Bargaining over communal endowments after prior interaction: Experimental evidence*

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March 31, 2024

Abstract

We report on a laboratory experiment that identifies the role that prior interaction plays in determining claims in subsequent bargaining. We implement a tacit bargaining game, in which a pair of players attempt to agree on an allocation of a discrete set of objects between them. Prior to the bargaining, in some treatments the pair jointly completes a route-finding task. We find that pairs who have this prior interaction are more likely to come to agreement in bargaining. These more frequent agreements result not from a reduction in the value of the objects people claim, but because they coordinate more successfully on an allocation which is suggested by the way in which the bargaining game is described. This observation is evidence that prior interaction alone makes people more likely to apply principles of team reasoning to attempt to resolve the strategic conflict in bargaining.

Keywords: Bargaining; joint production; team reasoning; focal points; experiment.

JEL Classification Codes: C72; C91; C92

*We thank for their helpful comments seminar participants at the Universities of Amsterdam, East Anglia, and Kent, and attendees at the 2018 World Meetings of the Economic Science Association, as well as Yan Chen, Emin Karagözoğlu, Robert Sugden, and participants in the ESA mentoring group. The Centre for Behavioural and Experimental Social Science at UEA provided funding for the experimental sessions. The comments of the editor and two anonymous referees likewise significantly improved the exposition. Turocy acknowledges the support of the Network for Integrated Behavioural Science (Economic and Social Research Council Grants ES/K002201/1 and ES/P008976/1). The standard disclaimer applies.

1 Introduction

The Treaty of Hong Canal is an influential event in the history of China. Chu and Han were two kingdoms who challenged the authority of the incumbent Qin dynasty; after a long military campaign, they were successful in deposing the Qin, before falling into contention with each other. In 203 BC they agreed to the Treaty, which was a cease-fire agreement that allocated the areas west of the canal to Chu, and those to the east of it to Han. The story became an influential allegory for conflict and agreement. For example, it is reflected in the layout of the Chinese chessboard, in which the starting positions of the players are divided by the "river", which is a stylised depiction of the Hong Canal and refers to the Chu-Han contention.

Chu and Han found themselves in a bargaining situation to determine how to divide up their gains after having been involved in a form of joint activity. Bargaining situations present a mix of opportunities for cooperation and conflict. It is better for the parties to come to a mutually-improving agreement; however, there are generally many possible mutually-improving agreements, each of which distributes the gains from agreement differently. Reaching agreement thus entails a dimension of coordinating expectations and claims; or in the terminology often used in noncooperative game theory, of selecting one equilibrium out of many possible equilibria, and then jointly playing it to achieve an efficient outcome.

The Hong Canal may have served a coordinating function as a *focal point* in helping to resolve, at least temporarily, the conflict between Chu and Han. The importance of focal points in facilitating agreements in the resolution of conflict was first proposed and documented by Schelling (1960), who observed that standard methods of game-theoretic reasoning in which players respond optimally to (correct) expectations about the choices of other players could not explain the success people have in avoiding conflicts, especially those which arise from a lack of coordination. In Schelling's theory, when individuals face a problem involving coordination, in order to coordinate their mutual expectations they look for a clue based on the context of the problem. This occurs because they recognise the need for coordination, even when preferences of where or how to coordinate may be opposed:

> "If a particular spot demands attention as the 'obvious' place to meet, the winner of the bargain is simply the one who happens to be closer to it [...]. The need for agreement overrules the potential disagreement, and each must concert with the other or lose together." (Schelling, 1960, pages 58-60)

Schelling's informal analysis suggested that players must, in at least some situations, frame their reasoning along the lines of identifying a focal point. Subsequently a family of theories of *team reasoning* has been developed, which aim to explain *when* and *why* players would do so.

Team reasoning was first proposed by Hodgson (1967) and expanded by Sugden (1993, 1995, 2000, 2005) and Bacharach (1995, 1999). A player is said to engage in team reasoning if she works out what strategy profile is best for the team as a whole, and then carries out her component of that strategy profile.

As developed by Schelling, Bacharach, and Sugden, team reasoning theory identifies the context in which the game is played as an essential factor in determining players' modes of strategic reasoning. Sugden (1993, p. 87) notes that a theory of team reasoning "should be expected to apply only to groups of individuals who *are* teams; and for a group of individuals to be a team in any genuine sense, their being a team must be mutually recognized" (emphasis in original). Recognising someone else as being a member of the same team is more than merely identifying with that person; a defining characteristic of a team is that a team engages in activity towards a common goal.[1] Chu and Han had come to control the region through a *joint activity* in conquest against the remnants of the Qin and other potentially competing powers, and their victory over those rivals resulted in a *joint endowment* of territory arising from that joint activity. When it comes time to divide up the proceeds, does the fact that the partners have worked together as a team influence the chances of a successful bargaining outcome? Team reasoning theory hypothesises the answer could be yes. Successfully carrying out a joint activity requires the parties to work together towards a common objective; it is plausible to think that when those parties face a subsequent bargaining problem, they are more likely to reason in terms of "we-thinking" (in the terminology of Bacharach, 2006). The argument of Sugden (1993) suggests that such players would look for a principle that would make an unambiguous recommendation for the joint profile of actions; that is to say, a focal solution.

We report a controlled laboratory experiment that provides evidence on the relevance of prior interaction to bargaining strategies and outcomes. We implement bargaining problems using a representation created by Isoni et al. (2013), in which players bargain over discrete objects laid out on a two-dimensional grid. Isoni et al. report that players frequently make bargaining claims consistent with focal cues suggested by the layout of the objects; however, in their experiment there is still a substantial probability that bargaining fails. We show that when people engage in a joint activity prior to bargaining, they are more likely to come to an agreement. The graphical representation of the bargaining setting allows us to identify a richer analysis of bargaining positions. We can distinguish between "aggressive" claims, in which a player demands a disproportionate amount of the surplus, from situations in which players claim objects on the "other player's side"

[1] A team is therefore more than simply a group. Our research questions therefore differ from those studied in the extensive literature on group identity, which includes priming natural identity based on gender or country of origin (Shih et al., 1999; Benjamin et al., 2007), existing group identity as students in the same university of members of the same organisation (Attanasi et al., 2016), or variations on the minimal group paradigm where groups are generated based on, for example, stated preferences between two works of art. (e.g. Tajfel et al., 1971; Yamagishi and Kiyonari, 2000; Chen and Li, 2009)

of the table, which we call "encroaching" claims. We show that bargaining outcomes improve not because players change the size of their demands, but because those demands are less frequently encroaching.

The laboratory setting is useful to isolate the role of prior interaction from other potentially confounding factors. One application is in the context of the dissolution of partnerships. Not all partnerships end for reasons that are exogenous to the success of the partnership. Dissolutions are sometimes triggered by negative events: business partners may decide to go their own ways due to disagreements about strategy, or the marriage of a divorcing couple may have been on the rocks for some time. If we observe adversarial strategies in these situations, it is likely that the reason underlying the dissolution itself significantly influences the attitudes of the bargainers. The experiment controls for this because bargaining occurs after every interaction, irrespective of the outcome of the interaction.

Teams within an organisation often have some resources (or responsibilities) which they have some discretion as to how to allocate amongst themselves. For example, a team may be allowed to decide who sits at which desk in the office, or who works certain shifts or is "on call" out of hours in case of an emergency, or where and when the staff holiday party will be held. In this case, the sense of being a team may be relevant to how (tacit or explicit) bargaining takes place. However, in these situations there is an ongoing relationship, and so the incentives from the theory of repeated games would apply. Each interaction in the experiment is one-shot; by design it is not possible to influence the outcomes of future bargaining situations through one's behaviour in the current one, ensuring that any effect of being a team is strictly backward-looking. Similarly, even when bargaining is not recurring, in applications bargaining usually offers some opportunity for communication and counter-offers. Our use of the one-shot, tacit bargaining framework helps to isolate the effects of prior interaction: because there is no interaction or dynamics within the bargaining itself, any difference we observe across our treatments is attributable to the presence or absence of the prior interaction *per se*.

Prior ownership and relative performance in joint production activities can influence norms of subjective entitlements and fairness that in turn influence bargaining outcomes (see Karagözoğlu, 2012, for a review). For example, earning the right to be the first mover in ultimatum games (Hoffman et al., 1994) or earning the surplus to be shared (Cherry et al., 2002; Rode and Le Menestrel, 2011) reduces the extent of other-regarding behaviour. Similar results are found by Leliveld et al. (2008) in which property rights are not earned but induced by placing tokens on a virtual table closer to one of the players.

Relative performance in joint activities, including investment tasks (Gantner et al., 2001; Cappelen et al., 2007) or real-effort ones (Gächter and Riedl, 2005), has also been shown to influence which norms of distributive justice are used to divide a commonly produced surplus, as the high performer feels entitled to a greater share of the pie. Real-effort or investment tasks, often used in these studies, usually involve non-complementary activities that subjects can do individually, such as taking quizzes (e.g. Gächter and Riedl, 2005; Karagözoğlu and Riedl, 2015), typing text or counting letters in a text (e.g. Cappelen et al., 2010; Rode and Le Menestrel, 2011). The individual contributions to these joint activities are often added up using some linear production function to generate the joint output, so observing the output gives an indication of each individual contribution. Having this information on the individual contributions to the surplus is key for the creation of entitlements. Karagözoğlu and Riedl (2015) find that when this information is not given, equality is the norm used in unstructured bargaining games to share the commonly produced output. Other factors that have been shown to influence sources of subjective entitlements on the generated surplus are the relative effort exerted in the production task, skills and productivity (Ruffle, 1998; Oxoby and Spraggon, 2008; Cappelen et al., 2010).

To control for these confounds and isolate the role of prior joint activity *per se* on bargaining, we design a novel route-finding activity prior to bargaining interactions. We vary whether this activity is done individually, or jointly between two players who will subsequently engage in bargaining. When participants complete the task in pairs, they take turns in choosing the next segment of the route. Because of the complementarity between the actions of the participants, it is difficult to separate the individual contributions. Such complementarity is found in many real-world partnerships, such as collaboration on academic papers, business startups where a technically-oriented person partners with a business-savvy entrepreneur to market a new product, or the fact that Chu and Han were in part successful in coming to control their territory because other kingdoms were jointly under pressure by the military activities of both. Similar activities in the literature include the puzzle-solving treatment of Eckel and Grossman (2005) and the word-finding task of Charness et al. (2014), although neither has the interactivity of our turn-taking task. Both those papers find increased contributions in a public-goods game in groups exposed to team-building activities, even when those activities do not lead to larger endowments. We are the first to apply such a technique in the context of bargaining.

In the paper that is closest to ours, Chen and Chen (2011) provide evidence that equilibrium selection in coordination games can be influenced by prior interaction. In their "enhanced" group identity treatments, which are the most analogous to our design, participants engage in a group problem-solving task, in which they collaborate via chat software to identify the painters of given paintings. The main experiment then consists of the play of a two-player minimum-effort coordination game, which has many Pareto-ranked equilibria. They find that effort levels, and therefore earnings, are higher when paired with another participant with whom they completed the task, relative to the baseline of no prior activity or other group identity.

However, the equilibrium selection problem in coordination games that arises from bargaining situations is different in character from the one in the minimum-effort coordination game. In their theoretical analysis, equilibrium selection is accomplished by introducing the possibility of pro-social preferences towards "in-group" members. In bargaining-type coordination games, the equilibria are not Pareto-ranked, and specifically in the games we study all equilibria have the same total monetary payoffs to the players. Further, these games are symmetric, and have an even number of Pareto-efficient equilibria; however all of these Pareto-efficient equilibria are asymmetric. Therefore, the Chen and Chen approach of endowing players with an appropriate form of social preferences is not on its own enough to generate a unique prediction. To achieve a high rate of bargaining success, players must find a way to break the symmetry using the presentation of the game. This provides a motivation for players to identify strategy profiles which are uniquely salient in the game's description, and thereby for team reasoning, which considers strategy profiles rather than individual strategies, to operate in a way that is complementary to but distinct from social preferences. We now turn to developing this idea more formally.

2 Theory

2.1 A simultaneous-claim bargaining game

The starting point for our experimental design is a class of simultaneous-move tacit bargaining games. We begin by formulating these in the standard way as games in normal form. There are two players $N = \{1, 2\}$, indexed by i, and a finite set of K indivisible objects $\Omega = \{\omega_1, \ldots, \omega_K\}$. Each object $\omega \in \Omega$ has a value $v(\omega) > 0$ if it is obtained by a player; this value is the same for both players. The *available surplus* is then $\sum_{\omega\in\Omega} v(\omega)$. The payoff to player $i \in N$ if she obtains a subset $\alpha \subseteq \Omega$ of the objects is given by $u_i(\alpha) = \sum_{\omega\in\alpha} v(\omega)$, with $u_i(\emptyset) = 0$ by convention. We refer to a given combination $(\Omega, v : \Omega \to \mathbb{R}_{++})$ as a *scenario*.

To divide the objects, the players play a simultaneous-move game. Each player i makes a *claim* on a subset of the objects; the strategy space for each player is therefore the power set $S_i \equiv 2^\Omega$. The *claim value* is the sum of the values of the objects included in a claim. If the two claims s_1 and s_2 have no objects in common, $s_1 \cap s_2 = \emptyset$, then each receives the set of objects they respectively claimed; we say that the bargaining results in *agreement*. If any object is claimed by both players, $s_1 \cap s_2 \neq \emptyset$, then neither player receives any objects; we say that the bargaining results in *disagreement*. The resulting payoffs are

$$\pi_1(s_1, s_2), \pi_2(s_1, s_2) = \begin{cases} u_1(s_1), u_2(s_2) & \text{if } s_1 \cap s_2 = \emptyset \\ 0, 0 & \text{if } s_1 \cap s_2 \neq \emptyset. \end{cases}$$

The *realised surplus* from the bargaining is then $\pi(s_1, s_2) = \pi_1(s_1, s_2) + \pi_2(s_1, s_2)$.

This game has a large number of pure-strategy Nash equilibria. In particular, any strategy pair (s_1, s_2) which has nonempty claims $s_1 \neq \emptyset$ and $s_2 \neq \emptyset$ and partitions Ω, $s_1 \cap s_2 = \emptyset$ and $s_1 \cup s_2 = \Omega$, is a strict Nash equilibrium. These equilibria result in agreement and are efficient in terms of the material payoffs of the game. The strategy pairs $(\Omega, \emptyset)$ and $(\emptyset, \Omega)$ are weak Nash equilibria that result in agreement and are likewise efficient. Finally, the strategy pair (Ω, Ω) is a weak Nash equilibrium that results in disagreement.

Observe that for any (s_1, s_2) that is an equilibrium, the symmetry of the game implies that (s_2, s_1) is also an equilibrium. Therefore the number of efficient equilibria is always even, and further all efficient pure strategy equilibria are asymmetric equilibria.

