careful in the stag hunt but more risk taking in the bargaining game, when faced with a foreign opponent. While this behaviour may seem odd, we can make sense of this by thinking about stereotypes. The British may expect East Asians to choose the safer options in both games, which would mean that the British should also play it safe in the stag hunt but take a risk in the bargaining game. When looking at the expectations data, East Asian participants do not show much difference between treatments. However, the British expect the East Asians to demand

¹⁴ Robust standard errors are given in parentheses. Significance at the 90%, 95%, and 99% level of confidence is indicated with *, **, and ***, respectively.

less of the pie than other British. The British also expect East Asians to be more likely to choose the safe option in the stag hunt compared to other British.

When looking at the same culture treatments, East Asians are more likely to hunt stag than British and also demand more of the pie in the bargaining game. This means that a stereotype of East Asians being cautious is not only misleading, but has real effects on behaviour. Even the East Asian students appear to be affected by their own stereotype in the bargaining game, where they demand less of the pie against British students than in the same culture treatment. East Asian students may lower their demands against the British students because they expect the British students to demand more, based on the stereotype that East Asians are cautious. These results are in-line with Hsee and Weber's (1999) study that finds Chinese to be more risk seeking than Americans, even though both groups predicted the opposite, and also Shih *et al's* (1999) finding that even stereotypes about one's own culture can affect behaviour.

5.2 Efficiency

We can also consider whether playing someone from a different culture improves or hinders efficiency. For both games, the payments are higher in the same culture treatments than the different culture treatments. However, for the bargaining game we notice fairly good coordination between East Asians and British in the different culture treatments. British increase their demands when facing an East Asian opponent compared to another British opponent, while East Asians lower their demands against the British. The players seem to be using cultural stereotypes to predict each other's behaviour and choose their action accordingly. Interestingly, players perform better by behaving according to the stereotype, even if the stereotype is untrue.

On the other hand, coordination is hindered in the different culture treatments in the stag hunt game. While East Asians tend to go for the payoff dominant outcome, British expect them to choose the opposite. Therefore, British tend to choose the certain outcome, possibly based on a misleading stereotype, when they could do better by choosing the payoff dominant outcome. Stereotypes may sometimes be a useful guide to behaviour when there is little else to base decisions on, but can also harm efficiency if the opponents do not behave according to their stereotypes.

5.3 Design Limitations

Another possibility is that participants did not consider the cultural identity of their opponent in decision making and treated the opponent simply as “another student”. In Eichberger *et al's* (2008) experiment, the participants are given descriptions of the granny and game theorist, which make them more believable and easier to imagine. Perhaps having students of a different culture on the other side of the room was not enough to distinguish a cultural identity. Eichberger *et al* (2008) find that other students are also a source of ambiguity, with other students being perceived as more ambiguous than the game theorist and just as ambiguous as the granny.

Three participants mentioned ethnicity or nationality as an aspect of the opponent’s identity they considered in making their decision. Their exact comments were:

“Their gender, their race/ethnicity, their nationality.”

“gender, ethnicity.”

“Gender, Appearance, Nationality.”

A further participant commented "*Decision making when looking at race?*" when asked what they thought the experiment was about. All of these comments came from British participants, which suggests the salience of our seating manipulation may have been higher for the British. This makes sense, as international students studying in the UK are probably more used to interacting with British people, than the local students are to interacting with East Asians. There also appears to be some misunderstanding about the identity question among East Asian participants. For example, when asked what aspects of the opponent's identity they considered, several students mentioned mutual benefit or what choice they thought the opponent would take.

We also need to consider whether our priming questionnaire had a differential impact on British students compared to East Asian students. The questionnaire probably felt quite normal for international students, with questions about how long you have lived in the UK and how often you speak to people from your home country. However, this questionnaire may have felt quite strange, or had little or no impact, for the British students. In addition, the questionnaire may have primed aspects of identity other than culture, such as a sense of family. Priming a sense of family could change the mood of East Asian students in a different way to British students. For example, East Asian students may feel sad when family is primed as they are probably very far away from their families, while British students are a lot closer.

These concerns highlight two key caveats with our data: 1. Subtle manipulation; 2. Sample bias. Although we endeavoured to make our manipulation subtle to avoid experimenter demand effects, seating participants from different cultures on different sides of the room may not have been salient enough to create a treatment effect. Although the manipulation appears to have worked for the British, the East Asian

students did not behave differently when faced with an opponent from a different culture. East Asian students may have not picked up on the culture of their opponent, which is one explanation for a lack of a treatment effect. Sample bias comes from comparing the behaviour of home students with international students, who may be inherently different in personality. Our results may be driven by differences between home and international students, rather than cultural differences. Our sample also only includes students. Therefore, our results cannot be used to generalise to entire cultures.

