CeDEx

CENTRE FOR DECISION RESEARCH & EXPERIMENTAL ECONOMICS

The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

Friends or Strangers? Strategic Uncertainty and Cooperation across Experimental Games of Strategic Complements and Substitutes

Gabriele Chierchia, Fabio Tufano and Giorgio Coricelli
March 2017

CEDEX

CENTRE FOR DECISION RESEARCH & EXPERIMENTAL ECONOMICS

The Centre for Decision Research and Experimental Economics was founded in 2000, and is based in the School of Economics at the University of Nottingham.

The focus for the Centre is research into individual and strategic decision-making using a combination of theoretical and experimental methods. On the theory side, members of the Centre investigate individual choice under uncertainty, cooperative and non-cooperative game theory, as well as theories of psychology, bounded rationality and evolutionary game theory. Members of the Centre have applied experimental methods in the fields of public economics, individual choice under risk and uncertainty, strategic interaction, and the performance of auctions, markets and other economic institutions. Much of the Centre's research involves collaborative projects with researchers from other departments in the UK and overseas.

Please visit http://www.nottingham.ac.uk/cedex for more information about the Centre or contact

Suzanne Robey
Centre for Decision Research and Experimental Economics
School of Economics
University of Nottingham
University Park
Nottingham
NG7 2RD
Tel: +44 (0)115 95 14763
Fax: +44 (0) 115 95 14159
suzanne.robey@nottingham.ac.uk

The full list of CeDEx Discussion Papers is available at

http://www.nottingham.ac.uk/cedex/publications/discussion-papers/index.aspx

Friends or Strangers?
Strategic Uncertainty and Cooperation across Experimental Games of Strategic Complements and Substitutes[*]

Gabriele Chierchia[a,b], Fabio Tufano[c] and Giorgio Coricelli[a,d]

[a] Center for Mind/Brain Science, University of Trento, Italy
[b] Max Planck Institute for Human Cognitive and Brain Sciences, Germany
[c] School of Economics, University of Nottingham, UK
[d] Department of Economics, University of Southern California, USA

Abstract: It is commonly assumed that friendship should decrease strategic uncertainty in games involving tacit coordination. However, this has never been tested on two "opposite poles" of coordination, namely, games of strategic complements and substitutes. We present an experimental study having participants interacting with either a friend or a stranger in two classic games: (i.) the stag hunt game, which exhibits strategic complementarity; (ii.) the entry game, which exhibits strategic substitutability. Both games capture a frequent trade-off between a potentially high paying but uncertain action and a lower paying but safe alternative. We find that, relative to strangers, friends exhibit a propensity towards uncertainty in the stag hunt game, but an aversion to uncertainty in the entry game. Friends also "trembled" less than strangers in the stag hunt game but this advantage was lost in the entry game. We further investigate the role of interpersonal similarities and friendship qualities on friendship's differential impact on uncertainty across games of strategic complements and substitutes.

Keywords: coordination; entry game; friendship; strategic complementarity; strategic substitutability; stag hunt game; strategic uncertainty

Highlights:
- Behaviour in experimental games of strategic complements and substitutes is observed
- Experimental participants play with either friends or strangers as game counterpart
- Friends are more prone to uncertainty in stag hunt games (strategic complements)
- Friends are more averse to uncertainty in entry games (strategic substitutes)

PsycINFO classification codes: 2300, 3000

JEL classification codes: C72, C92, D80

---

[*] Corresponding authors: G. Chierchia, Max Planck Institute for Human Cognitive and Brain Sciences, Department of Social Neuroscience, Stephanstraße 1A, 04103 Leipzig, Germany; G. Coricelli, University of Southern California, Department of Economics, 3620 S. Vermont Ave, USA.
E-mail addresses: chierchia@cbs.mpg.de (G. Chierchia), giorgio.coricelli@usc.edu (G. Coricelli), fabio.tufano@nottingham.ac.uk (F. Tufano).

1. Introduction

Standard economics tends to assume a parsimonious "social void" of homogeneous individuals (Charness et al. 2007) to explain their behaviour; differently, sociology, anthropology and social psychology tend to explain social behaviour by assuming that individuals are indeed heterogeneous along various important dimensions, such as their degree of relatedness (Hamilton 1964), their interpersonal similarities (Mcpherson et al. 2001) or their group membership (Tajfel and Turner 1979). Such factors suggest the notion of a social space (Fiske et al. 2007; Jones and Rachlin 2006) in which – since very early infancy (e.g., Hamlin et al. 2007; Olson and Spelke 2008), across species (e.g., Brosnan 2005; Massen and Koski 2014) and across cultures (Apicella et al. 2012; Bernhard et al. 2006) – tuning behaviour to the "social closeness" of others seems to be the rule rather than the exception of social interactions.

We turn to such a social space to investigate its potential as a coordination device. In fact, equilibrium selection in coordination problems with multiple equilibria is considered to be "the hardest problem of game theory" (Camerer 2003) and early experimentalists (e.g., Cooper and DeJong 1990) suggested that game theory's deductive rationality needed to be "augmented" by a theory of how subjects form *beliefs* about their counterparts' choices (or beliefs about their beliefs) in coordination games. Here we speculate that social closeness, and friendship as a paradigmatic instantiation of closeness, could play an important role in understanding beliefs formation and strategic reasoning. In line with this, it has been abundantly shown that, since early childhood (Meltzoff 2007), humans often attribute (or over-attribute) their own thoughts and preferences to others (Goldman 2006); and that this tendency to "self-project" (Krueger et al. 2012) is accentuated by social closeness (e.g., Ames 2004; Clement and Krueger 2002; Holtz and Miller 1985; Krueger and Zeiger 1993; Wilder 1984). For instance, it has been shown that humans recruit overlapping brain regions to answer questions about themselves and about their friends but not strangers (Krienen et al. 2010), and that this occurs to a greater extent if their friends are perceived to be similar to themselves (Benoit et al., 2010).

Indeed, many different forms of social closeness – in terms of proximity in social network (e.g., Apicella et al. 2012), artificial group membership (e.g., Balliet et al. 2014 for a meta-analysis), ecological group membership (Bernhard et al. 2006), social identification (Hoffman et al. 1996), pre/post play communication (e.g., Balliet 2009 for a meta-analysis), geographic proximity (Bradner and Mark 2002; Charness et al. 2003), motor synchronization (e.g., Wiltermuth and Heath 2009), facial resemblance (DeBruine 2002), and similarity (Cole and Teboul 2004) – have all been associated with increased cooperation in experimental games. Friendship makes no exception (e.g., Hruschka and Henrich 2006; Majolo and Ames 2006; Reuben and van Winden 2008). However, an open

question remains regarding whether the pattern of association between friendship and cooperation is stable across different families of games.

In particular, how persistent is the association between friendship and cooperation when considering games of strategic complements and substitutes? Games of strategic complements involve strategies that mutually enforce one another: that is, players have incentives to *match* their actions. For instance, joining a rebellion may be profitable only if enough others do the same, and dangerous otherwise. By contrast, games of strategic substitutes involve strategies that offset one-another and, consequently, players have incentives to *mismatch* their actions. For instance, many might prefer to take the free-way rather than a slower secondary route, but if all take the free-way at the same time, this could lead to a traffic jam. Thus one should take the free-way only if he or she expects others will *not* do so as well. Here, we conjectured that, if friends tend to assume that, relative to strangers, they have "coordinated/correlated minds" (Benoit et al., 2010; Montoya et al., 2008 for a meta-analysis), this might indeed help when they are to coordinate on the same choices (i.e., matching choices in games with strategic complements), but it might actually interfere when they are to coordinate on opposite ones (i.e., mismatching choices in games with strategic substitutes).