2.2 Equilibrium selection

Pure-strategy Nash equilibrium provides little in the way of guidance on how to play these games. Every claim is consistent with the play of an equilibrium which is efficient in the sense of maximising the sum of the material payoffs received by the players, so selecting claims or equilibria on the basis of maximising the realised surplus has no bite.

However, many of the equilibria in games of this form result in outcomes which are unequal in terms of the material payoffs to the two players. This suggests that the equity of the outcomes could be relevant in determining the outcome of the interaction. Assuming inequity aversion in the form proposed by Fehr and Schmidt (1999), the set of equilibria changes as a function of the players' attitudes towards disadvantageous and advantageous inequity. As players' aversion to disadvantageous inequity grows, the set of (material payoff efficient) pure-strategy equilibria shrinks, as equilibria with payoff differences are eliminated; for sufficient levels of aversion to disadvantageous inequity, only strategy profiles leading to equal material payoffs can be sustained as equilibria. As players' aversion to advantageous inequity grows, it becomes possible to sustain as equilibria strategy profiles which lead to inefficiencies in material payoffs by leaving objects unclaimed.[2]

Inequity aversion does not however fully solve the selection problem. The efficient pure-strategy equilibria always occur in pairs, and therefore inequity aversion never yields a unique recommendation among the set of efficient allocations. Even in games in which there are efficient and equal outcomes, a large number of equilibria can remain; for example, in a game with 2 objects worth 2 each and 6 worth 1 each, there are $2 \times \binom{6}{3} = 40$ such equilibria. But even in situations where only two equilibria were to survive, it remains the case that they are asymmetric equilibria of a symmetric game, leaving the problem of how players could coordinate successfully on one

[2] We provide a brief exposition of the relevant calculations in Appendix C.

equilibrium or the other.

The consequences of coordination failure in this game give the players sharp incentives to solve this equilibrium selection problem. A weaker version of the bargaining rule, for example, could resolve the interaction object-by-object, allocating an object claimed by only one of the players to the player who claimed it, while leaving contested objects unallocated. In that game, any profile of claims such that each object was claimed by exactly one player would still be an equilibrium. However, the consequences of coordination failure would be far milder, as conflict on one object does not result in total disagreement, and therefore fully solving the selection problem would be a less compelling issue for the players.

A way forward is suggested by the theory of focal points proposed by Schelling (1960). Schelling's theory accounts for the fact that people often are quite successful at coordination in situations which can be represented as non-cooperative games which have many equilibria. Schelling argued that in solving a coordination problem, people make a selection based on salient but payoff-irrelevant cues present in the situation; being payoff-irrelevant, these cues are not accounted for in standard game-theoretic analyses.

Our bargaining game differs somewhat from Schelling's "meeting in New York" example in that the problem our players face is selecting from among asymmetric equilibria in a formally symmetric game. This indicates that some mechanism of symmetry-breaking is required in order to achieve successful coordination. In settings in which our game model could be applicable, it is likely that at least some of the objects are more naturally associated with one player or the other. Likewise, it is probable that the objects themselves might have characteristics that naturally group them by similarity to each other.

Under the assumption that the objects have such characteristics, and that the interpretation of these characteristics is commonly shared by the players, Mehta et al. (1994) proposed two rules, *closeness* and *accession*, which operate on those natural associations and similarities and, in some situations, can yield a unique selection from among a number of candidate allocations. We provide a more formal statement of Mehta et al.'s rules by assuming that there exists over the set of players and objects $\Omega \cup N$ a metric $d : (\Omega \cup N) \times (\Omega \cup N) \to \mathbb{R}_+$. When comparing a player and an object, the metric measures how naturally the object is associated with that player; when comparing two objects, the metric measures the similarity or relationship between the objects.

Closeness The criterion of *closeness* assigns objects to players based on the relationship or association of each object with a player. Formally, objects are divided into two sets,

$$\begin{aligned}
\sigma_1^C &= \{\omega \in \Omega : d(1, \omega) < d(2, \omega)\} \\
\sigma_2^C &= \{\omega \in \Omega : d(2, \omega) < d(1, \omega)\}
\end{aligned}$$

A strategy profile (s_1, s_2) satisfies *closeness* if it assigns to each player the objects that are closer to that player than to the other player, $(s_1, s_2) = (\sigma_1^C, \sigma_2^C)$.

Accession The relationships between objects may lead to them naturally being formed into groups. A *cluster* $\sigma \subset \Omega$ is a subset of the objects such that, for all $\omega \in \sigma$, $\max_{\omega' \in \sigma} d(\omega, \omega') < \min_{\omega'' \in \Omega - \sigma} d(\omega, \omega'')$. Suppose that there exists a pair of clusters σ_A and σ_B which partition Ω. Let $D(i, \sigma) \equiv \min_{\omega \in \sigma} d(i, \omega)$ define the distance from player i to cluster σ. A strategy profile (s_1, s_2) satisfies *accession* if it assigns to each player the cluster closest to that player,

$$\begin{aligned} \sigma_1^A &= \arg \min_{\sigma \in \{\sigma_A, \sigma_B\}} D(1, \sigma) \\ \sigma_2^A &= \arg \min_{\sigma \in \{\sigma_A, \sigma_B\}} D(2, \sigma). \end{aligned}$$

Under the assumption that the game is represented in such a way that there is such a distance metric on which the players agree (or reasonably anticipate that each other will recognise), if closeness or accession yields a unique allocation of discs, we say the corresponding strategy profile of claims is the one suggested as a focal point.

3 Experimental design

3.1 Bargaining games

Our experiment is based on the design of Isoni et al. (2013).[3] In their experiment, bargaining scenarios were represented using a graphical "bargaining table" format. This format represents the objects being bargained over as *discs*, and arranges them on a 9-by-9 grid. Each player is represented by a square on the grid, coloured either blue or red, known as that player's *base*.

The participants in Isoni et al.'s experiment faced 24 different scenarios in bargaining table format. These scenarios varied both the distribution of values of the objects being bargained over, and the layout on the bargaining table of the discs representing those objects. From their 24 scenarios, we use the 12 scenarios which they designed with the intent that the layout would suggest a focal point solution based on the criteria of closeness and/or accession. Figure 1 shows the bargaining table representations of these 12 scenarios. Each participant always saw their own base at the left of the display. If a participant was assigned to play the role represented by the red base in the display, the display of the discs on that participant's screen would be mirror-imaged accordingly.

Given the two-dimensional layout of the bargaining table, it is natural to interpret distances on the bargaining table between a disc and a player's base, or between discs, as the $d(\cdot)$ metric

[3] We provide full instructions in Appendix A.

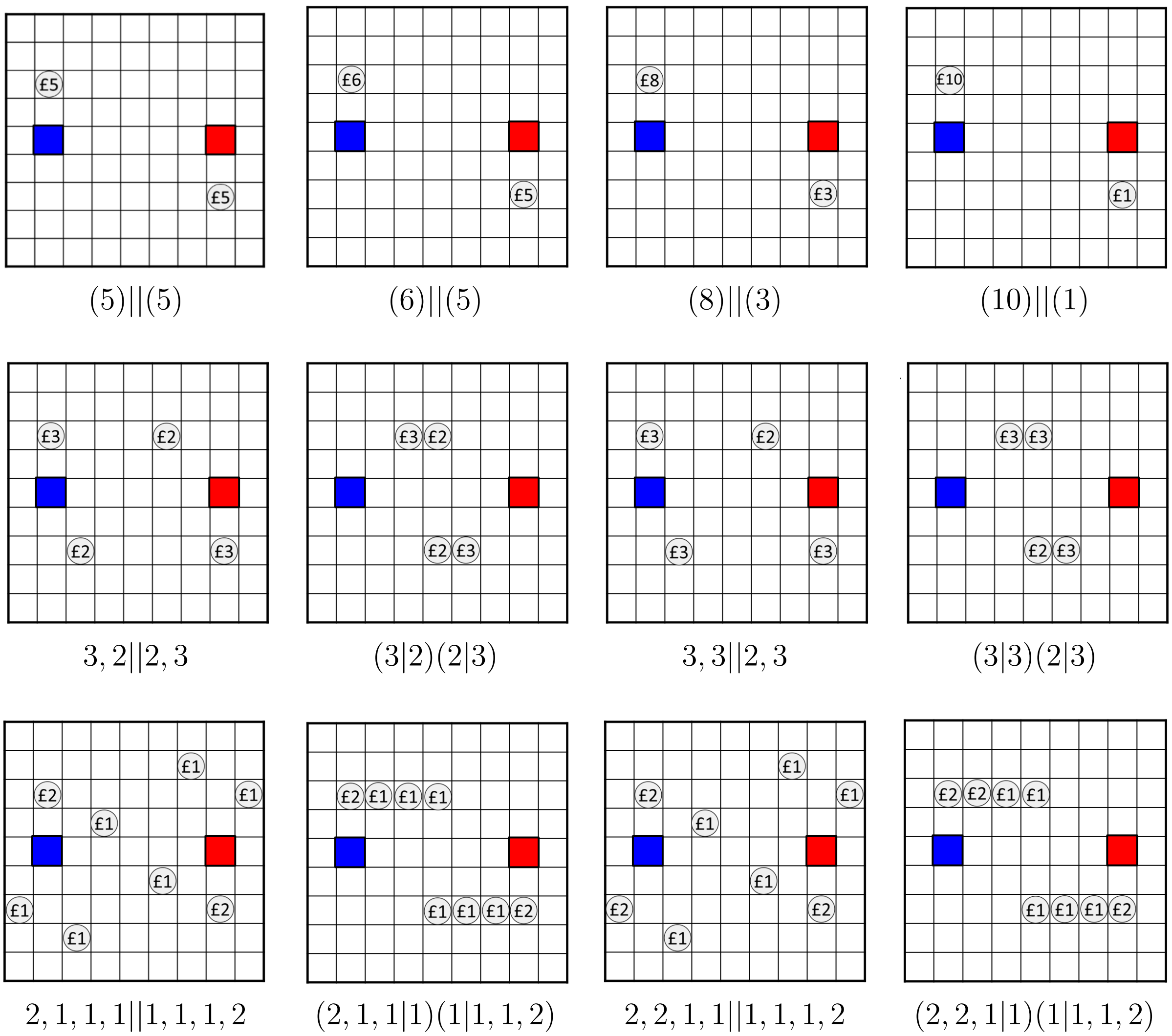


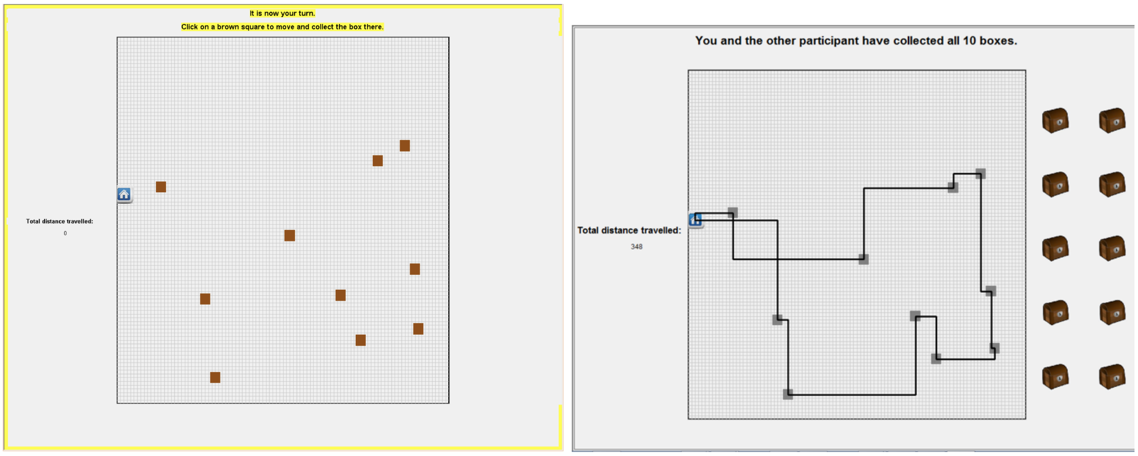
Figure 1: The bargaining table representations of the 12 scenarios used in the experiment.

assumed in the theoretical development. Following Isoni et al. we refer to the scenarios with a mnemonic system that summarises the layout of the discs and indicates the allocation selected by closeness or accession. Discs are listed in three groups separated by pipes, $G_L|G_C|G_R$, where discs in G_C are on the central column, G_L are to the left of the central column, and G_R are to the right. When accession determines the selected allocation, the partition of discs is indicated by grouping them with parentheses. When closeness determines the allocation, the partition is indicated by the separation of the groups of discs with a double pipe. Among the 12 scenarios, there are four each which have two discs, four discs, and eight discs, respectively. Closeness and accession make the same recommendation in the scenarios with two discs. Among the scenarios with four discs and with eight discs, the scenarios come in pairs. Within each group there is a pair of scenarios in which closeness applies, and a pair in which accession applies. Within those pairs, one scenario is fully symmetric with an available surplus of 10; the other scenario has the same layout but increases the value of one disc by one. The latter scenario is thus asymmetric; the available surplus is 11 and therefore there is no efficient equilibrium which results in equal payoffs to both players. We refer to the player to whom the focal point assigns a payoff of 6 to be in the *favoured* role, and the other player the *unfavoured* role.

Each bargaining interaction is formally a simultaneous-move game. All discs were initially marked as unclaimed. Participants then indicated their claims by clicking on the discs in the interface. Clicking a disc toggled whether it was included in the claim or not; discs could be clicked in any order and toggled any number of times. While making claims, participants could not see what discs their co-player was claiming. Moreover, in Isoni et al., participants made claims in all bargaining interactions without feedback on either the claims made by their co-player in previous games, or the outcome of those games. We maintain this design feature; participants did not receive any feedback on their decisions in the bargaining game parts of the experiment during the decision-making part of the sessions. One game was selected at random to determine earnings for the session. The only feedback on the decisions made in bargaining games came at the end of the session when the outcome of the randomly-selected interaction was revealed, and so no learning about the claims made about others in the cohort was possible during the decision-making portion of the session.

3.2 The shortest route task (SRT)

In the Isoni et al. protocol for bargaining games, the lack of feedback between games, and the absence of any identifiers referring to a participant's co-player in game, create an environment in which the bargaining games can be interpreted as a series of one-shot games. However, our research question depends crucially on there being interaction between players. To incorporate prior



(a) At the start of the stage

(b) A completed route

Figure 2: A typical instance of the Stage 1 shortest route task.

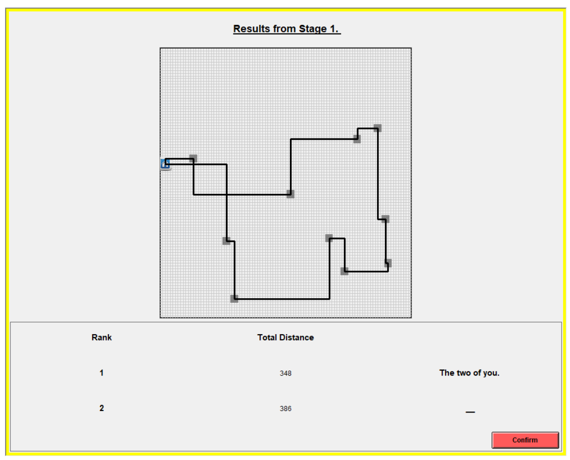


Figure 3: The feedback screen shows how the length of the route found compared to the routes of others. Participants saw this at the end of the round after the bargaining decisions were made.

interaction while retaining separation between games, each of the 12 *periods* in our experiment consisted of two stages. In Stage 2, participants made claims in one of the bargaining scenarios as described above. This was preceded in Stage 1 by an instance of a *shortest route task* (SRT).