6. Conclusions

We expected that players would experience more ambiguity when faced with an opponent from a different culture and therefore choose safer options in coordination games. This is because players may find it harder to predict each other's behaviour when they do not share similar social norms. In our stag hunt game and bargaining coordination games, East Asians did not behave significantly differently when faced a British or East Asian opponent. However, the British tended to go for the safe, risk dominant, outcome against the East Asians in the stag hunt, while increasing their demands against East Asians in the bargaining game. One possible reason for our results could be that the British were basing their expectations on a cultural stereotype of East Asians being cautious. Based on our results, this stereotype was proven to be misleading.

Appendix One: Experiment Instructions

Instructions

You are about to take part in an experiment. Your payoff from this experiment will depend on the decisions you make during the experiment. Therefore it is important that you carefully read and understand these instructions.

Please do not communicate with the other participants at any stage during the experiment. If you have a question, please raise your hand and the experimenter will assist you.

Your earnings from the experiment will be in Experimental Currency Units (ECU). Each ECU is worth £XX (*£0.05 for stag hunt, £0.20 for bargaining game*). After the experiment, your earnings will be converted into pounds, and you will be paid anonymously in cash before you leave the room. You will also receive a £2 show-up fee, in addition to any money earned during the experiment.

The experiment will start with a questionnaire which will shortly appear on the computer screen. Please complete the questions and then click the “OK” button at the bottom of the screen.

After everyone has completed the questionnaire, instructions will be handed out for the next stage of the experiment.

Stag Hunt Instructions

In the next stage of the experiment, you will play the game described below. You will be randomly matched with another player who is sitting on the other side of the room to you.

The game consists of a choice between 1 and 2. Your payoff depends on both your own choice and the choice of the player you are matched with, who is sitting on the other side of the room.

The payoff table for this game is illustrated below. The numbers in the table correspond to your payoffs in ECU, for every possible combination of choices by you and the other player. The first number in each cell is your payoff and the second number is the other player's payoff.

If both you and the other player choose 2, you each receive a payoff of 60 ECU. If both players choose 1, you each receive a payoff of 40. If one player chooses 2 while the other chooses 1, the player choosing 2 receives 0 while the player choosing 1 receives 40.

Please input your choice of 1 or 2 into the computer when asked to do so. You will not know the choice of the other player until after you have made a decision.

If you have a question, please raise your hand and the experimenter will assist you.

		Other Player's Choice	
		2	1
Your Choice	2	60, 60	0, 40
	1	40, 0	40, 40

Bargaining Game Instructions

In the next stage of the experiment, you will play the game described below. You will be randomly matched with another player who is sitting on the other side of the room to you.

You and another player are allocated 40 ECU to share between you. You need to decide how much of the 40 ECU you will demand for yourself and the other player will do the same. If the total demands from you and the other player exceed 40 ECU, you will both receive 0. If the total demands are less than or equal to 40, each of you will receive the amount you demanded.

The payoff table for this game is illustrated below. The numbers in the table correspond to your payoffs in ECU, for every possible combination of choices by you and the other player. The first number in each cell is your payoff and the second number is the other player's payoff.

As an example, if you choose 25 and the other player chooses 15, the total demands are 40. In this case, you will receive 25 and the other player will receive 15. However if you choose 25 and the other player also chooses 25, the total demands are 50. In this case, you will both receive 0.

As another example, if you choose 10 and the other player chooses 15, the total demands are 25, which is less than 40. In this case, you will receive 10 and the other player will receive 15.

Please input your choice of 10, 15, 25, or 30 into the computer when asked to do so. You will not know the choice of the other player until after you have made a decision.

If you have a question, please raise your hand and the experimenter will assist you.

Other Player's Choice

		Other Player's Choice			
		30	25	15	10
Your Choice	30	0, 0	0, 0	0, 0	30, 10
	25	0, 0	0, 0	25, 15	25, 10
	15	0, 0	15, 25	15, 15	15, 10
	10	10, 30	10, 25	10, 15	10, 10

Appendix Two: Follow-up Questionnaire

Please answer the following questions and click the "OK" button when complete.

How did you decide what option to choose?

What did you think the other player would choose?

Did you consider the identity of the other player when making your decision?

If you answered "yes" above, what aspects of the other player's identity did you consider?

What do you think this experiment was about? (Optional)

- OK Button -

Please answer the following questions and click the "OK" button when complete.