In this paper, we report on an experimental investigation demonstrating that friendship among players *differentially* mediates the impact of strategic uncertainty on individual choices across games of strategic complements and substitutes. While defining strategic uncertainty as uncertainty related to the players' behaviour in a situation with interdependent decisions (Brandenburger, 1996), we operationalize the probability of choosing the action leading to an uncertain payoff in a game with multiple equilibria as our measure of players' revealed strategic uncertainty. Specifically, a higher probability of choosing actions with an uncertain payoff reveals lower strategic uncertainty.

In our experiment, participants interacted with either a friend or a stranger in two classic two-player games with real monetary payoffs: in "stag-hunt" games, due to the existence of strategic complements players had the incentive to *match* their choices; conversely, in "entry games", due to the existence of strategic substitutes players had the incentive to *mismatch* their choices. Both cases capture a frequent trade-off between a potentially high paying but uncertain option and a lower paying but safe alternative. We find that, relative to strangers, friends exhibit a propensity towards actions leading to an uncertain payoff in the stag-hunt games, but an aversion to those actions in the entry games. Friends also "trembled" (i.e., switching back and forth between the uncertain and secure action) less than strangers in the stag-hunt game, but this advantage was lost in the entry game. Finally, friends' aversion to action leading to uncertain payoff in the entry game

was predicted by an elicited measure of perceived interpersonal similarities. In summary, friendship might indeed decrease revealed strategic uncertainty when players are to match their choices in stag-hunt games, but it could even increase uncertainty when they are to mismatch them in entry games.

Our study relates to several streams of economic literatures. It contributes to the vast experimental literature on coordination games with multiple Pareto-ranked equilibria reviewed in Ochs (1995), Camerer (2003) and Devetag and Ortmann (2007). It also provides relevant insights on the role of strategic uncertainty and strategic thinking in experimental games when mixed-motives are at play (e.g., Crawford et al., 2013). Our study adds also to the fast-growing literature on the importance of social identity in explaining economic behaviour in games played in the laboratory (e.g., Kranton et al., 2016; Chen and Chen, 2013; Charness et al., 2007) while bringing into focus real dyads with real friendship ties (e.g., Gächter et al., 2017).

The remainder of the paper is organised as follows. Section II introduces the experimental design and hypotheses. Section III presents the experimental procedures. Section IV reports on the experimental results. Section V discusses the implications of the empirical evidence. Section VI concludes.

2. Experimental Design

In this experiment, participants play two distinct two-player coordination games: that is, stag-hunt game and entry game. The payoff matrixes for the stag-hunt game and for the entry game are respectively detailed in Table 1. The payoffs represent dollars amounts. Each participant plays twenty variants of both those games twice: that is, once with an anonymous stranger and once with a friend; each variant is characterised by a different dollar value of $X \in \{0, 1, \ldots, 5, 6, 6.5, 7, \ldots, 9.5, 10, 11, 12, \ldots, 15\}$. Therefore, this experiment presents a within-subject design with two treatments: the *Stranger* treatment and the *Friend* treatment.

TABLE 1—COORDINATION GAMES

		Column Player				Column Player	
		A	**B**			**A**	**B**
Row Player	**A**	X, X	X, 0	**Row Player**	**A**	X, X	X, 15
	B	0, X	15, 15		**B**	15, X	0, 0

a. Stag-hunt Game   b. Entry Game

In both games, the set of available actions entails actions A and B; if chosen, action A yields the safe payoff X regardless of the opponent's choice. However, the consequences of action B differ

across games. In the stag-hunt game, players could jointly obtain the highest payoff equal to $15 only if they both choose B; in other words, the highest payoff requires a player to opt for B and their opponent to *match* such a choice. By contrast, in the entry game, a player could receive the highest payoff of $15 if they choose B while their opponent did not, that is the opponent would *mismatch*.

In the light of the existent evidence demonstrating a correlation between strategic uncertainty and risk attitude when choice elicitation is framed in a similar fashion (Heinemann et al., 2009), participants took part in a lottery task to control for inter-individual differences in risk attitudes. The lottery task was set up as a game against 'Nature' resembling the above coordination games: indeed, participants were to choose between option A and B; if chosen, option A yields the safe X (which assumes the exact same values used for the coordination games) payoff, regardless of the state of Nature. By contrast, option B could lead to $0 if the state of Nature was A or to the highest payoff equal to $15 if the state of Nature was B. The payoff matrix of the lottery task is reported below in Table 2.

TABLE 2—LOTTERY TASK: GAME AGAINST NATURE

		State of Nature	
		A $p=1/2$	B $(1-p)=1/2$
Player	A	X	X
	B	0	15

Notably, interpersonal similarities are one of the best-known predictors of closeness in social networks (see McPherson et al. 2001 for a review) and of friendship formation (see Montoya et al. 2008 for a meta-analysis; Morry 2007). In a test environment similar to our study, Chierchia and Coricelli (2015) demonstrate a significant impact of perceived similarities on tacit coordination. However, in Chierchia and Coricelli's study similarities were experimentally induced, while here we are interested in whether friends spontaneously perceive one another to be similar (relative to strangers), and whether the extent of this could mediate coordination patterns. In this vein, we adopt a similarity measure to control for participants' perceived similarities. The similarity measure consisted of 40 person-descriptive words (i.e., personality traits) that each participant rate twice on a continuous scale ranging from -50 to +50. The first ratings indicate how much they themselves were represented by the given traits ("self-ratings"); the second ratings indicate how much their friends were represented by the same traits ("friend ratings"). For both ratings of each person-descriptive word, the value of "0" on the scale represented an "average" student from their own university. The Pearson's correlation between self-ratings and friend-ratings will serve as a

"perceived similarity measure", given that it measures the degree to which friends think they are more likely than strangers to have similar personality traits.

Finally, as a further robustness check of our treatment manipulation, participants respond to the McGill Friendship Questionnaire ("MFQ" for short - Mendelson and Aboud 1999) taping into several dimensions of friendship quality and function.

3. Experimental Procedures

Seventy-eight participants (of whom 56 percent were females, with an overall sample average of 20.5 years of age – std. dev., 3 years) took part in the study across four experimental sessions implemented at the Los Angeles Behavioral Economics Laboratory ("Label") of the University of Southern California. Students from a wide range of academic disciplines were recruited by both ORSEE (Greiner 2015) and flyers. The average duration of each session was 84 minutes. Participants were paid individually and anonymously at the end of each experimental session.

Participants were required to bring a non-romantic friend to the experimental session. Upon arrival, they were randomly assigned to individually shielded computer cubicles. Instructions were read aloud and followed on individual handouts. Then, participants answered several control questions to ensure their understanding of the instructions and they could progress to the next stage only after providing the correct answers. After successfully answering the control questions, participants played each coordination game twice: that is, one with an anonymous stranger and once with their friend for an overall total of eighty coordination plays per participant. Importantly, participants did not receive any feedback on the outcome of any of their decisions until the end of the experimental session. To reduce excessive task switching, the stag-hunt game and the entry game were played in separate blocks, the order of which was counterbalanced across participants. Within each block, the level of social closeness (i.e., friend vs. stranger) and the values of the sure payoff X were randomized.