Figure 2a shows a typical instance of this task. Around the *map* there are 10 *boxes*, indicated by the brown squares. The objective is to construct a path to "collect" all 10 boxes. The path starts at the *home* location, marked by an icon in the shape of a house. The next box is collected by clicking on its location on the map; the path taken to the next box is drawn on the map, and a treasure chest icon representing the collected box appears on the screen. Figure 2b shows the screen after completing the task.

When expressed as an optimisation problem of finding the shortest path to collect all the boxes, this becomes the famous *travelling salesman problem*. However, we did not provide monetary incentives related to the length of the path. Instead, at the end of each period, after claims were made in the bargaining scenario, participants found out how the route they were involved in constructing compared with others. (See Figure 3.) The instructions mentioned that "The route with the shortest distance will receive the top rank," and advised that "You may be able to improve your ranking by thinking ahead."

Previous studies of individual performance on the travelling salesman problem in unincentivised conditions (Ormerod and Chronicle, 1999; MacGregor et al., 2000, 2006) report that people do a good, but not perfect, job in finding short paths, and, importantly, people do not appear to vary substantially in skill at the task.

3.3 Design of treatments

We can now describe the three treatments in our experiment. These treatments manipulate how the SRT is completed, and how the relationship between the SRT and the bargaining game was motivated to the participants. Treatments were assigned at the session level.

Our baseline condition is **SA** ("solo activity"). In a given period in **SA**, each participant completed an instance of the SRT on their own, prior to making their claim in the bargaining scenario for that period.

We have two conditions intended to test the effects of prior interaction: **JE** ("joint enterprise") and **JA** ("joint activity"). In both of these conditions, participants were formed into pairs who completed the SRT *jointly*. This was accomplished by participants taking turns. One participant was chosen at random to choose which box to collect first. The other participant then chose which box to collect next, and so on, with the participants alternating until all boxes were collected. The participants in a pair had no other means to communicate to coordinate on their strategy for the order in which to collect the boxes. Participants knew that their co-player in the bargaining scenario was the same person they completed the SRT with, but because no participant identifiers were used, they did not know whether they had previously been paired with that person.

In **JE**, each period consisted of an instance of the interactive SRT, followed by making claims in a bargaining scenario. Between Stages 1 and 2, participants saw a screen as in Figure 4, in which the 10 boxes are "opened". In the example shown, two of the 10 boxes collected in Stage 1 contained a disc. In this case, the following Stage 2 scenario would then be one of the scenarios with two discs. On the screen the boxes are grouped by whether or not they contain a disc; to preclude entitlement effects, the screen does not indicate the order in which the boxes were collected, nor by whom. In the instructions, participants were told, "In Stage 2, you and the other participant will learn how much each disc is worth, and will have the opportunity to agree on a division of the discs." This frames the discs as being common property at the interim stage.

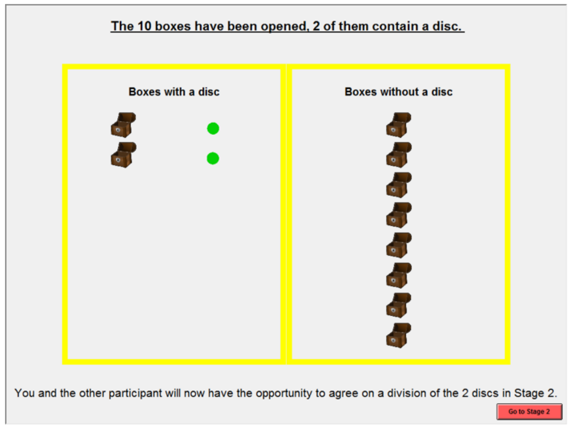


Figure 4: The interstitial screen linking Stage 1 and Stage 2 in **JE** only.

In a real-world setting in which bargaining occurs over assets that are initially common property, it can be difficult, if not impossible, to distinguish whether it is important for bargaining choices that the players recognise the communal nature of those assets, or if it is actually the mere fact that the players have interacted previously that could trigger differences in reasoning. In the lab, we are able to attempt such manipulations. Our treatment **JA** differs from **JE** by removing the interstitial stage. There is no screen in which the boxes are "opened." Instead, participants are simply told, "When all 10 boxes have been collected, you and the other participant will continue on to Stage 2."

3.4 Randomisation and statistical design

In sessions in treatments **JE** and **JA**, we divided participants randomly into cohorts of 4. The order in which the SRT maps and bargaining scenarios were played was determined randomly for each cohort. Within a cohort, participants were randomly rematched, and randomly assigned in each scenario to one of the two player roles. In the instructions, participants were told only that they would be matched in each scenario with "another participant in the room." Due to the interactions between participants in the SRT, we treat cohort as the unit of independent observation for **JE** and **JA**, and our principal measures of performance are aggregated at the cohort level.

In **SA**, participants do not directly interact at all, neither in the SRT nor via any feedback from the bargaining scenarios. However, because we did provide feedback on relative performance in the SRT to parallel **JE** and **JA**, our design required that groups of participants necessarily must face the SRT maps in the same order, and, because we used the same software for all sessions, it was convenient to randomise the order of the scenarios in groups of participants as well. We therefore define a "cohort" in **SA** as a group of participants who all faced the maps and scenarios in the same order. This stratification parallels the structure of **JE** and **JA**, and, as in **JE** and **JA**, addresses any effects arising from the running order of maps and scenarios, or session-level effects.

3.5 Session details

The sessions were conducted in the laboratory of the Centre for Behavioural and Experimental Social Science (CBESS) at the University of East Anglia. Participants were recruited from the lab's standing pool of participants, managed using the hRoot system (Bock et al., 2014). We did not recruit participants who previously participated in an experiment studying focal points, or an experiment using a game based on the bargaining table. The experiment was computerised using zTree (Fischbacher, 2007). Sessions lasted between 45 and 60 minutes. In addition to their earnings from the experiment, participants received a fixed participation fee of £5. The average earnings per participant were £7.60.

4 Research hypotheses

We ask whether people are more likely to come to agreement in bargaining after they have had prior interaction with each other, compared to a baseline in which they have not. To translate this generic prediction to hypotheses testable from the data that our experiment generates, we begin with a re-analysis of the bargaining claims in the data reported by Isoni et al. (2013). Table 1 reports, for each of the 12 scenarios, the success, or lack thereof, that their participants had in extracting the available surplus. Overall only about 54% of the possible surplus is successfully obtained by the participants, with 39.6% of bargaining interactions ending in conflict. This presents an ample opportunity for prior interaction to improve bargaining outcomes.

In our hypotheses, we generally ask first whether prior interaction has an effect on bargaining at all, and then, secondarily, whether our manipulation to frame the linkage between the SRT and bargaining has any effect. For compactness, we introduce the symbol **J•** to refer jointly to **JE** and **JA**.

Hypothesis 1 (Bargaining success). *As measured by higher earnings and lower rates of conflict, participants will be more successful (a) in **J•** than **SA**; (b) in **JE** than **JA**.*

If Hypothesis 1 is confirmed, it will be interesting to understand what underpins improvements in bargaining performance. We turn now to a new analysis which sheds light on the structure of bargaining failures in Isoni et al.. If, in a pair, the two players jointly claim more than the total surplus available, then conflict ensues, just as in, for example, the Nash demand game. However, in the bargaining table, bargaining success depends not only on *how much* each player claims, but *which items* they claim. With the exception of $(10)||(1)$, the claim indicated by the focal

Scenario	Surplus: Available	Surplus: Realised	% Disagreement
$(5)\|\|(5)$	10	8.43	14.7
$(6)\|\|(5)$	11	7.16	33.9
$(8)\|\|(3)$	11	5.65	48.7
$(10)\|\|(1)$	11	5.32	50.6
$3, 2\|\|2, 3$	10	6.61	24.8
$3, 3\|\|2, 3$	11	5.55	40.9
$(3\|2)(2\|3)$	10	4.06	51.4
$(3\|3)(2\|3)$	11	3.80	57.6
$2, 1, 1, 1\|\|1, 1, 1, 2$	10	5.18	38.0
$2, 2, 1, 1\|\|1, 1, 1, 2$	11	5.64	37.8
$(2, 1, 1\|1)(1\|1, 1, 2)$	10	5.80	32.5
$(2, 2, 1\|1)(1\|1, 1, 2)$	11	5.05	44.1
Overall	$10\frac{7}{12}$	5.69	39.6

Table 1: Bargaining performance by scenario in Isoni et al. (2013). Following their convention, these report achieved surplus and rates of conflict computed by matching the claims of all pairs of participants in each scenario.

point is in fact the modal strategy, and further choosing the claim recommended by the focal point is an empirical best response. These observations provide empirical support to the theoretical proposition that people would recognise and use the rules of closeness and accession in these scenarios.

We therefore use the claim suggested by the focal point to categorise the claims in Isoni et al.'s data.

- Given the empirical frequency of focal point claims, a significant cause of bargaining failure is when one player claims one or more discs that the focal point assigns to the other player. We classify any claim in which a player does this as an *encroaching* claim.

- If a player anticipated an encroaching claim, they might respond by only claiming a subset of the discs assigned to them by the focal point, as leaving a disc unclaimed removes the possibility of bargaining failure based on conflicting claims to that disc. We say a player's claim is *cautious* if the claim consists only of a strict subset of the discs that the focal point assigns to that player.

This partitions the strategy space of claims; any claim that is not exactly the focal point recommendation is either encroaching or cautious, but not neither or both. This taxonomy is useful for

		Percentage of claims			Claim value	
Scenario	Role	Encroaching	Focal point	Cautious	Average	Focal point
$(5)\|\|(5)$		8	91	1	4.95	5
$(6)\|\|(5)$	Favoured	26	72	2	5.62	6
	Unfavoured	18	82	0	5.18	5
$(8)\|\|(3)$	Favoured	34	66	0	6.46	8
	Unfavoured	42	58	0	5.16	3
$(10)\|\|(1)$	Favoured	22	78	0	8.42	10
	Unfavoured	62	36	2	6.56	1
$3, 2\|\|2, 3$		15	64	21	4.51	5
$3, 3\|\|2, 3$	Favoured	30	52	18	4.78	6
	Unfavoured	30	58	12	4.78	5
$(3\|2)(2\|3)$		41	43	16	4.37	5
$(3\|3)(2\|3)$	Favoured	60	26	14	4.88	6
	Unfavoured	36	46	18	4.70	5
$2, 1, 1, 1\|\|1, 1, 1, 2$		23	48	29	4.31	5
$2, 2, 1, 1\|\|1, 1, 1, 2$	Favoured	24	36	40	4.72	6
	Unfavoured	24	58	18	4.46	5
$(2, 1, 1\|1)(1\|1, 1, 2)$		21	61	18	4.21	5
$(2, 2, 1\|1)(1\|1, 1, 2)$	Favoured	38	36	26	4.58	6
	Unfavoured	24	62	14	4.36	5

Table 2: Analysis of claims in Isoni et al. (2013). The first three columns give the percentages of claims which were encroaching, cautious, or exactly the discs prescribed by the focal point. The last two columns compare the average value of discs claimed across all participants with the value of the discs assigned by the focal point.

summarising bargaining claims because it distinguishes the monetary size of a claim from the identity of the discs being claimed. For example, referring back to the bargaining tables in Figure 1, in scenario $3, 2||2, 3$, the player with the blue base might claim the disc worth 3 located directly above their base, and the disc worth 2 which is closer to the red base than the blue base. Although this claim is for exactly one-half of the available surplus, and in that sense is not a disproportionate claim for the blue player, it is classified as encroaching, because it includes a disc that closeness would assign to the red player.

In Table 2 we break down the claims in Isoni et al. into these three categories, as well as summarising the average claim values. The most common pattern is that claims which we classify as encroaching outnumber those which are cautious. However the average claim values are generally less than the amount prescribed by the focal point. In fact, in 4-disc and 8-disc asymmetric scenarios, the focal point claim assigns discs with a total value of 6 to the player in the favoured role. However, players in the favoured role make claims with an average value of less than 5.

Hypothesis 2 (**Claim characteristics**). *Participants are less likely to make encroaching claims (a) in* ***J•*** *than* ***SA****; (b) in* ***JE*** *than* ***JA****. The participants' claimed values will be closer to the focal point recommendation (a) in* ***J•*** *than* ***SA****; (b) in* ***JE*** *than* ***JA****.*

Tables 1 and 2 show that bargaining is generally less successful in asymmetric scenarios. This is consistent with broader experimental evidence that small asymmetries in games lead to significantly more conflict through failures to coordinate and to come to an agreement, both when the overall stakes are smaller and larger (Crawford et al., 2008; Parravano and Poulsen, 2015). An effect of prior interaction, predicted in particular by team reasoning, could be to make the asymmetry less salient relative to a focus on coming to an agreement and thereby ensuring the pair extracts the surplus available. This tension arising from the impossibility of a symmetric and efficient settlement in asymmetric scenarios does not exist in symmetric scenarios.

Hypothesis 3 (**Asymmetric games**). ***J•*** *will reduce encroaching claims more in asymmetric scenarios than in symmetric scenarios.*

Aside from evaluating the changes in claims in the bargaining itself, we also capture process data from the SRT tasks. The SRT was not incentivised, and we did not reveal the optimal solution to the SRT. Although the route chosen on the SRT did not directly affect earnings, the data nevertheless may shed some insights into how the task did or did not affect bargaining. Recall that the intention of the SRT is to provide a vehicle for nontrivial prior interaction between people, while at the same time limiting the scope for performance on the task to result in entitlement effects in the bargaining game.

We selected the SRT because previous studies suggested there are not large differences across people when trying to construct solutions to instances of the SRT of similar size to the ones we used in the experiment. Nevertheless, the SRT is a task involving spatial reasoning in two dimensions, and the bargaining table likewise represents the discs in a two-dimensional layout. It is plausible *a priori* that people who find shorter routes in the SRT are also more likely to recognise and follow focal point cues in the bargaining game; if this were true, it would be an undesirable feature for our objectives. We can use the data from **SA**, in which participants complete the SRT on their own, to confirm whether or not this is the case.