Age (in years):

Gender:

Subject major:

Nationality:

Nationality(ies) of your parents:

Country of birth:

Native language:

Second languages:

- OK Button -

References

- Akerlof, G. A., & Kranton, R. E. (2000). Economics and Identity. *The Quarterly Journal of Economics*, 115:3, 715-753.
- Benjamin, D. J., Choi, J. J., & Strickland, A. J. (2010). Social Identity and Preferences. *American Economic Review*, 100:4, 1913-1928.
- Berninghaus, S. K., Haller, S., Kruger, T., Neumann, T., Schosser, S., & Vogt, B. (2013). Risk attitude, beliefs, and information in a Corruption Game – An experimental analysis. *Journal of Economic Psychology*, 34, 46-60.
- Bordalo, P., Coffman, K., Gennaioli, N., & Shleifer, A. (2016). Stereotypes. *Quarterly Journal of Economics*, 131:4, 1753-1794.
- Brislin, R. W., & Lonner, W. J. (1973). *Cross-Cultural Research Methods*. New York, London: Wiley-Interscience.
- Chen, R., & Chen, Y. (2011). The Potential of Social Identity for Equilibrium Selection. *American Economic Review*, 101:6, 2562-2589.
- Chen, Y., Li, S. X., Liu, T. X., & Shih, M. (2014). Which Hat to Wear? Impact of Natural Identities on Coordination and Cooperation. *Games and Economic Behavior*, 84, 58-86.
- Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., & Wagner, G. G. (2011). Individual Risk Attitudes: Measurement, Determinants, and Behavioral Consequences. *Journal of the European Economic Association*, 9:3, 522-550.
- Eichberger, J., & Kelsey, D. (2000). Non-Additive Beliefs and Strategic Equilibria. *Games and Economic Behaviour*, 30:2, 183-215.
- Eichberger, J., & Kelsey, D. (2002). Strategic Complements, Substitutes, and Ambiguity: The Implications for Public Goods. *Journal of Economic Theory*, 106:2, 436-466.
- Eichberger, J., Kelsey, D., & Schipper, B. (2008). Ambiguity and social interaction. *Oxford Economic Papers*, 61:2, 355-379.
- Eichberger, J., Kelsey, D., & Schipper, B. (2008). Granny Versus Game Theorist: Ambiguity in Experimental Games. *Theory and Decision*, 64:2, 333-362.
- Fershtman, C., & Gneezy, U. (2001). Discrimination in a Segmented Society: An Experimental Approach. *The Quarterly Journal of Economics*, 116:1, 351-377.
- Fischbacher, U. (2007). z-Tree: Zurich Toolbox for Ready-made Economic Experiments. *Experimental Economics*, 10:2, 171-178.
- Geisinger, A. (2004). A Group Identity Theory of Social Norms and Its Implications. *Tulane Law Review*, 78:605, 605-652.
- Greiner, B. (2004). An Online Recruitment System for Economic Experiments. In K. Kremer, & V. Macho. (Eds.), *Forschung und wissenschaftliches Rechnen*, (2003.). GWDG Bericht 63, Göttingen : Ges. für Wiss. Datenverarbeitung, 79-93.

- Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-Related Values*. Newbury Park (CA), London, New Delhi: Sage Publications.
- Hsee, C. K., & Weber, E. U. (1999). Cross-National Differences in Risk Preference and Lay Predictions. *Journal of Behavioural Decision Making*, 12, 161-179.
- Huyck, J. B., Battalio, R. C., & Beil, R. O. (1990). Tacit Coordination Games, Strategic Uncertainty, and Coordination Failure. *The American Economic Review*, 80:1, 234-248.
- Kahheman, D., & Tversky, A. (1972). Subjective Probability: A Judgement of Representativeness. *Cognitive Psychology*, 3:3, 430-454.
- Kelsey, D., & le Roux, S. (2016). Dragon Slaying with Ambiguity: Theory and Experiments, *Journal of Public Economic Theory*, 19:1, 178-197.
- Neumann, T., & Vogt, B. (2009). *Do Players' Beliefs or Risk Attitudes Determine The Equilibrium Selections in 2x2 Coordination Games?* Working Paper. Otto von Guericke University Magdeburg.
- Shih, M., Pittinsky, T. L., & Ambady, N. (1999). Stereotype Susceptibility: Identity Salience and Shifts in Quantitative Performance. *Psychological Science*, 10:1, 80-83.
- Singh, T. B. (2012). A social interactions perspective on trust and its determinants, *Journal of Trust Research*, 2:2, 107-135.