Visually, each trial was as follows: participants viewed the dollar value of the safe payoff (e.g., $8.50) on one side of the screen (labelled "A"), and the fixed $15 on the other (labelled "B"). (The sides were randomized). The two coordination games were differentiated only by what was written next to the uncertain $15 option. Stag-hunt games were represented by the following: "$15.00 only if your counterpart chooses B, 0.00 if your counterpart chooses A"; while entry games simply inverted the positions of A and B in the text: that is, "$15.00 only if your counterpart chooses A, 0.00 if your counterpart chooses B". At the top centre of the screen, participants were informed whom they were matched with. Specifically, they either read "You are matched with a stranger" or "You are matched with [friend's name]." Immediately below, the following was written: "You are

both reading these same instructions. You both have to choose between the following two options: A or B. Which one do you prefer?" As illustration, Figure 1 below presents an example of a screenshot from a variant of the stag-hunt game. Full instructions are available in the Appendix A.
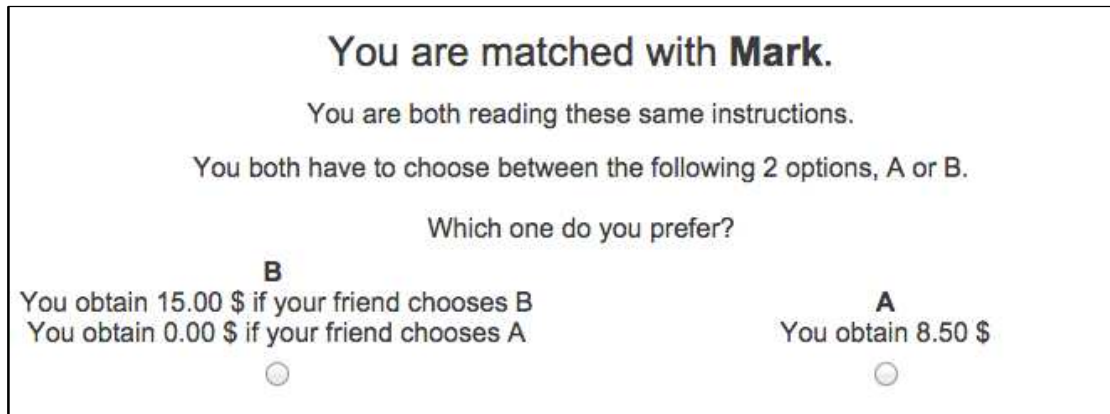

You are matched with **Mark**.

You are both reading these same instructions.

You both have to choose between the following 2 options, A or B.

Which one do you prefer?

B
You obtain 15.00 $ if your friend chooses B
You obtain 0.00 $ if your friend chooses A
○

A
You obtain 8.50 $
○

FIGURE 1. AN EXAMPLE OF A SCREENSHOT FROM A VARIANT OF THE STAG-HUNT GAME.

Notes: In the example above, a participant is taking part in a stag-hunt game with a friend (in the example above, called "Mark"). Before taking part in the games, participants were asked to write the name of their friend, which then reappeared in the friend condition. In the stranger condition, one's friend's name was replaced with the words "a stranger", and "your friend" was replaced by "stranger". Entry games were depicted exactly like stag-hunt games with the sole exception that, within the "B" option, the letters "B" and "A" were exchanged.

After playing the coordination games, participants went through the lottery task and made twenty choices. (A screenshot of the coordination and lottery tasks are reproduced in the appendix: figures A1 and A2, respectively). To further stress the difference with the coordination games played against other participants, the lottery task was physically played out in front of them. In fact, at the start of each experimental session, we drew participants' attention to an empty opaque box in which we openly placed one red ball and one blue ball. It was then explained to participants that, at the end of the session, a single ball would have been blindly drawn by one of them, and that all lottery-task payoffs would have depended from which one of the two balls was drawn. In each lottery trial, the colour of the winning ball was randomized (i.e., on some trials participants were asked to bet on "blue" and on some trials to bet on "red"). Following the lottery task, participants completed a post-experimental questionnaire consisting of two main sets of items: the "similarity measure" items and MFQ items.

All tasks were computerised in Qualtrics (Qualtrics, Povo). While participants were completing the post-experimental questionnaire, we downloaded their responses from the Qualtrics website and ran an in-house script to randomly select a trial, randomly match the participants and determine their payoffs according to their actual choices. All procedures were approved by the local ethical committee. Our data is available upon request.

4.   Results

Our main interest lies in understanding – comparatively across game settings – how friendship affects players' strategic uncertainty and therefore the likelihood of choosing the action leading to uncertain payoffs against the alternative action leading to safe payoffs. For the sake of the exposition, in the remaining of the paper, we will refer to the former as UP (short for 'Uncertain Payoff') action and the latter as SP (short for 'Safe Payoff') action. In addition to the likelihood of UP actions, we investigate also how friendship affects other coordination-related measures: that is, the players' adoption of different (if any) 'threshold' strategies (i.e., strategies involving choosing an action – say UP – as long as the sure payoff is below a certain value threshold and then switch to the other available action – say SP), the rates of coordination and the expected payoffs.

4.1   Friendship and Strategic Uncertainty

To investigate the impact of friendship on strategic uncertainty, we estimate mixed effects logistic models regressing the UP action (assuming value 1 for UP actions and 0 otherwise) on the safe payoff X, the game (Stag-hunt game = 1 vs. Entry game = 0), the type of counterpart (Stranger=1 vs. Friend=0), individual risk attitudes and the relevant interactions among the above variables of interest.

TABLE 3—INVESTIGATING UP ACTIONS: MIXED EFFECTS LOGISTIC REGRESSIONS

Estimation method: Mixed Effects Logistic
Controls for individual effects: Clustering
Dep. variable: UP action (dummy)

	Model 1		Model 2	
Safe payoff	-0.203***	(0.014)	-0.203***	(0.014)
Game	4.150***	(0.217)	4.14***	(0.216)
Counterpart	0.658***	(0.154)	0.658***	(0.153)
Game*Safe payoff	-0.115***	(0.019)	-0.115***	(0.019)
Counterpart*Safe payoff	-0.048***	(0.018)	-0.047***	(0.018)
Game*Counterpart	-1.732***		-1.732***	(0.147)
Risk			2.477***	(0.646)
Constant	-0.810***		0.047	(0.324)
No. Observations	6196		6196	
No. Individuals	78		78	
Log-likelihood	-2904.980		-2898.3	

Notes: (Robust) Standard errors are in parentheses.
*** represents significance at the 1 percent level.
** represents significance at the 5 percent level.

