Economics Letters 216 (2022) 110552

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Social closeness can help, harm and be irrelevant in solving pure coordination problems

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ARTICLE INFO

Article history:
Received 18 December 2021
Received in revised form 20 April 2022
Accepted 21 April 2022
Available online 4 May 2022

JEL classification:
C72 (Noncooperative Games)
C92 (Laboratory, Group Behaviour)
C93 (Field Experiments)

Keywords:
Coordination
Lab-in-the-field experiment
Oneness
Salience
Social closeness
Social distance

ABSTRACT

Experimental research has shown that ordinary people often perform remarkably well in solving coordination games that involve no conflicts of interest. While most experiments in the past studied such coordination games among socially distant anonymous players, here we study behaviour in a set of two player coordination games and compare the outcomes depending on whether the players are socially close or socially distant. We find that social closeness influences prospects for coordination, but whether it helps, harms, or has no impact on coordination probabilities, depends on the structure of the game.

1. Introduction

Coordination problems are pervasive in social life. While it is well-established that people are remarkably successful in exploiting focal points to mutual benefit in pure coordination games (e.g., Mehta et al., 1994), how they achieve this remains poorly understood. This paper investigates whether "social closeness" affects coordination success in tacit, "pure-matching" (or "Schelling") coordination games with multiple Nash equilibria.

In his classic book *The Strategy of Conflict*, Schelling (1960) proposed that focal points – salient, but payoff-irrelevant labels attached to actions within a pure-matching coordination game – allow individuals to solve equilibrium selection problems (i.e., coordinate with high probability by choosing salient options). Label saliency depends on features of the decision situation and the individuals involved; and successful coordination may rely on shared knowledge or common cultural perceptions of the participants. In short, what individuals know about each other may be an important determinant of salience-based coordination (e.g., Abele et al., 2014; Sontuoso and Bhatia, 2021).

Most previous empirical studies of focal points in pure-matching games studied *socially distant* and *anonymous* players (e.g., Cooper and Weber, 2020; Rojo Arjona, 2020). Yet the social distance between individuals might be an important factor determining their ability to exploit salience for coordination in everyday settings. While *close* friends will know more about each other than *distant* acquaintances, it is an open question how this affects the prospects for coordination via focal points. For example, social closeness might promote coordination by enhancing the focality of options or impair coordination by increasing the number of potentially salient options recognised by the players.

We investigate the impact of social closeness in six coordination games with different structures selected to test specific hypotheses. We explain the experimental design, the specific games we use and the hypotheses we test in Section 2.

2. Experimental design

Participants were Swiss Army soldiers attending a four-week Joint Officer Training Programme (JOTP). On arrival, the several

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https://doi.org/10.1016/j.econlet.2022.110552

hundred officer candidates from across the country were randomly allocated to platoons and classes of approximately 25 people. Over the four weeks, they lived in the training academy and interacted almost exclusively with other candidates from their own class. After the JOTP, platoons and classes were dissolved, and candidates returned to their home bases (for a description of JOTP see also Goette et al., 2012).

We recruited 308 participants over two JOTP waves in 2016–17. Participants were randomly allocated to either the C-treatment, in which they were paired with a person socially *close* to them, or to the D-treatment, in which they were paired with a person they were unlikely to have met before (a socially *distant* person). Participants in the *C-treatment* received a printed booklet showing a photograph of one of their classmates (randomly drawn from the same class) with whom they were matched to play a series of two-player games. It is unlikely that they would have known this person before the JOTP but by the time of completing our study, they would have been interacting with this person across the four weeks of the JOTP. Participants in the *D-treatment* received the same instructions, but the person they were paired with and pictured in their booklets was selected in the expectation that they would be someone the participant considered socially distant: in Wave 1 the pictured person was a soldier who attended a previous JOTP training camp; for Wave 2, it was a Swiss undergraduate student of comparable age. As a manipulation check, after the general instructions, participants answered questions to assess how close they felt to the person pictured in their booklet. We used the "oneness scale" (Cialdini et al., 1997; Gächter et al., 2015), which measures subjective perception of social closeness on a seven-point scale.

To explore how social closeness affects coordination on focal options, participants took part in both open-form and closed-form coordination games[1] (e.g., Chuah et al., 2019; Hargreaves Heap et al., 2017) inspired by tasks used in Mehta et al. (1994) and Crawford et al. (2008), respectively.