Hypothesis 4 (No SRT-focal point connection). *There is no correlation in **SA** between performance on the SRT, measured by route length, and the propensity to choose focal point claims.*

Hypothesis 4 is important when we analyse the relationship in **J•** between the interactive version of SRT and bargaining. Our objective in adopting the SRT was to have a mechanism for participants to engage in an interactive activity, where the interaction is structured and well-controlled, and where the correct or optimal answer to the puzzle presented in the activity is not obvious. Although our interaction is more controlled than, for example, the chat-based task in Chen and Chen (2011), the fact that there is genuine freedom of choice in the interaction as to what box to collect next means that there will be variation in the performance of teams. A team might perform poorly on the SRT because one or both of the participants is less skilled at the task; or, the team might suffer from miscoordination, in which the two members have quite different approaches to the task.

Because participants have no other means of communication and no means of identifying whether they have previously completed a SRT with their current co-player, we expect that teams will not do as well as individuals on the task. However, other things being equal, there may be teams which, through some combination of individual skill and compatible approaches to the problem, will tend to produce shorter routes, and therefore may feel they had a more positive experience in the interaction. A positive experience may then influence the decisions made in the subsequent bargaining scenario.

Hypothesis 5 (Team-building). *In general, teams (in **J•**) will perform less well on the SRT than individuals (**SA**). Participants in pairs who perform better in the SRT will be less likely to make encroaching claims.*

If Hypotheses 4 and 5 are both supported in the data, the implication would be that improved bargaining outcomes after better SRT performances would be attributable principally to the effects of having had a positive interaction, and not because the team members themselves were inherently more likely to choose focal points *a priori*.

A way to check whether our manipulations in **J•** had the intended effect is to ask participants directly about their attitudes towards others in the session. As part of the end-of-session questionnaire, we elicited the "we-scale" measure used by Cialdini et al. (1997), by asking participants, *Please indicate to what extent would you use the term "we" to characterise you and the person matched with you in each scenario.* Participants responded on a seven-point Likert scale with endpoints labeled "Not at all" to "Very much so". We say that the reported we-scale score is higher when participants express greater agreement to the proposition.

Hypothesis 6 (We-scale). *Participants will report higher we-scale scores (a) in* ***J•*** *than* ***SA****; (b) in* ***JE*** *than* ***JA****. Cohorts with higher we-scale scores will earn more and make fewer encroaching claims.*

5 Results

In **JA** and **JE** there were 20 cohorts each, with a total of 80 participants in each treatment. In **SA** there were a total of 96 participants. These participants faced 17 different running orders of SRT maps and bargaining scenarios; following the principle outlined in Section 3.4 we group them into 17 cohorts. Within a cohort, the participants were paired for each scenario; we refer to a pairing of two participants for a specific scenario as a scenario-pair.

For comparisons of test statistics where magnitude is meaningful, we use the Fisher-Pitman permutation test (Kaiser, 2007; Holt and Sullivan, 2023).[4] We write a test between treatments x and y as FP(x,y), and report the test statistic as d alongside its corresponding p-value.[5] When only rank-order is meaningful, we use the Mann-Whitney-Wilcoxon (MWW) test. written as MWW(x,y). For these tests, we report r, the probability that, given a randomly-selected cohort from treatment x and a randomly-selected cohort from treatment y, the value of the statistic being tested in the cohort from treatment x is larger than the value in the cohort from treatment y.

Treatment	Realised surplus	Sum of claims	% Disagreement
SA	£6.90	£10.70	31.9%
JA	£8.00	£10.82	22.8%
JE	£7.76	£10.70	24.2%

Table 3: Summary of bargaining performance per scenario-pair, averaged across cohorts.

We begin with the most fundamental measure of success: How much surplus is successfully realised in bargaining. Table 3 provides summary statistics on bargaining performance per scenario-pair, averaged across cohorts. In cohorts with prior interaction, disagreement rates are lower and realised surplus is higher. Figure 5 plots the distribution of these measures cohort-by-cohort.

[4]We thank an anonymous referee for the suggestion of adopting this test.

[5]Specifically, we conduct a Monte Carlo version of the test, in which we draw 50,000 permutations of the group labels at random, and estimate the p-value as the proportion of permuted samples in which the absolute value of the simulated test statistic exceeds the observed value.

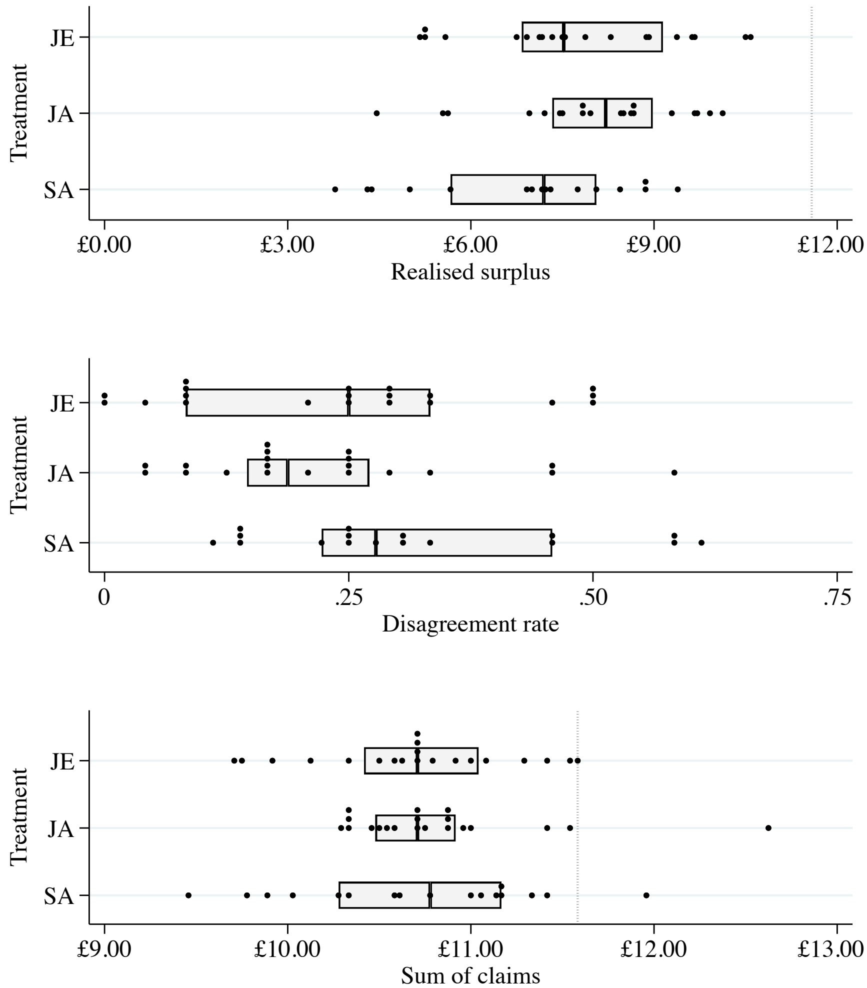


Figure 5: Measures of bargaining performance. Each dot represents a cohort. The boxes represent the interquartile range. The vertical lines in surplus and claims represent the maximum attainable surplus for a pair.

Result 1 (**Bargaining success**). *Prior interaction increases bargaining success. After prior interaction, pairs realise more of the available surplus and have lower disagreement rates. Linking the prior activity to the surplus has no effect on bargaining performance.*

Support. Comparing **SA** cohorts against those with interaction, we find that **SA** cohorts realise less surplus (FP(**SA**,**J•**), $p = .044$, $d = -.98$). Whether the interaction did or did not link the SRT task to the endowment does not make a difference to realised surplus (FP(**JA**,**JE**), $p = .65$, $d = .24$). The higher realised surplus is driven principally by fewer bargaining games resulting in disagreement after interaction (FP(**SA**,**J•**), $p = .074$, $d = 8.4$), and not by changes in the total values of discs being claimed (FP(**SA**,**J•**), $p = .75$, $d = -.056$) □

Treatment	Agreement with focal	Claim types		Claim values vs. focal	
		% Encroaching	% Cautious	Difference	Excess
SA	85.6%	22.3%	7.0%	£1.18	£0.55
JA	92.1%	14.2%	5.0%	£1.08	£0.51
JE	90.0%	14.5%	7.3%	£1.17	£0.49

Table 4: Properties of claim strategies, by treatment.

We next look at how the structure of claims differs between treatments to generate these differences in bargaining success. Table 4 provides summary statistics describing claims, continuing our distinction between the patterns of which discs are claimed and the values of those discs. We begin with a simple measure of how different claims are from the focal point: for each player in each scenario, and for each disc, we compute whether the player's claim on that disc matches the claim recommended by the focal point; we aggregate these across each cohort to produce an overall measure. Following our classification in Section 4, we then categorise claims into encroaching or cautious. Figure 6 plots the distribution of these measures cohort-by-cohort.

We also report measures based on the values of the discs claimed. To parallel our distance from the focal measure on discs, we take, for each participant in each scenario, the absolute value of the difference between the value of the discs they claimed, and the value of the discs assigned to them by the focal point, and then average over all participants and scenarios in the cohort. This measure treats large and small claims symmetrically, while in the game large claims tend to be an impediment to agreement while small claims are not. Therefore, we also compute the mean excess claim value, which differs from the mean absolute value in only considering claims which exceed the focal point value. Figure 7 plots the distribution of these measures cohort-by-cohort.

Result 2 (**Claim characteristics**). *The improved bargaining performance after prior interaction is driven by a reduction in encroaching claims, and not by changes in the total value claimed.*

Support. Measured by which discs are and are not claimed, claims in **SA** are farther from the focal point (FP(**SA**,**J•**), $p = .006$, $d = .055$). The movement towards the focal point comes primarily from a reduction in encroaching claims. Encroaching claims are more frequent in **SA** than in cohorts with prior interaction (FP(**SA**,**J•**), $p = .011$, $d = 8.0$), while the frequency of cautious claims is unchanged (FP(**SA**,**J•**), $p = .62$, $d = .80$). There are no differences between **JA** and **JE** in the distance of claims from the focal point (FP(**JA**,**JE**), $p = .25$, $d = -.02$), nor in the frequency of either encroaching (FP(**JA**,**JE**), $p = .95$, $d = -.30$) or cautious (FP(**JA**,**JE**), $p = .30$, $d = -.22$) claims.

We have already seen that there is no difference in average claim values, so we look specifically at whether the distribution of claim values around the focal point differs. We find no differences

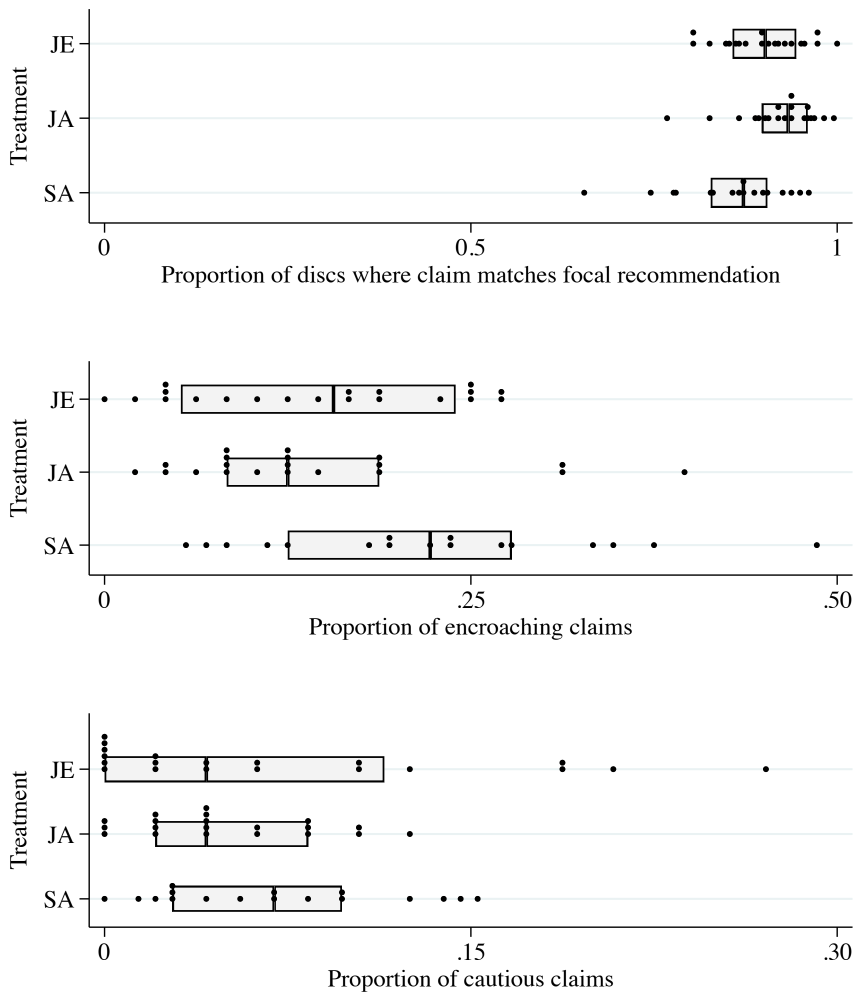


Figure 6: Properties of claim strategies. Each dot represents a cohort. The boxes represent the interquartile range.

between individual and prior interaction treatments using either the mean distance from the focal point value (FP(**SA**,**J•**), $p = .44$, $d = .058$), or the mean excess claim over the focal point value (FP(**SA**,**J•**), $p = .23$, $d = .059$). □

We had hypothesised that if prior interaction improved bargaining outcomes, it would do so primarily in asymmetric scenarios. For each cohort, we construct the average realised surplus and the agreement rate over pairs, and the proportion of encroaching claims, separately for symmetric and asymmetric scenarios. The averages of these across cohorts are reported in Table 5, alongside the net difference between symmetric and asymmetric scenarios. Overall there is no evidence of an interaction effect between prior interaction and the (a)symmetry of a scenario.

Result 3 (**Asymmetric games**)**.** *Prior interaction improves bargaining performance and reduces*

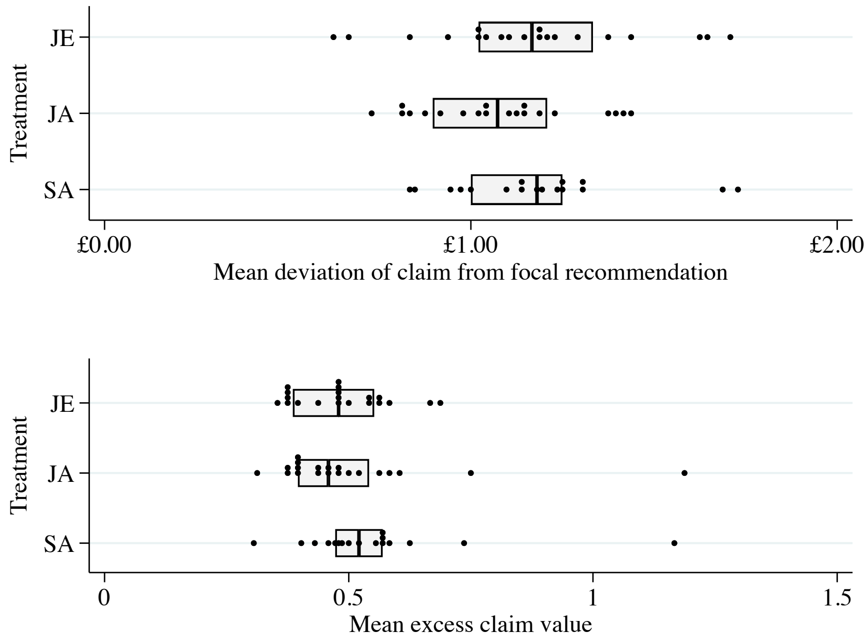


Figure 7: Properties of values of claimed discs from claim strategies. Each dot represents a cohort. The boxes represent the interquartile range.

encroaching claims by similar amounts in symmetric and asymmetric games.