Table 3 reports the estimations obtained after clustering at subject level to control for individuals as random effects. All variables in Model 1 have a significant impact on UP actions. For instance, in line with our expectations, increasing safe payoff values (log) linearly decrease the odds

of a UP action across both environments. Specifically, a one unit increase in safe payoff is associated with a -0.203 unit decrease in the expected log odds of UP action in the entry game, and of a -0.318 (i.e., -0.203-0.115) unit decrease in the stag hunt. Furthermore, the (log) odds of UP actions was higher in stag hunts than entry games. More importantly, however, friendship significantly interacted with the game environment by increasing the log odds of a UP action in the stag hunt while decreasing it in the entry game. These effects appear very stark in Figure 2, which builds on Model-1 regression. In fact, Figure 2 plots the estimated probabilities of choosing UP action across different values of safe payoff, when interacting with either friends or strangers in both stag-hunt games and entry games.
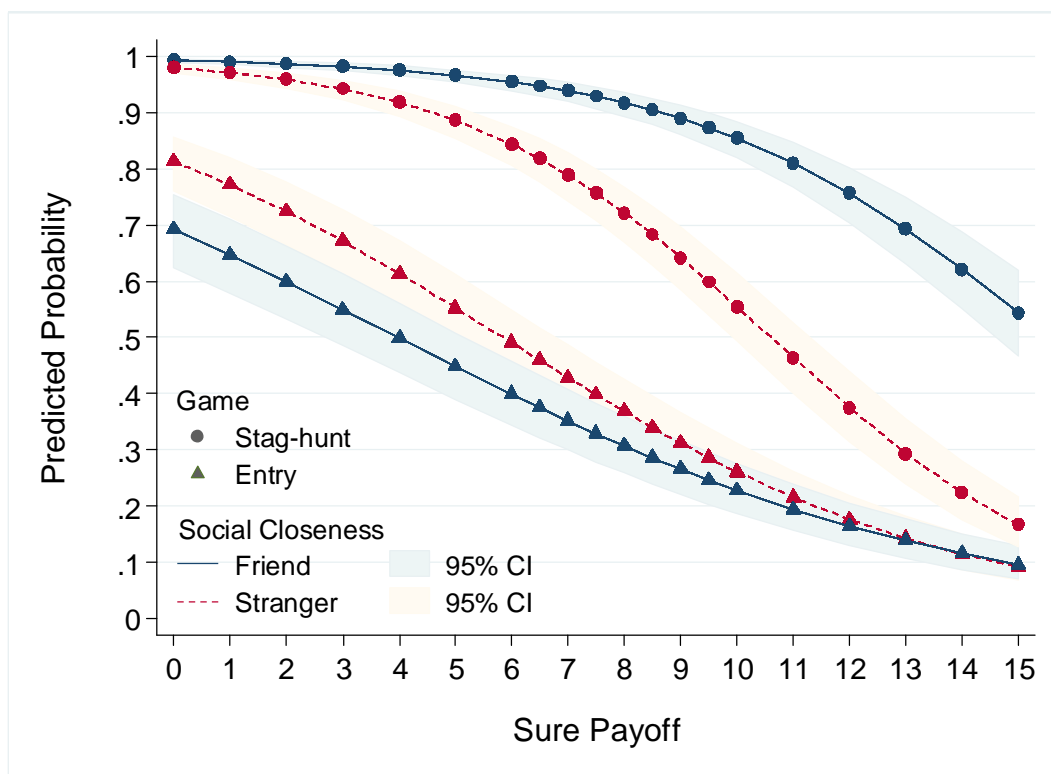

FIGURE 2. THE IMPACT OF FRIENDSHIP ON TACIT COORDINATION.

Notes: Curves represent predicted probabilities of choosing UP actions (y-axis) across different values of a safe alternative (x-axis), when interacting with either friends (blue solid lines) or strangers (red dashed lines) in both stag-hunt games (circle marker) and entry games (triangle marker). The predicted probabilities were obtained from Model-1 mixed effects logistic regression. Error bands represent 95% confidence bands of the fixed effects.

In synthesis, friends appear significantly more likely to choose the UP action than strangers when there were to match their choices in stag hunt games; by contrast, friends were significantly less likely to do so when mismatching their choices in entry games. These effects are particularly clear at opposite SP ranges in the two games, that is, at low SPs in the entry game, and high SPs in the stag hunt.

From an economic perspective, in the light of the existent evidence demonstrating a correlation between strategic uncertainty and risk attitude when choice elicitation is framed in a similar fashion (Heinemann et al., 2009), it is legitimate to explore the role of risk attitudes and their interplay with friendship. Model 2 in Table 3 aims exactly at estimating the importance of risk seeking, as measured by participants' choices in the lottery task, in explaining UP actions. Corroborating previous findings, risk seeking positively affects players' choices of UP, that is, participants that chose the UP more frequently in lotteries, also did so in the strategic games. Furthermore, the effects of friendship, including its interaction with the game environment, remained highly significant, even when controlling for individual differences in risk-attitudes.

From a psychological perspective, this effect of friendship on coordination may partially be explained by friends' perceived interpersonal similarities, given that people tend to become friends with people who share similar traits (e.g., McPherson et al., 2001). In line with this, our similarity task revealed that, indeed, friends believed they were more likely than strangers to be described by the same personality traits (r=0.28, 95% CI [0.2 0.36], p<0.001), and we took the participant-specific extent of this correlation, as a measure of the degree to which they attributed similar traits to themselves and their friends, but not strangers. However, the coordination effect may also be mediated by general friendship quality, independently of similarity. In fact, we found that our measure of similarity did not predict general friendship quality (r=0.07, p>0.4), as measured by the MFQ score[1]. We thus forwarded these measures to the mixed effects logistic regressions in Table 4 to assess their impact on UP actions choices across games. As these measures did not apply to strangers, we restricted this model to the friendship condition only. In Table 4 below, in addition to the terms employed in Table 3, Model 1 investigates the possible import of perceived interpersonal similarity (in interaction with the game environment) on UP action, while Model 2 analyses friendship quality and Model 3 focuses on the terms that had a significant impact on UP action in either of the first two models.

In Model 1 (Table 4), increasing similarity scores decreases the log odds of a UP choice in the entry game (i.e., by -0.576) and this does not significantly interact with the stag hunt. In Model 2, friendship quality does not have an impact on UP likelihood in the entry game, but strongly interacts with the game environment by increasing the log odds of a UP action in the stag hunt game. These findings were unaltered when simultaneously controlling for both similarity and friendship quality in Model 3.

---

[1] Since the MFQ subscales were all highly inter-correlated (all correlations r>0.75, p<0.001) we aggregated across them and took this resulting average MFQ score as a general measure of friendship quality.

Estimation method: Mixed Effects Logistic
Controls for individual effects: Clustering
Dependent variable: UP action (dummy)

	Model 1		*Model 2*		*Model 3*	
Safe payoff	-0.207***	(0.016)	-0.209***	(0.016)	-0.209***	(0.016)
Game	4.428***	(0.334)	1.456***	(0.544)	1.437***	(0.527)
Game*Safe payoff	-0.126***	(0.030)	-0.137***	(0.030)	-0.137***	(0.031)
Similarity index	-0.828*	(0.387)			-1.006***	(0.37)
Similarity index*Game	-0.245	(0.323)				
MFQ index			-0.017	(0.089)		
MFQ index*Game			0.432***	(0.089)	0.435***	(0.067)
Constant	1.066***	(0.203)	0.962	(0.661)	1.124***	(0.201)
No. Observations	3112		3112		3112	
No. Individuals	78		78		78	
Log-likelihood	-1341.35		-1318.97		-1320.53	

Notes: (Robust) Standard errors are in parentheses.
*** represents significance at the 1 percent level.
** represents significance at the 5 percent level.
* represents significance at the 10 percent level.