The three open-form games (games 1–3 in Fig. 1) consisted of writing down: any positive number ("Number"); any year ("Year"); a Swiss town ("Town"). In both treatments, all participants (including the past JOTP attendees and the Swiss students) made decisions knowing that they would receive CHF30 ($\approx$ USD30.5) conditional on successful coordination (zero otherwise) with their identified matched participant.[2] In these games, the range of possible options is not fixed and this suggests some potential effects of our treatment variable. Consider the Town game. Existing evidence shows that distant pairs are often successful in coordinating on options such as the city they are in, or their country's capital (consistent with these being focal). Now consider a close pair that happens to know that they are both from the same city, but it is not the current location or the capital. A priori, it is unclear whether access to additional potential focal points like this would help or hinder coordination.

The three closed-form games were the "P-games" shown as games 4–6 in Fig. 1. For each P-game, participants had to pick one of the three pie slices knowing that selecting the same slice as their partner would result in the pair of payoffs indicated on that slice (zero otherwise). P-game A is different in structure from the other two P-games in that coordinating on any slice results in identical payoffs. Based on existing evidence, we expected that the visual salience of the bottom-slice (based on both its position and distinctive white colouring) would facilitate coordination among distant players, and we test whether this is enhanced or reduced by closeness.[3] P-games B and C progressively penalise the relative return to coordination on the visually salient slice. Existing evidence (e.g., Bardsley et al., 2010) demonstrates that such penalties, even when small, dramatically reduce the tendency for individuals to select otherwise focal options. Conditional on replicating this pattern, our design allows us to test whether closeness mitigates the negative impact of the payoff penalties.

Participants were not allowed to communicate during the 90-minute experiment and received no feedback before the payment stage. After the session, five booklets and five tasks in each booklet were randomly drawn for payment. For each selected booklet, we paid both the person who completed it and the co-player pictured in it. To avoid side payments, we used bank transfers after the JOTP ended. The average payoff to those selected for payment was CHF142 in Wave 1 and CHF185 in Wave 2. These payoffs were substantial, being similar in magnitude to cadets' compensation for a day at the JOTP.

3. Results

We first conduct a manipulation check: as expected, individuals in the C-treatment, on average, report higher closeness ratings with the person they are paired with.[4] (Mean oneness: C-treatment = 3.96; D-treatment = 2.47; Mann–Whitney $z = 9.25$, $p < 0.001$).

For the main analysis, we examine the influence of social closeness through the lens of a *coordination probability* statistic. For each individual we calculate their coordination probability on a given task as the likelihood that their answer is the same as that of another randomly selected individual from their group, wave and treatment (see Appendix A.1, for details). The coordination probabilities reported in Fig. 2 are the average of individual probabilities for a given task and treatment. Fig. 2 also reports a *random benchmark* which is the coordination rate that would arise if each subject picked randomly from among the range of "available" options.[5] The *modal response* (the relative frequency of the most common response) is also shown in Fig. 2, but since that moves broadly in line with the coordination probability, for brevity we focus on the latter (online Supplemental Material, Table SM3.1 reports distributions of responses).

For the open-form games, we see that – in line with existing evidence (e.g., Mehta et al., 1994) based on distant players – coordination rates are markedly above the random benchmark. Our results indicate that the same is true for close players. While eyeballing shows some differences between average coordination probabilities across treatments (most obviously for "Year"), the direction of difference is not consistent. To test whether treatment differences are statistically significant, we estimate an OLS model (with bootstrapped standard errors) for each game by regressing the coordination probability on a treatment dummy, a wave dummy and an interaction (see Appendix A.2).[6] We find a significant treatment effect in only one case (the Year game:

[1] These coordination games were part of a larger experiment with further tasks exploring issues beyond those discussed here. Online Supplemental Material (SM1 and SM2) describes the full set of tasks.

[2] Past JOTP attendees were recontacted to participate in this study, while the students were recruited separately.

[3] Crawford et al. (2008) find high rates of coordination in their "Pie-game S1", a close analogue of P-game A.

[4] Contrary to the intended manipulation, 2 participants in the D-treatment did recognise their partner, while 9 participants in the C-treatment did not. We exclude them from the analysis.