Support. For each cohort, we construct the average realised surplus and the agreement rate over pairs, and the proportion of encroaching claims, separately for symmetric and asymmetric scenarios. The averages of these across cohorts are reported in Table 5. We find no effect of prior interaction in the differences in the proportion of encroaching claims (FP(**SA**,**J•**), $p = .95$, $d = -.13$), the disagreement rate (FP(**SA**,**J•**), $p = .88$, $d = .75$), nor the realised surplus (FP(**SA**,**J•**), $p = .77$, $d = -.15$). □

We note that this result seems particularly surprising given that in Isoni et al. and in our **SA** data, there were more encroaching claims and higher rates of disagreement in asymmetric scenarios than symmetric scenarios. As such, the way we compare symmetric and asymmetric scenarios in Result 3 stacks the deck in favour of a finding of prior interaction being more effective under asymmetry, simply because there was more room for improvement in performance in asymmetric scenarios against the **SA** baseline.

We now turn to analysing whether the existence of team-building SRT task, and the quality of participants' experience in doing the task, correlate with bargaining performance. The shortest path in each of the 12 SRT maps has a different length; therefore it is convenient to label the maps by the length of the shortest path. In Table 6, we summarise the performance by map for each

Treatment	Realised surplus			% Disagreement			% Encroaching		
	Symmetric			Symmetric			Symmetric		
	Yes	No	Diff	Yes	No	Diff	Yes	No	Diff
SA	6.98	6.84	0.14	26.9%	35.4%	-8.6%	17.9%	25.5%	-7.5%
JA	8.06	7.96	0.10	18.5%	25.7%	-7.2%	10.3%	17.0%	-7.2%
JE	8.05	7.56	0.48	17.5%	28.9%	-8.1%	9.8%	17.9%	-8.1%

Table 5: Bargaining performance and claim characteristics, by treatment and whether the scenario was symmetric. For each metric, the column Diff reports the difference between symmetric and asymmetric games.

of the three treatments. For each map, we measure performance by the additional distance taken beyond the shortest route; therefore, 0 is the best possible score and lower scores are better.

The possible scores on each map are discrete, and distributed differently, in that some maps have several routes which are close to the optimal length while others do not. Therefore comparisons of the magnitudes of path lengths across different maps do not have a straightforward interpretation. We focus first on **SA** and construct a measure of a participant's performance overall on the SRT tasks they faced. Let M denote the set of maps, P denote the set of participants, $r(p, m)$ denote the path chosen by a given participant p for map m, and $|r|$ the length of a path r. Then we compute the round-robin winning percentage of a given participant p on map m as

$$W(p, m) = \frac{1}{|P| - 1} \sum_{q \in P, q \neq p} \mathbf{1}(|r(p, m)| < |r(q, m)|) + \frac{1}{2} \times \mathbf{1}(|r(p, m)| = |r(q, m)|). \tag{1}$$

The overall winning percentage for participant p is then the average across all maps.[6]

$$W(p) = \frac{1}{|M|} \sum_{m \in M} W(p, m). \tag{2}$$

Result 4 (No SRT-focal point connection). *Bargaining claims in* **SA** *are not correlated with performance on the SRT.*

Support. For each participant in **SA**, we compute $W(p)$ as in (2), and we tabulate the number of times each participant makes an encroaching claim. Figure 8 provides a scatterplot of the data. We find no correlation between participants' ranking by $W(p)$ and their count of encroaching claims

[6] Ranking players by $W(p)$ is exactly the same as ranking them by their average rank across all maps. Writing these as winning percentages instead of average ranks gives a more intuitive interpretation, as this amounts to the probability that a given participant p would win a head-to-head competition on a randomly-selected map m against a randomly selected opponent $q \neq p$.

	Median			Mean		
Map	**SA**	**JA**	**JE**	**SA**	**JA**	**JE**
280	26.0	27.0	36.0	35.5	39.4	45.5
290	10.0	14.0	15.0	17.4	21.3	27.7
308	10.0	11.0	12.0	16.8	20.0	19.5
310	28.0	28.0	28.0	25.6	36.0	40.7
318	12.0	18.0	22.0	20.4	20.1	29.4
322	6.0	12.0	24.0	22.1	22.2	22.5
330	30.0	28.0	37.0	35.2	31.2	45.0
340	0.0	2.0	1.0	12.5	17.0	19.3
348	32.0	56.0	106.0	53.2	83.4	114.6
376	23.0	28.0	30.0	39.3	37.8	49.8
384	24.0	20.0	26.0	43.3	37.5	42.4
390	0.0	16.0	16.0	16.9	41.0	26.2

Table 6: Summary statistics on SRT performance, by treatment and map. The scores for median and mean are measured in length of path in excess of the shortest length; scores are therefore non-negative and zero exactly when the path constructed was the shortest path. The statistics are based on paths constructed by individual participants in **SA** and on pairs of participants taking turns in **JA** and **JE**.

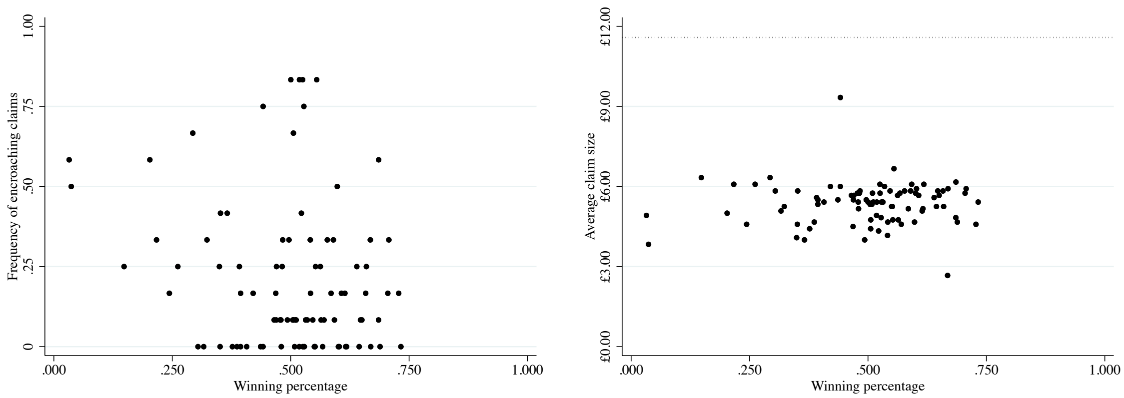
(Spearman's $\rho = -0.14$, $p = 0.20$). We likewise compute each participant's average claim size; we find no correlation between the ranking by $W(p)$ and average claim size (Spearman's $\rho = 0.07$, $p = 0.50$). □

We observe that, as measured both by mean and median scores, participants in **SA**, who did the task on their own, generated shorter routes than those in **JA** and **JE**. To make comparisons between **SA** and the treatments with prior interaction, we modify the round-robin winning percentage idea from (2) to respect the cohort as the unit of independent observation. Let $R(m, c)$ denote the set of paths constructed on a map m in a cohort c. Then, we write the winning percentage of a cohort c against a cohort d as

$$W(c, d) = \frac{1}{|R(m, c)||R(m, d)|} \sum_{m \in M} \sum_{r \in R(m,c)} \sum_{s \in R(m,d)} \mathbf{1}(|r| < |s|) + \frac{1}{2} \times \mathbf{1}(|r| = |s|). \qquad (3)$$

Let C denote the set of all cohorts. The overall winning percentage of a cohort c is their average winning percentage against all other cohorts,

$$W(c) = \frac{1}{|C| - 1} \sum_{d \in C, d \neq c} W(c, d) \qquad (4)$$



(a) Correlation with encroaching claims

(b) Correlation with claim size

Figure 8: Correlation between participant winning percentage, and encroaching claims and claim size, in **SA**. Each dot represents one participant. The dashed line in claims represents the maximum possible, achieved by claiming all discs in all scenarios.

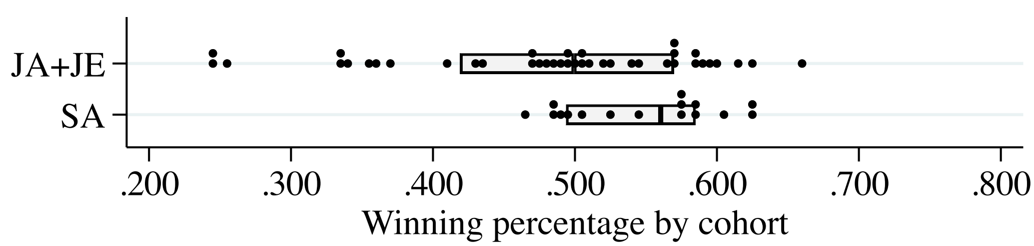
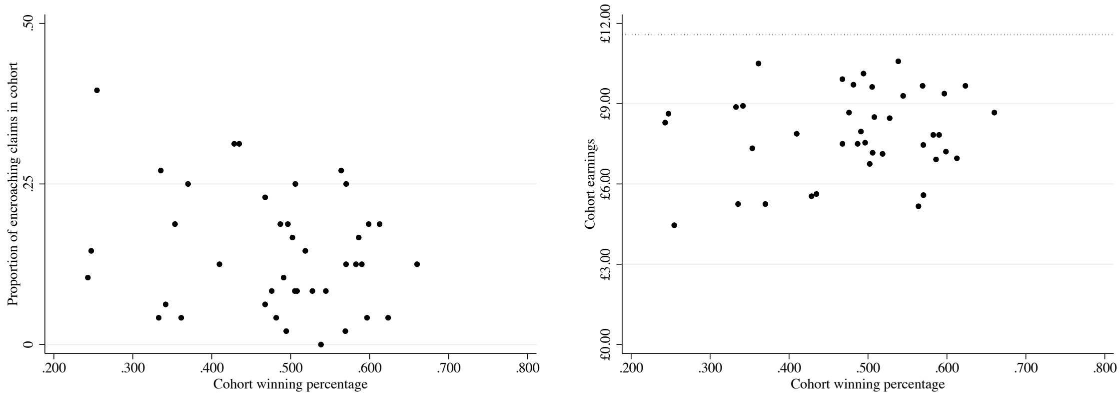


Figure 9: Dotplot of cohort winning percentages. Each dot represents one cohort; winning percentages are stacked in bins of width .005. The boxes show the median and interquartile range.

Figure 9 plots the distribution of cohort winning percentages. Cohorts in **SA** do have systematically higher winning percentages; the mean value of $W(c)$ across cohorts in **SA** is .547, compared to .504 in **JA** and .458 in **JE**. Furthermore, the performance of cohorts in which the routes were produced jointly is more variable than those in which participants completed the routes individually. Because this variability is greater than in **SA**, it cannot be attributed to individual characteristics of the members of cohorts alone and is evidence that some cohorts were much more successful than others in having mutually-compatible plans for the SRT. We exploit this variability to test whether success on the SRT - or lack thereof - influences bargaining performance.

Result 5 (**Team-building**). *As predicted, pairs in **JA** and **JE** produce longer paths than those produced by participants working on their own in **SA**. However, the lengths of paths produced by pairs in a cohort do not predict the cohort's proportion of encroaching claims nor its earnings.*

Support. To show that paths in **SA** are shorter, for each cohort c we compute $W(c)$ as in (4).



(a) Correlation with encroaching claims

(b) Correlation with earnings

Figure 10: Correlation between cohort winning percentage, and encroaching claims and earnings, by cohort in **JA** and **JE**. Each dot represents one cohort. The dotted line in earnings represents the maximum feasible earnings for a cohort.

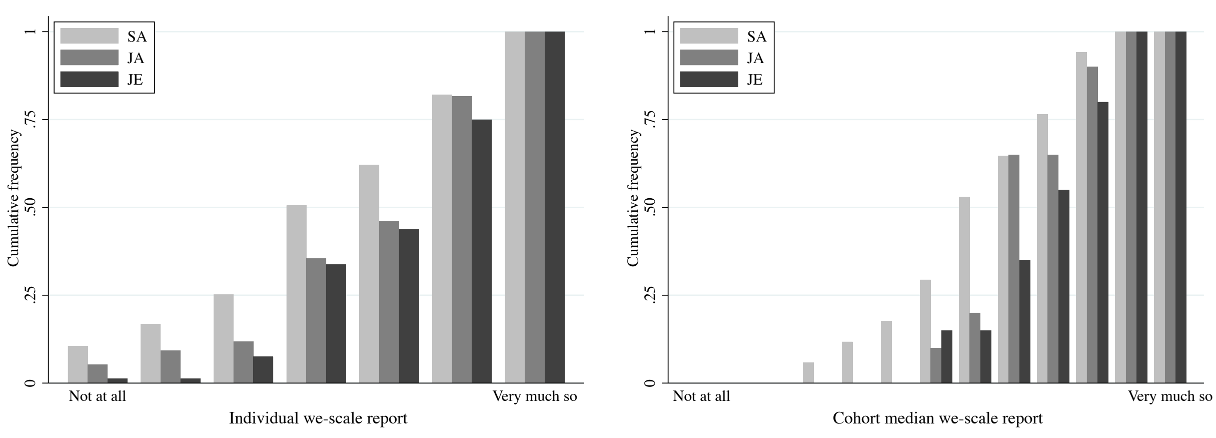
We find that $W(c)$ values are higher in **SA** than in treatments with prior interaction (FP(**SA**,**J•**, $p = .018$, $d = .066$).