To follow up on this analysis, we aggregated over UP actions for each game environment, thus obtaining two measures for each participant: the frequency of UP actions in the stag hunt game and the corresponding measure for the entry game. We then correlated each of these two variables with the friendship quality and similarity scores. We found the while friendship quality predicted higher frequencies of UP actions when participants coordinated with their friends in stag hunt games (r=0.3, 95% CI [0.09 0.49], p<0.01), while it did not in entry games (r=-0.03, 95% CI [-0.25 0.19], p=0.77). Vice versa, we found that perceived similarity among friends predicted lower frequencies of UP actions when friends coordinated in entry games (r=-22, 95% CI [-0.42 0], p<0.05), but not in stag hunt games (r=-0.17, 95% CI [-0.38 0.04], p=0.12).

In synthesis, Table 4 econometric estimations and the correlations above converge in suggesting that, while friendship quality appears to play a role in fostering "assurance" in stag hunt games, perceived interpersonal similarities could deter friends from entering in entry games.

4.2 Friendship and Threshold Strategies

Following Heinemann et al. (2009) a "perfect threshold" strategy is one in which a participant chooses one option (i.e., the UP action) for all sure payoff values below some

(idiosyncratic) threshold value, and then switches to the other option for all sure payoff values above that threshold. For instance, a typical "perfect" threshold strategy would be one in which a participant chooses the UP action for all sure payoff values below $8 and then chooses the SP action for all sure payoff values equal or greater than $8.

TABLE 5—TREMBLING AND FRIENDSHIP: MIXED EFFECTS LOGISTIC REGRESSIONS

Estimation method: Mixed Effects Logistic
Controls for individual effects: Clustering
Dependent variable: threshold (dummy)

Safe payoff	-0.073***	(0.015)
Game	3.342***	(0.292)
Game*Safe payoff	0.240***	(0.029)
Counterpart (dummy)	-0.213	(0.190)
Counterpart*Safe payoff	0.025	(0.022)
Game*Counterpart	1.135***	(0.378)
Game*Counterpart*Safe payoff	-0.113***	(0.039)
Constant	-0.504***	(0.149)
No. Observations	5848	
No. Individuals	78	
Log-likelihood	-2611.6	

Notes: (Robust) Standard errors are in parentheses.
*** represents significance at the 1 percent level.
** represents significance at the 5 percent level.
* represents significance at the 10 percent level.

Importantly, participants need not to exhibit perfect threshold strategies, but could switch back and forth between the UP and the SP actions multiple times (i.e., exhibiting violations of monotonicity). We thus proceeded to count their thresholds and called this a "trembling rate". To label such thresholds, within each of our decision environments, we first ordered the trials in ascending order, on the basis of the sure payoff term. We then dummy coded each trial – excluding the first (namely, the trial for which the sure payoff was equal to $0) – with a "1" if the choice had changed, relative to the previous one, and with a "0" if it had not. We thus proceeded to examine how friendship affected "trembling" in each of the game environments.

To this aim, we implemented a mixed logistic regression estimating a model like Model 1 in Table 3 with the only difference that the dependent variable was in this case the "trembling rate"

computed as described above. This last mixed effects logistic regression (Table 5) revealed a significant 3-way *interaction* between game, friendship and sure payoff suggesting that friendship differentially affected the likelihood that participants would switch back and forth between actions in the two games. In fact, when participants had to match their choices, they were more likely to "tremble" when playing with strangers rather than friends, especially at low sure payoffs. Conversely, mismatching with friends as opposed to strangers raised the likelihood of switching one's choice in entry-game environments, albeit non-significantly (p=0.26), hence the significant 3-way interaction.

4.3 Friendship, Coordination and Earnings

To further investigate and characterise how friendship affected performance in the two classes of games considered, we computed two related measures: expected coordination and expected payoff rates. We illustrate each in turn. For the Friend treatment, we computed the expected coordination rate for each participant in the stag hunt game (resp. entry game) as the percentage of times a player matched (resp. mismatched) their choice with their friend counterpart across the twenty variants of the game played (one variant for each sure payoff value we used). For instance, if participant "*i*" in the Friend treatment did match their choices with their friend counterpart 18 out of 20 times – i.e., 90% of times – then *i*'s expected coordination rate was quantified as 0.90 (as was the coordination rate of *i*'s friend). For the Stranger treatment, for each participant in the stag hunt game (resp. entry game) we first obtained the percentage of times a player could be paired with any other stranger counterpart in our subject pool who chose the same (resp. a different) action on the same game variant; then, we averaged over these percentages to compute the expected coordination rate. For instance, if participant "*j*" in the Stranger treatment chose the UP action in a stag hunt game with a sure payoff of $5, and 78% of the other players had also chosen the UP action on that game variant, then *j*'s the expected coordination rate for the $5 sure payoff variant was quantified as 0.78; we would than average the coordination rates so obtained across the twenty variants of the game to determine the "expected coordination rate." Everything else being equal, had *j* chosen the SP action instead of the UP action, their "expected coordination rate" for the same trial would have been (1-0.78) = 0.22. Notably, it can be easily understood that expected coordination rates and expected payoff rates are not identical concepts. Consider two hypothetical stag hunt games in which all participants always chose the UP action or always chose the SP action. Expected coordination rates (as we defined them above) would be identical for the two groups, though the expected payoff rates of the first group would be higher, because they coordinated on the efficient equilibrium rather than the inefficient one.

TABLE 6—COORDINATION AND EARNINGS: OLS REGRESSIONS

Estimation method: Ordinary Least Square

Controls for individual effects: Clustering

Dependent variable:	Model 1 Expected Coordination Rates		Model 2 Expected Payoff Rates	
Game	0.348***	(0.028)	4.074***	(0.314)
Counterpart	-0.047**	(0.022)	-0.615***	(0.203)
Game*Counterpart	-0.097***	(0.027)	-1.397***	(0.317)
Constant	0.458***	(0.024)	8.914***	(0.210)
No. Observations	312		312	
No. Individuals	78		78	
R^2	0.568		0.604	

Notes: (Robust) Standard errors are in parentheses.
*** represents significance at the 1 percent level.
** represents significance at the 5 percent level.

We thus proceeded to also computing expected payoffs. To do so, we follow a strategy similar to the one adopted for calculating the expected coordination rates with one modification. Specifically, had a participant chosen the UP action on a given variant of the stag hunt (resp. entry) game, we simply took the percentage of times a player matched (resp. mismatched) their choice with their friend counterpart and multiplied this by the maximum payoff of $15. At last, in all environments, had player *i* chosen the SP action instead of the UP action, their payoff was unconditionally the sure payoff value (i.e., in the example above: $7). In this fashion, we computed expected payoff rates for each treatment and proceeded to investigate how they were affected by friendship.To assess whether friendship differentially affected coordination and expected payoff rates in the two games of interest, we report in Table 6 above two corresponding OLS regression models. Expected coordination and payoff rates are significantly higher when playing the stag hunt game as well as when the counterpart is a friend. Both models also reveal significant interaction effects between the stag hunt game and the treatment dummy (i.e., stranger counterpart) suggesting that the coordination and payoff advantage of playing with friends (as opposed to strangers), though still maintained[2], was importantly decreased when passing from the stag hunt to the entry game.