[5] For the open-form games, we use the number of distinct answers given by all subjects in a treatment/wave as the available range (see Table SM3.1). The random benchmark is equivalent to the reciprocal of the range of responses, hence 1/3 by construction in the P-Games. We see no evidence that the range varies systematically with treatment for the open-form games.

[6] The OLS model can generate predictions outside the unit interval. We probe the robustness of the reported inferences in two ways: (1) via fractional logit regression analysis (Papke and Wooldridge, 1996) for proportions data, which

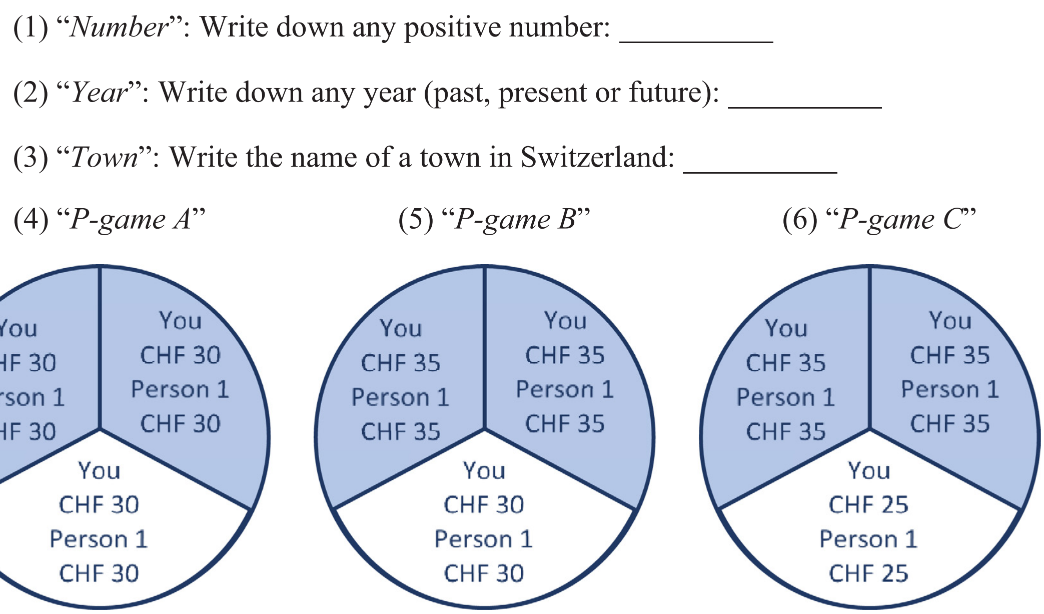

Fig. 1. Illustration of the three open-form (1–3) and the three closed-form (4–6) coordination games.

Fig. 2. Random benchmarks, coordination probabilities and modal responses.

$\beta_{C\text{-}treatment} = 0.188$; std. err. = 0.052; $p < 0.001$). The direction of the effect is consistent with closeness *improving* coordination; it is highly significant, but the positive effects of closeness are also confined to Wave 1 only. The open-form games are also ones with a candidate solution which may not be the most immediately obvious but might be expected to emerge via "team reasoning" (Sugden, 2003; Bacharach, 2006): the answers of "1", the current year or "Bern" (the Swiss capital and the JOTP location) for the Number, Year and Town games, respectively. There is some indication that these answers are more common in the close treatment for the Number and Year games, but again only in Wave 1 (see Table SM3.1).

Turning to the closed-form games, we focus first on P-game A. Here we replicate past results of coordination rates much better than chance amongst distant players and we extend existing evidence by showing that closeness *reduces* coordination success ($\beta_{C\text{-}treatment} = -0.119$; std. err. = 0.037; $p = 0.001$). As expected, for P-games B and C, coordination rates fall close to the random benchmark for distant players, consistent with existing evidence (Crawford et al., 2008). Our results show that closeness does nothing to prevent that.

4. Summary and conclusion

We presented evidence from a lab-in-the-field experiment on tacit, two-player, pure-matching coordination games involving pairs of people who are either socially close or distant. We varied two structural features of the games: whether they are open or closed form and whether or not the option expected to be salient in the closed-form game is payoff dominated. We find

allows zeros and ones together with intermediate values; and (2) via non-parametric bootstrapping analysis inspired by earlier contributions (Bardsley et al., 2010; Hargreaves Heap et al., 2017). These analyses broadly confirm our inferences, except for suggesting some caution about the robustness of the significance of effects for P-games B and C (see Supplemental Material, SM4 and SM5, for details).