Focusing on treatments with prior interaction, in Figure 10 we provide scatterplots comparing a cohort's winning percentage with its proportion of encroaching claims and with its earnings. We cannot reject the null hypothesis of no correlation between the winning percentage and the proportion of encroaching claims (Spearman's $\rho = -.13$, $p = .41$) nor the null hypothesis of no correlation between winning percentage and earnings (Spearman's $\rho = .054$, $p = .74$). $\square$

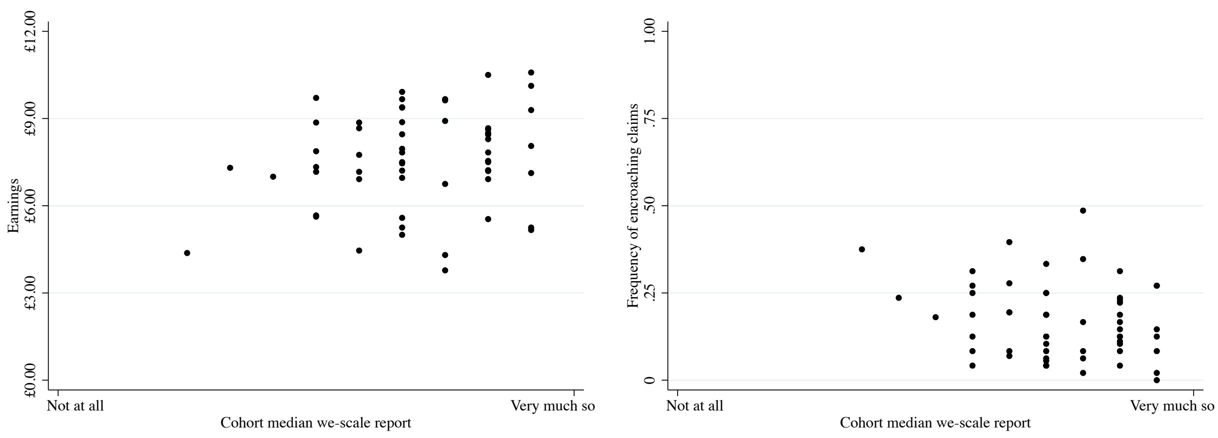
Finally, we look at the participants' reported we-scale scores. Figure 11a plots the cumulative distributions of we-scale reports. The left panel shows the distribution for individuals; respecting the cohort as the unit of observation, we also aggregate these by cohort by taking the median across cohort members, and report this distribution in the right panel. By both measures, a shift towards higher scores is evident when comparing **SA** to **JA** and **JE**. In Figure 11b, we plot the cohort we-scale reports (for all treatments) against cohort earnings and frequency of encroaching claims. Broadly speaking, cohorts reporting higher we-scale scores earn somewhat more and make somewhat fewer encroaching claims.

Result 6 (**We-scale**). *Cohorts who interact prior to bargaining report higher we-scale measures. There is weak evidence that suggests cohorts with higher we-scale measures make fewer encroaching claims and earn more.*

Support. Cohorts in which there was interaction prior to bargaining reported significantly higher we-scale measures (MWW(**SA**,**J•**), $p = .039$, $r = .329$).



(a) Empirical cumulative distributions of individual we-scale reports, and of cohort-median we-scale reports.



(b) Relationship between cohort-median reports and cohort earnings and frequency of encroaching claims.

Figure 11: Distribution of reported we-scale measures and their relationship with bargaining outcomes.

The correlations between cohort-level we-scale measures and bargaining performance have the expected signs: the Spearman rank-order correlation between we-scale report and earnings is +0.24, and between we-scale report and frequency of encroaching claims is -0.18. Using Cuzick's test, we cannot reject the null hypothesis of no trend for encroaching claims ($p = .105$) or for earnings ($p = .154$). $\square$

We asked the we-scale question prior to revealing the outcome of the bargaining. Therefore, these reports are not influenced by the outcome of the payoff-relevant portion of the experiment. The reports suggest that even the limited interaction afforded by the SRT does have an effect on how participants view their relationship with their co-players in the bargaining game.

6 Conclusion

Using a new approach to implementing a joint activity prior to bargaining, we find that people who have jointly completed a prior unrelated task are more likely to come to an agreement in a simultaneous tacit bargaining game. They accomplish this by coordinating more frequently on agreements suggested by focal points, and in particular, by not making encroaching claims which tread on the "territory" of the other player. We contribute to the literature by isolating more cleanly the effect of the prior joint activity itself; our data show that the prior activity does not activate subjective endowments based on norms or performance on the activity.

Because our bargaining interaction involves making claims over a set of separately identifiable objects, our resulting choice data is richer: we see not only how much our participants claim, but what specifically they claim. This richer data provides more evidence about the influence that prior interaction may have on approaches to bargaining. Our data from **SA** broadly reproduce the data of Isoni et al. (2013) that suggest that bargaining failure in this class of games arises not so much from people claiming *too much*, but from claiming the *wrong objects*.

When prior interaction is added, we find that the total value of claims does not change, but the pattern of which objects are claimed does. Specifically, there is a decrease in the frequency of claims which violate the allocation suggested by the rules of closeness or accession. As a result, the outcomes of bargaining are better: agreements are more frequent, and participants earn more money.

Our preferred mechanism for explaining our data is team reasoning, specifically as formulated by Sugden (1993). Sugden's team reasoners look for a rule which is capable of breaking the symmetry of the formal game, and suggests a unique solution, by using the salient cues in the environment. Our bargaining table representations are designed specifically that there the focal point cues provide such a unique solution. If the prior interaction functions as a team-building exercise, then players will be more likely to reason as a team, and engaging in Sugden-style team reasoning would enhance the attractiveness of making claims that align with the suggestion of the focal point.

A practical challenge in recommending team reasoning as the best explanation of a behavioural phenomenon is that many decisions predicted by team reasoning would also be consistent with various theories of social preferences. Making a decision that is likely to result in a good outcome for the team implies that the payoffs of the other players enter into the reasoning process of a player. But even more importantly, it is human nature to feel more positively inclined towards someone else whom we consider a teammate or partner. It is therefore reasonable to consider whether the prior interaction simply encourages our participants to think more carefully about the impact of their claims on the outcome of the other player.

The treatment effects we observe in our data are not explained well by theories of social preference alone. Inequity aversion broadly predicts a reduction in the values of claims: an increase in aversion to disadvantageous inequity rules out as equilibria those which have extreme differences in earnings, while an increase in aversion to advantageous inequity would create equilibria in which the sum of claims is less than the total value. However, we do not observe differences in the values of claims. Instead, what we do observe is differences in the structure of claims. Theories of social preference alone cannot address the problem of selection from the multiplicity of equilibria that inherently remain due to the fact that the game is symmetric while the pure-strategy equilibria are asymmetric.

Our results therefore are distinct from, but importantly complementary to, Chen and Chen (2011). We illustrate a different channel through which outcomes in coordination games can be improved after prior interaction, via successful play of asymmetric equilibria. We achieve this through a manipulation which is likewise lighter-touch than their "enhanced" identity treatment, in which participants engaged in interactive chat; our participants interact solely through the alternation of moves in the SRT.

The design of the bargaining table scenarios in the experiment intends that the relational cues suggest a focal point to coordinate on. In order for any suggestion to be compelling as a focal point, a player must pick up on the cue themselves, and also believe that it is likely the other player will do so as well. Although the SRT and bargaining table are distinct tasks, in the SRT constructing a good solution involves spatial reasoning, and in the bargaining table the proposed relational cues of closeness and accession require people to group discs based on their spatial layout. If the spatial nature of the tasks linked them in people's perceptions, completing the SRT might prime people to think in terms of spatial layout and therefore make them more likely to recognise the relational clues in formulating their bargaining claims. This cannot be an explanation for our treatment effects, because participants in **SA** also complete the SRT prior to bargaining, and so if there is any priming effect, it applies equally across all treatments.

Our experiment does investigate whether the mere framing of the bargaining endowment as having been linked to the prior activity matters. We find no treatment differences between **JA** and **JE**. Given the existing literature on joint endowments, our aim was to investigate the absolutely minimal framing of the endowment as arising from the prior activity, specifically to control for subjective entitlements. A potentially interesting avenue for future research is to develop techniques similar to ours which allow for a potentially more compelling link between the prior activity and production of the endowment, while avoiding confounds due to entitlements, relative performance, or conflicts during the endowment-generating activity.

The contribution made by a laboratory experiment is the control it affords us to isolate the role of prior interaction. Whether or not people engaged in bargaining have had prior interaction will be one contextual factor among many which influences their bargaining strategies. In the case of Chu and Han, history of course affords us no counterfactuals to know whether the Hong Canal would have been a salient border had their recent history been different. Other factors were also in play in their broader strategic interaction, and, indeed, the treaty was broken the following year by Han, who eventually triumphed and founded the next dynasty to rule China.

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A Experimental Instructions

A.1 Treatment JE

Introduction

This is an experiment in the economics of decision-making. If you follow the instructions and make appropriate decisions, you can earn an appreciable amount of money. You will receive your earnings for today's session in cash before you leave the laboratory

It is important that you remain silent and do not look at other people's work. If you have any questions, or need assistance of any kind, please raise your hand and an experimenter will come to you. If you talk, laugh, exclaim out loud, etc., you will be asked to leave and you will not be paid. We expect and appreciate your cooperation.

We will now describe the session in more detail. Please follow along with these instructions as they are read aloud.

Everyone in the room is receiving exactly the same instructions.

You will be presented with twelve (12) different scenarios, one after the other. Each scenario consists of two (2) stages. Everyone in the room will make decisions in the same 12 scenarios. Each scenario is an interaction between two participants. For each scenario, you will be matched with another participant in the room. Each match is anonymous: You will never find out with whom you are matched in a scenario. You will not be matched with the same participant in two consecutive scenarios.

At the end of the experiment, one of the scenarios will be randomly selected to determine the earnings for the session. Because you will not know which scenario will be selected until you have made decisions in all of them, **you should treat each scenario as if it was the selected one.** So, when thinking about each scenario, remember that it could be the selected one and think about it in isolation from the others. Your total earnings for the session will be given by the earnings from the selected scenario, plus a £5 participation payment.

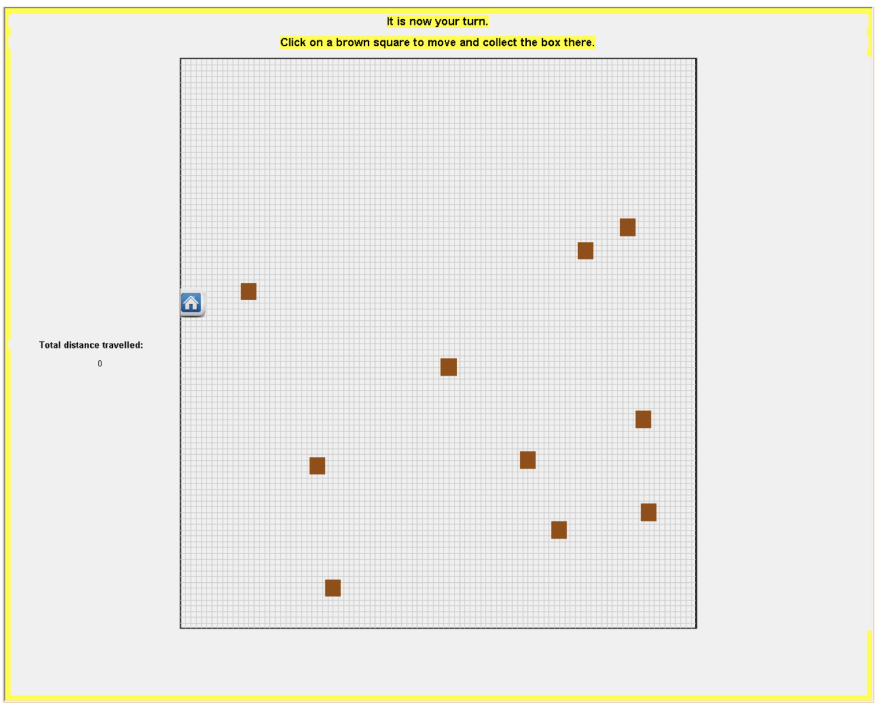
The scenario

Each scenario consists of 2 stages. At the start of the scenario, you will be matched with one other participant. You will remain matched with that participant through the whole scenario, but will be matched with a different participant in the subsequent scenario.

Stage 1

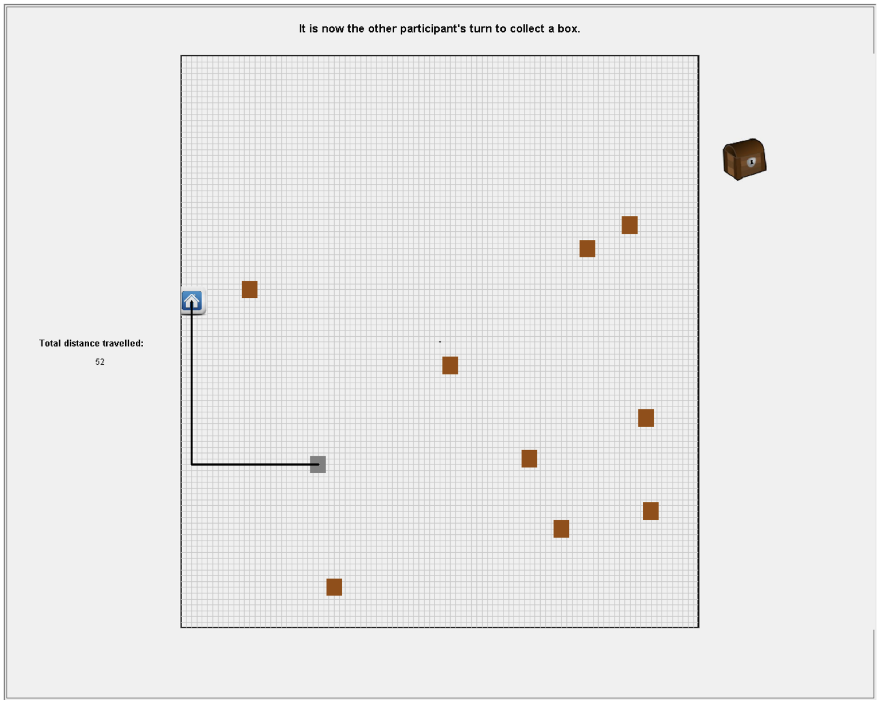
In Stage 1, you and the other participant with whom you are matched will collect ten (10) boxes. Each box either contains one disc, or is empty. Discs are worth various amounts of money. In Stage 2 of the scenario, you and the other participant will have the opportunity to agree on a division of the discs.

These boxes will be placed at 10 different points on a map. Each box is represented by a square. The locations of the 10 boxes will be different in each scenario. You and the participant with whom you are matched will start from a home location, which will be indicated by a picture of a house. The two of you will move around the map collecting the boxes, and then return to the home location. Here is an example of a typical map.



The two of you will take turns deciding which box to collect next. When it is your turn, you will see the message“It is now your turn” at the top of the screen. Click on a brown square to move and collect the box located there. Each collected box appears as a picture on the right side of the screen.