---

[2] We suspect that this is due to the fact that there was "more space" to "earn up" rather than down in our entry games, and thus that friends' better performance could be a by-product of their lower entry rates.

5.   Discussion

In this study we investigated how friendship affects strategic uncertainty and cooperation across experimental games of strategic complements and substitute. We find that, relative to strangers, friends exhibit a propensity towards uncertainty when they are to tacitly match their choice in games of strategic complements (i.e., stag-hunt games). Conversely, relative to strangers, friends show aversion to uncertainty when they are to mismatch their choices in a game with strategic substitutes. Furthermore, friends also tremble less than strangers in matching contexts but lose this advantage when facing mismatching contexts. The reported experimental evidence challenge the intuitive notion that social closeness should always decrease strategic uncertainty in situations involving tacit coordination. We identify two potential mechanisms that may mediate the friends' propensity for matching choices in games of strategic complements and aversion to mismatching choices in games of strategic substitute: that is, (1.) social inference and (2.) social preferences. In what follows, we briefly discuss these two mechanisms in turn.

5.1   Social Inference and Strategic Reasoning

As anticipated in the introduction, early experimentalists expressed the need for a theoretical refinement for beliefs formation in coordination games (Cooper and DeJong, 1990). Here, we conjectured that social psychology and neuroscience could provide such a refinement. Specifically, there is much accumulated evidence that one way to access the minds of others is to make use of the models subjects have of *their own* minds to make inferences about others (Goldman, 2006 for a review) and that this strategy for belief formation is particularly useful for close, rather than more distant others (Ames, 2004; Clement and Krueger, 2002 for a meta-analysis). Our findings are consistent with this notion: if agents expect that, relative to strangers, their friends are more likely to share their thoughts and preferences (Benoit et al., 2010; Montoya et al, 2008 for a meta-analysis), this could provide assurance in stag hunts but deterrence in entry games.

A related interpretation of our results may come from level-k or cognitive hierarchy models of strategic reasoning (Camerer et al. 2004; Nagel 1995). Those models postulate the existence of players with different levels of strategic reasoning; each player acts by best-responding to co-players, who are assumed to be one level lower relatively to the player's own strategic reasoning level. In a stag-hut game, those models predict that the optimal decision will not change for higher reasoning levels. By contrast, in an entry game, those models will predict players' best reposes to oscillate between UP and SP actions depending on the players' level of strategic reasoning. Specifically, at low sure payoff ranges, level-1 players by best-responding to level-0 players will choose more frequently UP actions relatively to level-2 players, who will choose them less

frequently. The behaviour of participants in the stranger condition was most akin to that of level-1 players with higher frequency of UP actions at low sure payoffs. Differently, participants in the friend condition did behave more as being level-2 player, leading to less frequently chosen UP actions at low sure payoff. In other words, it seems that players in the friend condition made decisions as if they had higher levels of reasoning.

Our findings could also provide an interesting extension to Abele and Stasser (2008). They showed that successful matching but not successful mismatching benefitted interpersonal perceptions amongst strangers: that is, strangers began to like each other more (and felt more similar) to their game counterparts when they successfully matched their choices, rather then successfully mismatched them. This suggests that matching rather than mismatching could be particularly conducive to the formation of social ties. In fact, in a different study, Chartier and Abele (2015) found that a similar mechanism could also work the other way around: when positive interpersonal perceptions are already in place – as in the case of the romantic couples which they invited as participants – this leads to coordination advantages in matching but not mismatching problems. Our results could extend those findings: "friendly interpersonal perceptions" (as well as the common knowledge that friends share but strangers do not) can alleviate uncertainty in matching problems, and potentially even increase uncertainty in mismatching problems.

We also find that the friendship effect in stag hunt games but not in entry games is mediated by friendship quality. This might be due to the fact that friendship quality is frequently related to mutual reliance, or expected reciprocity, which could provide assurance to both participants in stag hunt games, while the same knowledge is of no clear use – and could even interfere – in entry games. On the other hand, we find that perceived similarity to one's friend acts as a deterrent in entry games, discouraging friends from pursuing the UP action. This is in line with previous findings linking perceived interpersonal similarities to aversion to uncertainty in entry games (Chierchia & Coricelli, 2015). However, in that study, perceived similarities were experimentally manipulated (e.g., by showing both players that they shared similar traits) among stranger participants while here, perceived similarities emerged spontaneously among actual friends[3].

---

[3] This difference could perhaps also underlie one of our unexpected findings, namely, that perceived interpersonal among friends did not, as in that study, raise UP likelihood in stag hunts. We speculate that perceived similarities may not be as central in raising efficient coordination in stag hunt among friends, as it is among strangers. Perhaps, the perceived interpersonal similarities that play an important role in initially forming friendships, may make way for different coordination mechanisms as friendships consolidate over time.

5.2   Social Preferences

Social preference models (e.g., Fehr and Fischbacher 2003; Kollock 1998; Lange 1999) tend to neglect the role social closeness may have on inferences (Hayashi and Ostrom 1999), while stressing the role it may have on agents' motivations/preferences (Zajonc 1980). Specifically, it has often been proposed that, among social species, humans exhibit particularly high levels of "altruistic behavior" (e.g., Fehr and Fischbacher 2003), and that this altruism is proportional to social closeness (e.g., Jones and Rachlin 2006). In fact, by transforming the payoffs of the game (e.g., Kollock 1998; Lange 1999), it can be mathematically shown that, all else being equal, if agents are assumed to "care" for the payoffs of their co-player (as well as their own), this increases the expected utility of the uncertain payoff in games involving strategic complements, but decreases it in games with strategic substitutes. It follows that social preferences models also afford a seemingly simple explanation of our results: in the stag-hunt game, friends cooperate more than strangers because they want their friends not to lose out (by choosing the uncertain option alone); conversely, in the entry game, friends could avoid choosing the uncertain option relative to strangers because they avoid options that may damage them.

5.3   Social Inference Vs Social Preference

While social preferences are usually advocated in the context of mixed-motive games (e.g., Yamagishi et al. 2013), by now several studies have shown that even in those games, the effects of social closeness on cooperation are mostly due to changes in inferences rather than preferences (e.g., Balliet et al. 2014). For instance, while ingroup members are known to cooperate more frequently than outgroup members in games, this ingroup favoritism collapses when participants are informed that their ingroup counterparts are unaware of whether they are playing with an ingroup or an outgroup (Foddy et al. 2009; Guala et al. 2013). This suggests that ingroup cooperation stems also from the inferences (i.e., that one's cooperation will be more likely be reciprocated by an ingroup than by an outgroup), and not exclusively from the motivation to benefit ingroups more than outgroups per se. Indeed, another study even showed that *out*group favoritism prevailed when participants' own payoffs were dependent on outgroup member (Rabbie et al. 1989). We might already speculate that both social inference and preferences are likely to be at play. However, whether our results are due to friendship's impacting players' behaviour via either inferences or preferences or both will require further experimentation.

6.   Conclusions

In this study, we report the finding that, relative to strangers, friends exhibit a propensity for matching choices in games with strategic compliments (i.e., two-player stag-hunt game), and an aversion to mismatching choices in games with strategic substitutes (i.e., two-player entry game).