Table A.2
Testing for treatment differences in the individual coordination probability.

Dependent variable: coordination prob.	(1) *Number*	(2) *Year*	(3) *Town*	(4) *P-game A*	(5) *P-game B*	(6) *P-game C*
C-treatment	−0.012 (0.017)	0.188*** (0.053)	−0.026 (0.049)	−0.119*** (0.037)	−0.023 (0.018)	0.007 (0.011)
Wave 2	−0.009 (0.014)	0.143*** (0.042)	0.005 (0.040)	−0.072** (0.033)	−0.010 (0.018)	0.022** (0.011)
C-treatment × Wave 2	−0.002 (0.019)	−0.192*** (0.065)	−0.013 (0.059)	0.042 (0.040)	0.043** (0.021)	0.016 (0.019)
Constant	0.085*** (0.012)	0.243*** (0.032)	0.457*** (0.033)	0.519*** (0.031)	0.351*** (0.016)	0.325*** (0.007)
N	296	295	297	295	297	295

Note: OLS coefficients. Bootstrapped standard errors in parentheses.
*p < 0.1; **p < 0.05; ***p < 0.01. Variable coding: C-treatment (dummy variable: 0 = Distant; 1 = Close); Wave 2 (dummy variable: 0 = Wave 1; 1 = Wave 2); C-treatment × Wave 2 (interaction: value = 1 for C-treatment and Wave 2; otherwise, 0).

evidence that both dimensions mediate the impact of closeness. In games that do not penalise coordination on a salient option, our participants' decisions imply coordination rates much better than chance. But while social closeness significantly lifts coordination rates in one open-form game, it hinders coordination in the closed-form game featuring equally-ranked equilibria. Confirming existing evidence, we find that focality loses its force in equilibrium selection when the salient option is also payoff dominated and we extend this finding by showing that closeness does not help recover its power. Hence closeness helps, harms, or has no impact on coordination probabilities, depending on the structure of the game.

Naturally, based on a single experiment, the patterns identified in our data should not be taken as reliable claims about behaviour more generally. That said, our results provide motivation for further work to examine the role of social closeness by testing replicability of our results and, conditional on that, exploring the mechanisms at work.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data and analysis code are available at https://osf.io/dqapk.

Acknowledgements

We are grateful to the Swiss Army, the Swiss Military Academy and Hubert Annen, for their invaluable support. We thank Matthew Boyer, Katrin Dallimore, Chih Hsueh, Deborah Kistler, Nicole Jehle, Lionel Roger, Peter Stöckli and Jason Wettstein for valuable research assistance and Yang Zu for helpful discussions. We thank the Editor and an anonymous referee for helpful comments. This work was supported by the UK Economic and Social Research Council [Grant Numbers ES/K002201/1, ES/P008976/1] and the European Research Council [Grant number ERC-AdG 295707 COOPERATION].

Appendix A

A.1. Coordination probabilities: Definitions and calculations

Here we explain construction of (individual and task level) coordination probabilities. Let $CProb^D_{igw}$ be the coordination probability for individual i, game g and wave w in the D-treatment. In calculating $CProb^D_{igw}$, we exclude the response of i themselves and we also exclude the decision of their distant match (the distant player was not a member of the current JOTP; they were in a different population and responding in a different context). After these exclusions $CProb^D_{igw} = (n^D_{gw} - 1)/(N^D_{gw} - 1)$, where n^D_{gw} is the number of respondents giving a particular answer and N^D_{gw} is the total number of responses to game g in wave w of the D-treatment. For symmetry, we apply the same exclusion rules for the C-treatment, hence, $CProb^C_{igw} = (n^C_{gw} - 1)/(N^C_{gw} - 1)$.

The mean coordination probability reported in Fig. 2 is an average of the individual coordination probabilities calculated as: $Mean_{gt} = (Mean^{w=1}_{gt} + Mean^{w=2}_{gt})/2$ where t is the treatment (C or D). We use this formulation because salient responses could differ across waves (specifically, for the Year Game). While our coordination index is inspired by the approach developed in Mehta et al. (1994), ours has a different interpretation because it measures *potential* coordination from matching participants in ways that they did not have in mind.

A.2. Coordination probabilities and treatment differences

See Table A.2.

Appendix B. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.econlet.2022.110552.

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