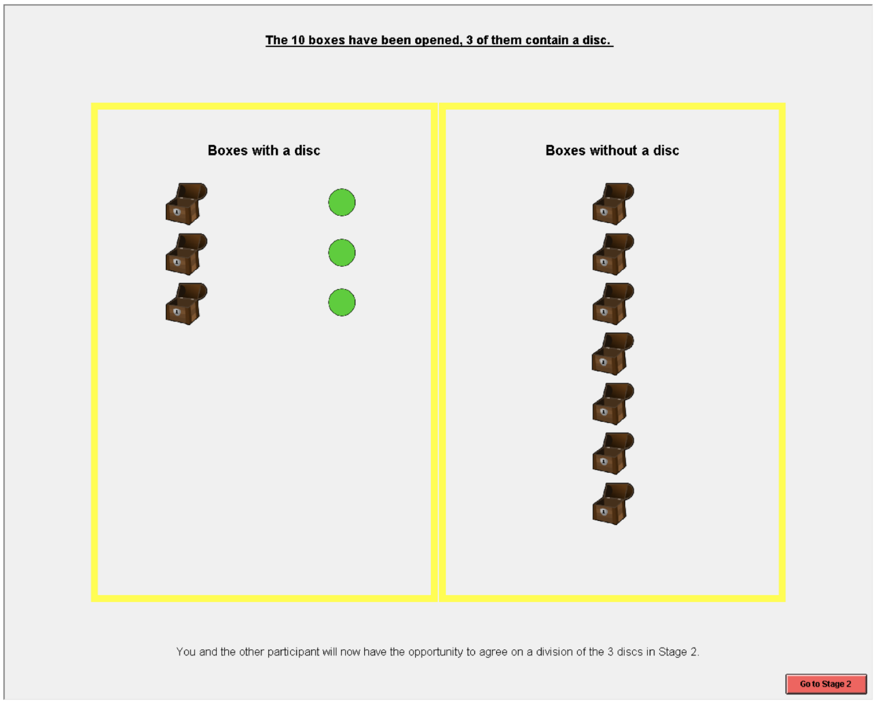
After you click to collect a box, it will be the other participant’s turn. Your screen will display the message“It is now the other participant’s turn to collect a box.” as shown in this screen:



As the two of you move around the map collecting boxes, the computer will draw the path the two of you take. The locations of boxes which have already been collected will be shown as grey squares; the locations of boxes which still have to be collected will be shown as brown squares. As there are 10 boxes to be collected, you and the other participant will each collect 5 boxes.

At the left of the map, the computer will report the total distance travelled by the two of you. After Stage 2 of the scenario, you will see a ranking listing the total distance the two of you travelled, and the distances travelled by other participants in the session. The route with the shortest distance will receive the top rank. You may be able to improve your ranking by thinking ahead. The route with the shortest total distance is not necessarily the one which always moves to the next closest box. Instead, it may sometimes be useful to collect a more distant box first to set up shorter moves later on.

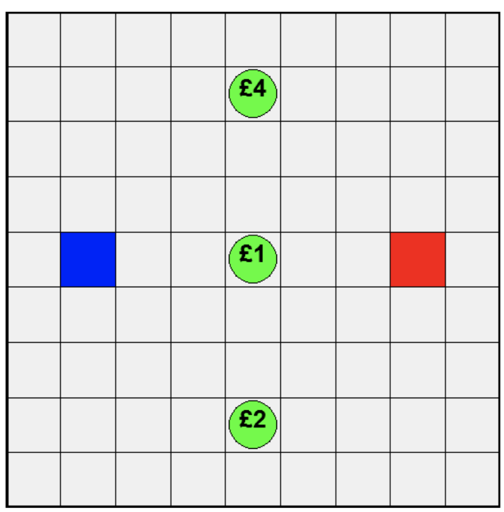
After the two of you have collected all 10 boxes, the boxes will be opened. Some boxes will be empty, and some will contain a disc.



In this example, 3 of the 10 boxes contained a disc, and 7 of the 10 boxes were empty. In Stage 2, you and the other participant will learn how much each disc is worth, and will have the opportunity to agree on a division of the discs.

Stage 2

In Stage 2, each scenario is represented by a picture like this on your screen.



We will call this picture a **table**. The discs which the two of you collected together in Stage 1 of the scenario will be laid out on it. Each disc is labelled with its corresponding monetary value. In this example, the 3 discs collected in Stage 1 are worth £4, £1, and £2, respectively.

You and the other participant will be either Red or Blue. The role of Red or Blue will be randomly decided by the computer. Each of you has a **base**, represented by a red square for the Red participant and a blue square for the Blue participant. You will see "YOU" on your base. Your base will keep the same colour and the same position on the table in all the scenarios you will encounter.

The basic rules

You and the other participant have the opportunity to agree on a division of the discs.

Each of you separately record which discs you propose to take. We will say that you are **claiming** those discs. You can claim as many (or as few) discs as you want. These claims determine whether there is an agreement or not.

There is an agreement if you have not claimed any of the discs that the other participant claimed, that is, if you and the other participant claimed different discs. In this case, you get all the discs that are yours according to the agreement. You then earn the total value of these discs.

But if **any** disc has been claimed by both you and the other participant, there is no agreement. In this case, you get no discs and so earn nothing from the scenario.

You can claim a disc by clicking on it with your mouse. If you do this, a coloured line connecting the disc to your base will appear on the table. If you have claimed a disc but change your mind and decide you no longer want to claim it, you simply click on it again. The coloured line connecting it to your base then disappears.

In each scenario, you can claim as many discs as you like. You should remember that the other participant will be claiming discs too.

You will not know which discs the other participant has claimed.

When you are happy with the claims you have made in a scenario, you go on to the next scenario by pressing the CONFIRM button.

Your earnings

When you have finished all 12 scenarios, you will be told which of them was selected to determine your earnings. The earnings of you and the participant matched with you in that scenario are determined by the decisions you have made in Stage 2. The Table in that scenario in Stage 2 will appear on your screen again, and this time you will see both the claims you made and the claims made by the other participant. You will not be able to change your claims at this stage.

How much you earn depends on these claims. Remember the rules that determine your earnings:

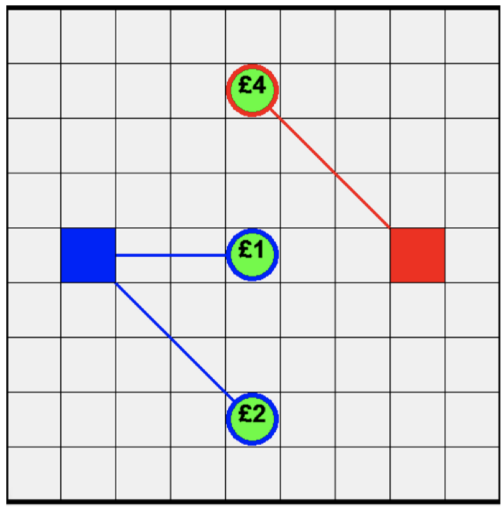
- There is an agreement if you have not claimed any of the discs that the other participant claimed, that is, you and the other participant claimed different discs. In this case, you get all the discs that are yours according to the agreement. You then earn the total value of these discs.

- But if any disc has been claimed by both you and the other participant, there is no agreement. In this case, you get no discs and so earn nothing from the scenario.

We will now show some examples of how these rules work.

Example 1

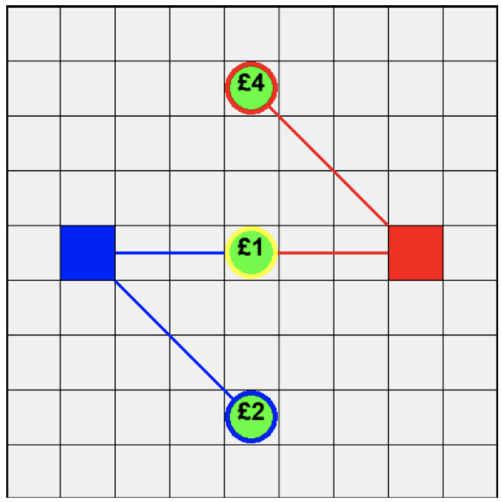
Suppose the Table in the selected Scenario is the one displayed on the screen, and that the Red participant's and the Blue participant's claims are as shown.



In this case, no disc has been claimed by both Red and Blue, and so there is an agreement. According to this agreement, Blue gets the £4 disc, and Red gets the £2 disc and the £1 disc. So Blue earns £4 and Red earns £3 from the Scenario.

Example 2

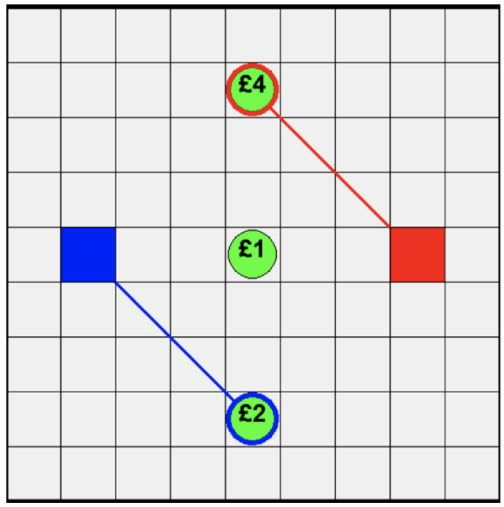
Suppose instead the claims are as now shown. The £1 disc, which is outlined in yellow on the screen, has been claimed by both Red and Blue.



In this case, because the £1 disc has been claimed by both Red and Blue, there is no agreement. So neither participant gets any discs, and so they both earn nothing from the Scenario.

Example 3

Suppose instead the claims are as now shown. Here, no one has claimed the £1 disc.



In this case, no disc has been claimed by both Red and Blue, and so there is an agreement. According to this agreement, Blue gets the £4 disc and Red gets the £2 disc. No one gets the £1 disc. So Blue earns £4 and Red earns £2 from the Scenario.

Your total earnings from the experiment will be given by the earnings from the Scenario selected for payment, as just described, plus a £5 participation payment.

A.2 Treatment JA

Introduction

This is an experiment in the economics of decision-making. If you follow the instructions and make appropriate decisions, you can earn an appreciable amount of money. You will receive your earnings for today's session in cash before you leave the laboratory

It is important that you remain silent and do not look at other people's work. If you have any questions, or need assistance of any kind, please raise your hand and an experimenter will come to you. If you talk, laugh, exclaim out loud, etc., you will be asked to leave and you will not be paid. We expect and appreciate your cooperation.

We will now describe the session in more detail. Please follow along with these instructions as they are read aloud.

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You will be presented with twelve (12) different scenarios, one after the other. Each scenario consists of two (2) stages. Everyone in the room will make decisions in the same 12 scenarios. Each scenario is an interaction between two participants. For each scenario, you will be matched with another participant in the room. Each match is anonymous: You will never find out with whom you are matched in a scenario. You will not be matched with the same participant in two consecutive scenarios.

At the end of the experiment, one of the scenarios will be randomly selected to determine the earnings for the session. Because you will not know which scenario will be selected until you have made decisions in all of them, **you should treat each scenario as if it was the selected one.** So, when thinking about each scenario, remember that it could be the selected one and think about it in isolation from the others. Your total earnings for the session will be given by the earnings from the selected scenario, plus a £5 participation payment.

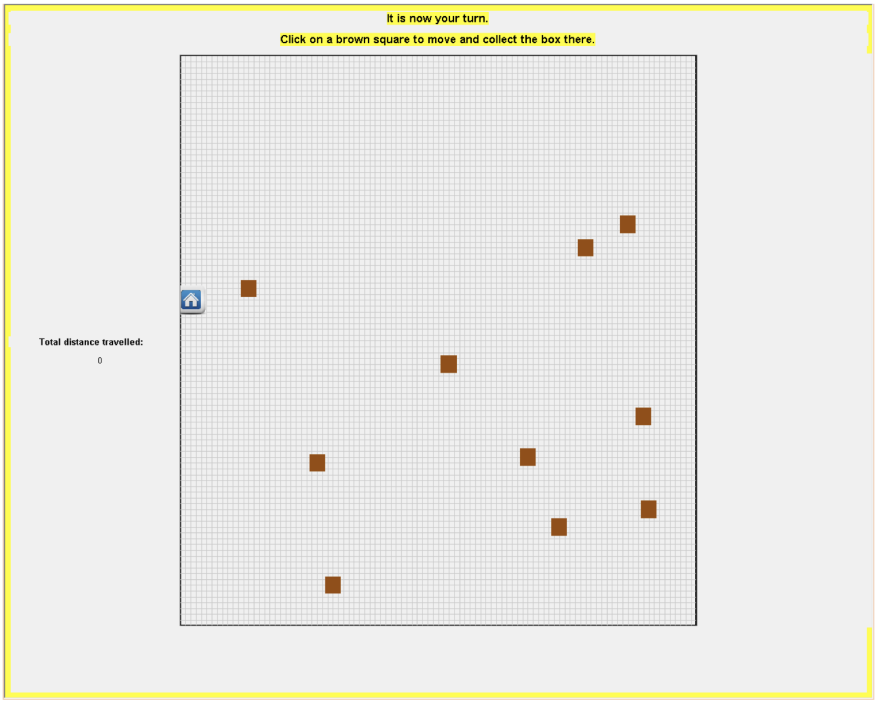
The scenario

Each scenario consists of 2 stages. At the start of the scenario, you will be matched with one other participant. You will remain matched with that participant through the whole scenario, but will be matched with a different participant in the subsequent scenario.

Stage 1

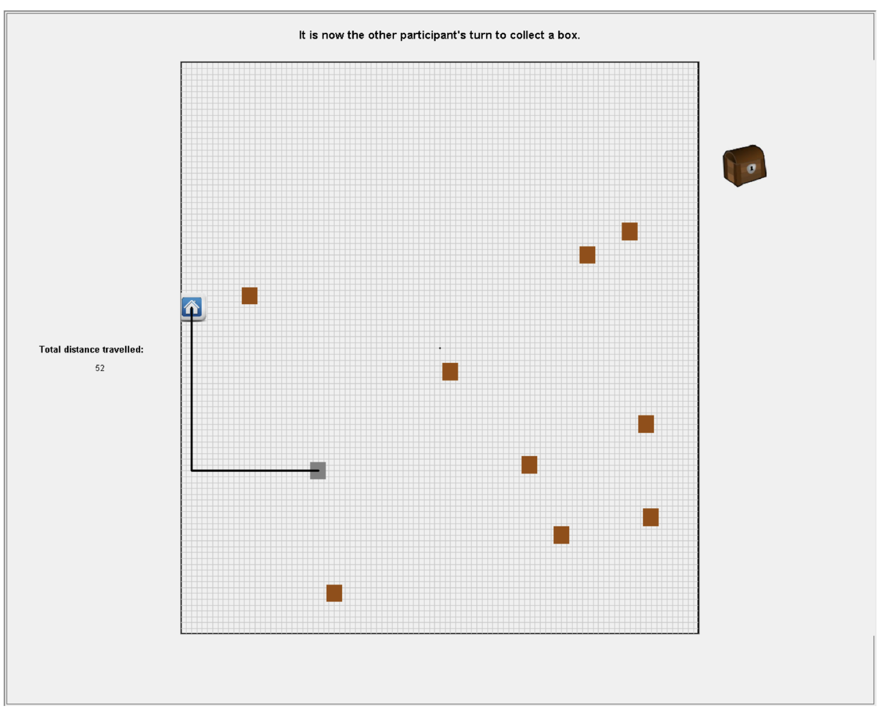
In Stage 1, you and the other participant with whom you are matched will collect ten (10) boxes. These boxes will be placed at 10 different points on a map. Each box is represented by a square. The locations of the 10 boxes will be different in each scenario.

You and the participant with whom you are matched will start from a home location, which will be indicated by a picture of a house. The two of you will move around the map collecting the boxes, and then return to the home location. Here is an example of a typical map.