Our findings could be considered from three different viewpoints: that is, theoretical, experimental and applied viewpoints.

From a theoretical viewpoint, our findings may prompt new developments for modelling behaviour and underlying motives in strategic interactions across families of games and social contexts. Notably, while social preferences models could technically explain some aspects of this behavioural pattern, theories involving social inference and strategic reasoning may account for much of the same data, and possibly even for more. On this basis, the notion of friendship we propose is one that does not only entail altruism, or compassion, but importantly knowledge of the other co-players: indeed, if social closeness also leads to "mutually enhanced predictability", this can provide the reassurance agents need for effectively matching their actions in settings with strategic complements, while simultaneously increasing fear of mismatching in settings with strategic substitutes.

From an experimental viewpoint, our results illustrate the scope for exploring the differential role of friendship across a variety of strategic situations characterised by different trade-offs ranging from pure coordination games, through mixed-motive games, to pure conflictual (i.e., zero-sum) games.

From an applied viewpoint, our findings have also potential relevant implications for understanding team production in organizations. In fact, within organizations team members are embedded in a social space, they constantly tune their behaviour onto the "social closeness" of others and their interactions may display either strategic complements or substitutes depending on members' roles, tasks, skills, and objectives. Such an understanding is far from being fully attained; consequently, there is considerable scope for future research on the mechanics of cooperation in social environments featuring strategic complements/substitutes to drawing valuable lessons for teams in organizations.

References

Abele, S., & Stasser, G. (2008). Coordination success and interpersonal perceptions: matching versus mismatching. *Journal of Personality and Social Psychology*, *95*(3), 576–592.

Ames, D. (2004). Strategies for social inference: a similarity contingency model of projection and stereotyping in attribute prevalence estimates. *Journal of personality and social psychology*, *87*(5), 573–585.

Apicella, C., Marlowe, F., Fowler, J., & Christakis, N. (2012). Social networks and cooperation in hunter-gatherers. *Nature*, *481*(7382), 497–501.

Balliet, D. (2009). Communication and Cooperation in Social Dilemmas: A Meta-Analytic Review. *Journal of Conflict Resolution*, *54*(1), 39–57.

Balliet, D., Wu, J., & De Dreu, C. K. (2014). Ingroup favoritism in cooperation: A meta-analysis. *Psychological Bulletin*, *140*(6), 1556.

Bernhard, H., Fischbacher, U., & Fehr, E. (2006). Parochial altruism in humans. *Nature*, *442*, 912–915.

Bradner, E., & Mark, G. (2002). Why distance matters: effects on cooperation, persuasion and deception. In ACM (Ed.), *Proceedings of the 2002 ACM conference on Computer supported cooperative work* (pp. 226–235). New York.

Brosnan, S. (2005). Tolerance for inequity may increase with social closeness in chimpanzees. *Proceedings of the Royal Society of London B: Biological Sciences*, *272*(1560), 253–258.

Camerer, C. (2003). *Behavioral game theory: Experiments in strategic interaction*. (P. University, Ed.). New York.

Camerer, C., Ho, T., & Chong, J. (2004). A cognitive hierarchy model of games. *The Quarterly Journal of Economics*, *119*(3), 861–898.

Charness, B. G., Rigotti, L., & Rustichini, A. (2007). Individual Behavior and Group Membership. *The American Economic Review*, *5*(4), 1340–1352.

Charness, G., Haruvy, E., & Sonsino, D. (2007). Social Distance and Reciprocity : An Internet Experiment. *Journal of economic behavior & organization*, *63*(1), 88–103.

Chartier, C., & Abele, S. (2016). Tacit coordination in close dyads: The use of social focal points. *Group Processes & Intergroup Relations,* 19(1) : 125-134.

Chen, R., & Chen, Y. (2011). The potential of social identity for equilibrium selection. *The American Economic Review*, *101*(6), 2562–2589.

Chierchia, G., & Coricelli, G. (2015). The impact of perceived similarity on tacit coordination: propensity for matching and aversion to decoupling choices. *Frontiers in behavioral neuroscience*, *9*(202).

Clement, R., & Krueger, J. (2002). Social categorization moderates social projection. *Journal of*

Experimental Social Psychology, *38*(3), 219–231.

Cole, T., & Teboul, B. (2004). Non-zero-sum collaboration, reciprocity, and the preference for similarity: Developing an adaptive model of close relational functioning. *Personal Relationships*, *11*(2), 135–160.

Cooper, R., & DeJong, D. (1990). Selection criteria in coordination games: Some experimental results. *The American Economic Review*, *80*(1), 218–233.

Crawford, V.P., Costa-Gomes, M.A., and Iriberri, N. (2013). Structural models of nonequilibrium strategic thinking: Theory, evidence, and applications. *Journal of Economic Literature* 51(1), 5-62.

DeBruine, L. (2002). Facial resemblance enhances trust. *Proceedings of the Royal Society of London B: Biological Sciences*, *269*(1498), 1307–1312.

Devetag, Giovanna, and Ortmann, Andreas. 2007. When and Why? A Critical Survey on Coordination Failure in the Laboratory. *Experimental Economics*, 10(3): 331-44.

Fehr, E., & Fischbacher, U. (2003). The nature of human altruism. *Nature*, *425*(6960), 785–791.

Fiske, S., Cuddy, A., & Glick, P. (2007). Universal dimensions of social cognition: Warmth and competence. *Trends in cognitive sciences*, *11*(2), 77–83.

Foddy, M., Platow, M., & Yamagishi, T. (2009). Group-Based Trust in Strangers The Role of Stereotypes and Expectations. *Psychological Science*, *20*(4), 419–422.

Gächter, S., Starmer, C., & Tufano, F. (2017). The Hidden Power of Group Cohesion for Coordination and Cooperation. Mimeo.

Goldman, A. I. (2006). *Simulating minds: The philosophy, psychology, and neuroscience of mindreading*. New York: Oxford University Press.

Greiner, B. (2015). Subject pool recruitment procedures: organizing experiments with ORSEE. *Journal of the Economic Science Association*, (1), 1-12.

Guala, F., Mittone, L., & Ploner, M. (2013). Group membership, team preferences, and expectations. *Journal of Economic Behavior & Organization*, *86*, 183–190.

Hamilton, W. (1964). The genetical evolution of social behaviour. I. *Journal of theoretical biology*, *7*, 1–16.

Hamlin, J. K., Wynn, K., & Bloom, P. (2007). Social evaluation by preverbal infants. *Nature*, *450*(7169), 557–559.

Hayashi, N., & Ostrom, E. (1999). Reciprocity, trust, and the sense of control a cross-societal study. *Rationality and society*, *11*(1), 27–46.

Heinemann, F. (2009). Measuring strategic uncertainty in coordination games. *The Review of Economic Studies*, *76*(1), 181–221.

Hoffman, E., McCabe, K., & Smith, V. L. (1996). Social distance and other-regarding behavior in

dictator games. *The American Economic Review*, *86*(3), 653–660.

Holtz, R., & Miller, N. (1985). Assumed similarity and opinion certainty. *Journal of Personality and Social Psychology*, *48*(4), 890–898.

Hruschka, D., & Henrich, J. (2006). Friendship, cliquishness, and the emergence of cooperation. *Journal of Theoretical Biology*, *239*(1), 1–15.

Jones, B., & Rachlin, H. (2006). Social discounting. *Psychological Science*, *17*(4), 283–286.

Kollock, P. (1998). Social dilemmas: The anatomy of cooperation. *Annual review of sociology*, 183–214.

Kranton, R., Pease, M., Sanders, S., &Huettel, S. (2016). Groupy and Non-Groupy Behavior: Deconstructing Bias in Social Preferences. Mimeo.

Krienen, F., Tu, P., & Buckner, R. (2010). Clan mentality: evidence that the medial prefrontal cortex responds to close others. *The Journal of Neuroscience*, *30*(41), 13906–13915.

Krueger, J., DiDonato, T., & Freestone, D. (2012). Social projection can solve social dilemmas. *Psychological Inquiry*, *23*(1), 1–27.

Krueger, J., & Zeiger, J. (1993). Social categorization and the truly false consensus effect. *Journal of Personality and Social Psychology*, *65*(4), 670–680.

Lange, P. Van. (1999). The pursuit of joint outcomes and equality in outcomes: An integrative model of social value orientation. *Journal of personality and social psychology*, *77*(2), 337–349.

Majolo, B., & Ames, K. (2006). Human friendship favours cooperation in the Iterated Prisoner's Dilemma. *Behavior*, *143*(11), 1383–1395.

Massen, J., & Koski, S. (2014). Chimps of a feather sit together: chimpanzee friendships are based on homophily in personality. *Evolution and Human Behavior, 35*(1), 1–8.

McPherson, M., Smith-Lovin, L., & Cook, J. (2001). Birds of a feather: Homophily in social networks. *Annual review of sociology*, *27*, 415–444.

Meltzoff, A. (2007). "Like me": a foundation for social cognition. *Developmental science*, *10*(1), 126–134.

Mendelson, M., & Aboud, F. (1999). Measuring friendship quality in late adolescents and young adults: McGill Friendship Questionnaires. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement*, *31*(2), 130–132.

Montoya, R., Horton, R., & Kirchner, J. (2008). Is actual similarity necessary for attraction? A meta-analysis of actual and perceived similarity. *Journal of Social and Personal Relationships*, *25*(6), 889–922.

Morry, M. (2007). The attraction-similarity hypothesis among cross-sex friends: Relationship satisfaction, perceived similarities, and self-serving perceptions. *Journal of Social and Personal*

Relationships, *24*(1), 117–138.

Nagel, R. (1995). Unraveling in guessing games: An experimental study. *The American Economic Review*, *85*(5), 1313–1326.

Ochs, Jack. 1995. Coordination Problems. In *Handbook of Experimental Economics*, John H. Kagel and Alvin E. Roth, 195-252. Princeton: Princeton University Press.

Olson, K., & Spelke, E. (2008). Foundations of cooperation in young children. Cognition, 108(1), 222–231.

Qualtrics. (n.d.). UT, USA. qualtrics.com. Accessed 7 September 2015

Rabbie, J., Schot, J., & Visser, L. (1989). Social identity theory: A conceptual and empirical critique from the perspective of a behavioural interaction model. *European Journal of Social …*, *19*(3), 171–202.

Reuben, E., & van Winden, F. (2008). Social ties and coordination on negative reciprocity: The role of affect. *Journal of Public Economics*, *92*(1-2), 34–53. doi:10.1016/j.jpubeco.2007.04.012

Tajfel, H., & Turner, J. (1979). An integrative theory of intergroup conflict. *The social psychology of intergroup relations*, *33*(47), 74.

Wilder, D. (1984). Intergroup contact: The typical member and the exception to the rule. *Journal of Experimental Social Psychology*, *20*(2), 177–194.

Wiltermuth, S. S., & Heath, C. (2009). Synchrony and cooperation. *Psychological science*, *20*(1), 1–5.

Yamagishi, T., Mifune, N., Li, Y., Shinada, M., Hashimoto, H., Horita, Y., et al. (2013). Is behavioral pro-sociality game-specific? Pro-social preference and expectations of pro-sociality. *Organizational behavior and human decision processes*, *120*(2), 260–271.

Zajonc, R. (1980). Feeling and thinking: Preferences need no inferences. *American psychologist*, *35*(2), 151–175.

Appendix A

Dear participant,

welcome, and thank you for participating in our experiment on decision-making!

You will earn a show-up fee just for having participated:

In addition to the show-up fee, you will be able to earn up to 15.00 $ on the basis of your decisions (for a potential total of 20.00 $).

To increase your chances of earning more it is sufficient that you *carefully follow the brief and simple instructions*, which we will also read out loud together.

Remember that there are no right or wrong answers!

It is important that you fully understand the simple tasks and that you never respond randomly as this will decrease your payoff and damage the entire research.

If at any time during the experiment you feel that the tasks are unclear, please do not hesitate to raise your hand and an experimenter will immediately assist you.

From now, until the end of the experiment please refrain from using any personal electronic device. This will result in exclusion from the experiment. Any form of communication is also not allowed and will result in exclusion from the experiment, unless otherwise noted

We will now proceed to the instructions of the games.

GAME 1 and GAME 2

In both games you will be matched with a counterpart in this room.

We will tell you if your counterpart is the friend you came here with or a stranger.

You and your counterpart will both have to choose between two options, "A" and "B", without communicating.

"A" is a dollar amount and, in both games, if you choose it, you will obtain "A" dollars no matter what your counterpart chooses.

THE CRITICAL DIFFERENCE BETWEEN GAME 1 AND GAME 2 IS IN OPTION B.

In GAME 1, if you choose option B, you will obtain 15.00 $ ONLY IF your counterpart also chooses option B, and zero if he/she chooses A.

In GAME 2, if you choose option B, you will obtain 15.00 $ ONLY IF your counterpart DOES NOT choose B, and zero if he/she also chooses B.

"STRANGER" or "FRIEND" COUNTERPART

For each decision you make we will tell you if your current counterpart is a stranger or your friend:

In the **"FRIEND"** case you will actually be playing with the friend you came here with. You will not be allowed to communicate - attempts to communicate will result in exclusion from the experiment.

In the **"STRANGER"** case you will play with a randomly selected participant in the room.

You and your "stranger" counterpart will remain anonymous to one another *both during and after* the experiment.

The only thing that you know about your "stranger counterpart" is that he/she is *NOT* the friend you came with.

Your "stranger counterpart" will possibly be a different participant every time (as it is random, we don't know).

ATTENTION:
IN EITHER CASE YOU WILL NOT KNOW THE OUTCOMES OF ANY OF YOUR DECISIONS BEFORE THE END OF THE EXPERIMENT!

Screenshot of the coordination game. In the example above, a participant is taking part in a "stag hunt game, in the friendship condition" (see Methods). Before taking part in the games, participants were asked to write the name of their friend, which then reappeared in the friendship condition (in the example above the participant's friend's name is "Mark). In the stranger condition, one's friend's name was replaced with "a stranger". In an "entry game", in the "B" option, the letters "B" and "A" are simply exchanged.

Screenshot of the lottery condition. As for the coordination games, in the lottery condition, participants were to choose between an uncertain option ("B") and a lower paying but certain alternative ("A"). The outcome of the uncertain option depended on the extraction of a lottery containing a 1 "winning ball" and 1 "losing one".