The two of you will take turns deciding which box to collect next. When it is your turn, you will see the message“It is now your turn” at the top of the screen. Click on a brown square to move and collect the box located there. Each collected box appears as a picture on the right side of the screen.

After you click to collect a box, it will be the other participant’s turn. Your screen will display the message“It is now the other participant’s turn to collect a box.” as shown in this screen:



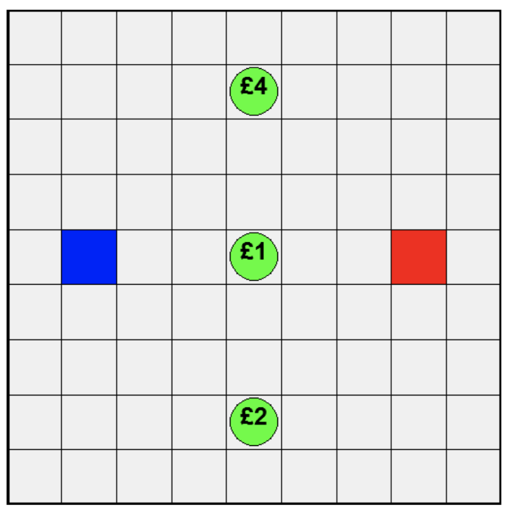
As the two of you move around the map collecting boxes, the computer will draw the path the two of you take. The locations of boxes which have already been collected will be shown as grey squares; the locations of boxes which still have to be collected will be shown as brown squares. As there are 10 boxes to be collected, you and the other participant will each collect 5 boxes.

At the left of the map, the computer will report the total distance travelled by the two of you. After Stage 2 of the scenario, you will see a ranking listing the total distance the two of you travelled, and the distances travelled by other participants in the session. The route with the shortest distance will receive the top rank. You may be able to improve your ranking by thinking ahead. The route with the shortest total distance is not necessarily the one which always moves to the next closest box. Instead, it may sometimes be useful to collect a more distant box first to set up shorter moves later on.

When all 10 boxes have been collected, you and the other participant will continue on to Stage 2.

Stage 2

Stage 2 of each scenario is represented by a picture like this on your screen.



We will call this picture a **table**. Several discs are laid out on it. Each disc is labelled with its corresponding monetary value. In this example, the 3 discs collected in Stage 1 are worth £4, £1, and £2, respectively.

You and the other participant will be either Red or Blue. The role of Red or Blue will be randomly decided by the computer. Each of you has a **base**, represented by a red square for the Red participant and a blue square for the Blue participant. You will see "YOU" on your base. Your base will keep the same colour and the same position on the table in all the scenarios you will encounter.

The basic rules

You and the other participant have the opportunity to agree on a division of the discs.

Each of you separately record which discs you propose to take. We will say that you are **claiming** those discs. You can claim as many (or as few) discs as you want. These claims determine whether there is an agreement or not.

There is an agreement if you have not claimed any of the discs that the other participant claimed, that is, if you and the other participant claimed different discs. In this case, you get all the discs that are yours according to the agreement. You then earn the total value of these discs.

But if **any** disc has been claimed by both you and the other participant, there is no agreement. In this case, you get no discs and so earn nothing from the scenario.

You can claim a disc by clicking on it with your mouse. If you do this, a coloured line connecting the disc to your base will appear on the table. If you have claimed a disc but change your mind and decide you no longer want to claim it, you simply click on it again. The coloured line connecting it to your base then disappears.

In each scenario, you can claim as many discs as you like. You should remember that the other participant will be claiming discs too.

You will not know which discs the other participant has claimed.

When you are happy with the claims you have made in a scenario, you go on to the next scenario by pressing the CONFIRM button.

Your earnings

When you have finished all 12 scenarios, you will be told which of them was selected to determine your earnings. The earnings of you and the participant matched with you in that scenario are determined by the decisions you have made in Stage 2. The Table in that scenario in Stage 2 will appear on your screen again, and this time you will see both the claims you made and the claims made by the other participant. You will not be able to change your claims at this stage.

How much you earn depends on these claims. Remember the rules that determine your earnings:

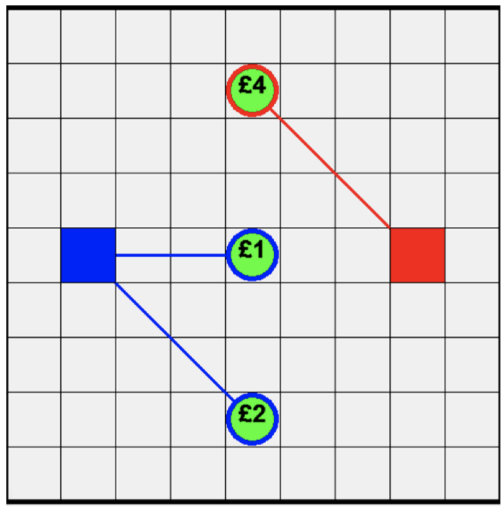
- There is an agreement if you have not claimed any of the discs that the other participant claimed, that is, you and the other participant claimed different discs. In this case, you get all the discs that are yours according to the agreement. You then earn the total value of these discs.

- But if any disc has been claimed by both you and the other participant, there is no agreement. In this case, you get no discs and so earn nothing from the scenario.

We will now show some examples of how these rules work.

Example 1

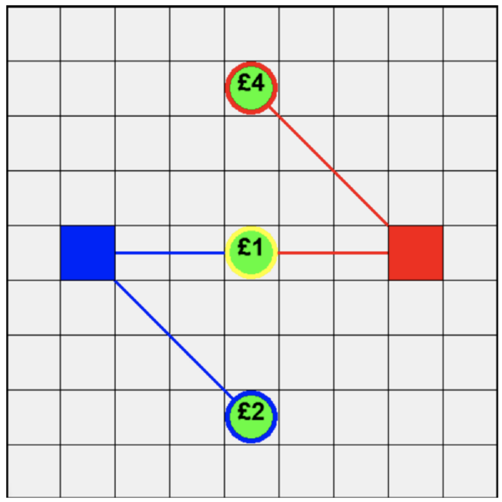
Suppose the Table in the selected Scenario is the one displayed on the screen, and that the Red participant's and the Blue participant's claims are as shown.



In this case, no disc has been claimed by both Red and Blue, and so there is an agreement. According to this agreement, Blue gets the £4 disc, and Red gets the £2 disc and the £1 disc. So Blue earns £4 and Red earns £3 from the Scenario.

Example 2

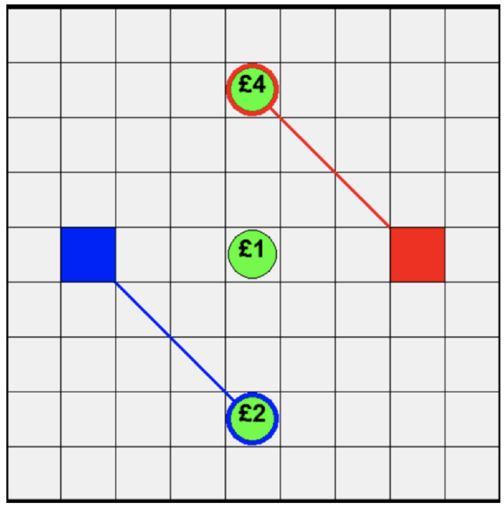
Suppose instead the claims are as now shown. The £1 disc, which is outlined in yellow on the screen, has been claimed by both Red and Blue.



In this case, because the £1 disc has been claimed by both Red and Blue, there is no agreement. So neither participant gets any discs, and so they both earn nothing from the Scenario.

Example 3

Suppose instead the claims are as now shown. Here, no one has claimed the £1 disc.



In this case, no disc has been claimed by both Red and Blue, and so there is an agreement. According to this agreement, Blue gets the £4 disc and Red gets the £2 disc. No one gets the £1 disc. So Blue earns £4 and Red earns £2 from the Scenario.

Your total earnings from the experiment will be given by the earnings from the Scenario selected for payment, as just described, plus a £5 participation payment.

A.3 Treatment SA

Introduction

This is an experiment in the economics of decision-making. If you follow the instructions and make appropriate decisions, you can earn an appreciable amount of money. You will receive your earnings for today's session in cash before you leave the laboratory

It is important that you remain silent and do not look at other people's work. If you have any questions, or need assistance of any kind, please raise your hand and an experimenter will come to you. If you talk, laugh, exclaim out loud, etc., you will be asked to leave and you will not be paid. We expect and appreciate your cooperation.

We will now describe the session in more detail. Please follow along with these instructions as they are read aloud.

Everyone in the room is receiving exactly the same instructions.

You will be presented with twelve (12) different scenarios, one after the other. Each scenario consists of two (2) stages. Everyone in the room will make decisions in the same 12 scenarios. Each scenario is an interaction between two participants. For each scenario, you will be matched with another participant in the room. Each match is anonymous: You will never find out with whom you are matched in a scenario. You will not be matched with the same participant in two consecutive scenarios.

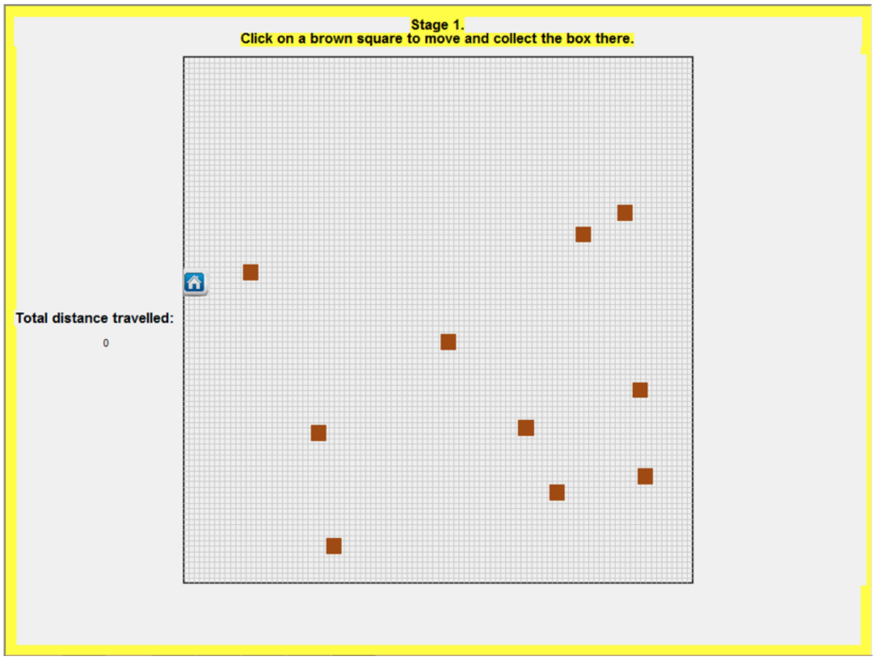
At the end of the experiment, one of the scenarios will be randomly selected to determine the earnings for the session. Because you will not know which scenario will be selected until you have made decisions in all of them, **you should treat each scenario as if it was the selected one.** So, when thinking about each scenario, remember that it could be the selected one and think about it in isolation from the others. Your total earnings for the session will be given by the earnings from the selected scenario, plus a £5 participation payment.

The scenario

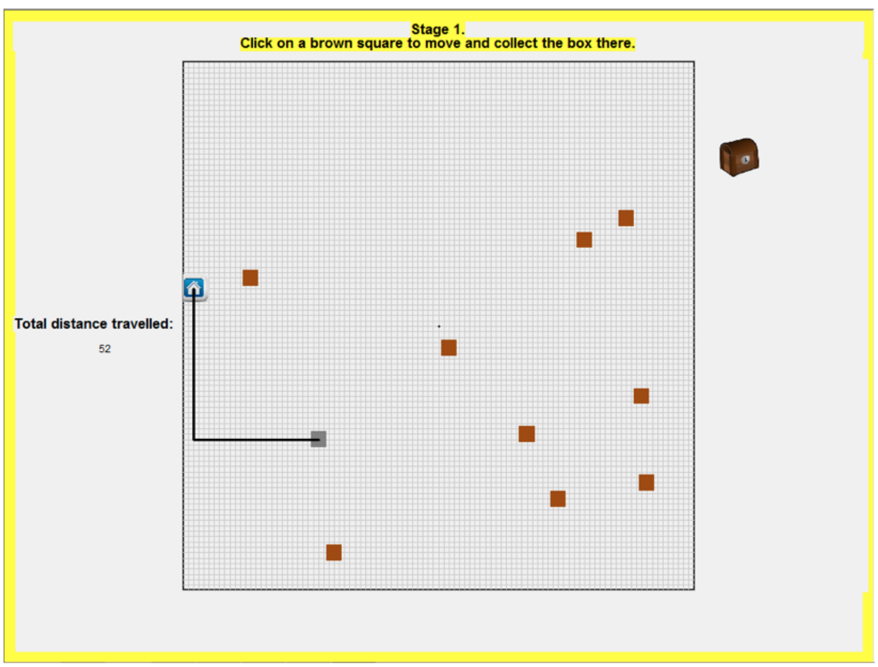
Each scenario consists of 2 stages.

Stage 1

In Stage 1, you will collect ten (10) boxes. These boxes will be placed at 10 different points on a map. Each box is represented by a square. The locations of the 10 boxes will be different in each scenario. Here is an example of a typical map.



You will start from a home location, which will be indicated by a picture of a house. You will move around the map collecting the boxes, and then return to the home location.



After you click on a brown square to collect a box, the collected box will appear as a picture on the right side of the screen.

As you move around the map collecting boxes, the computer will draw the path you take. The locations of boxes which have already been collected will be shown as grey squares; the locations of boxes which still have to be collected will be shown as brown squares.

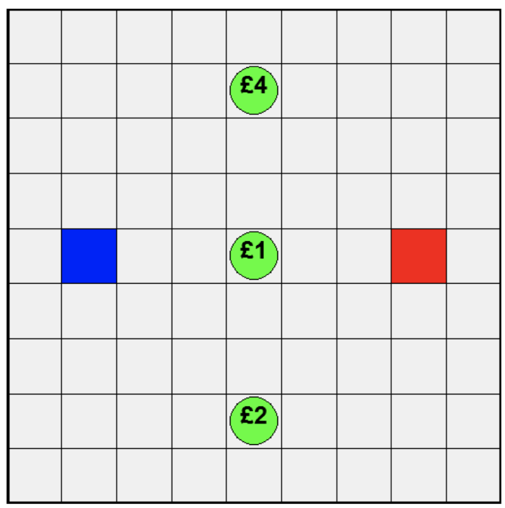
At on the left of the map, the computer will report the total distance travelled by you. After Stage 2 of the scenario, you will see a ranking listing the total distance you travelled, and the distances travelled by other participants in the session. The route with the shortest distance will receive the top rank. You may be able to improve your ranking by thinking ahead. The route with the shortest total distance is not necessarily the one which always moves to the next closest box. Instead, it may sometimes be useful to collect a more distant box first to set up shorter moves later on.

When all 10 boxes have been collected, you will continue on to Stage 2.

Stage 2

At the start of Stage 2, you will be matched with one other participant. You will not be matched with the same other participant in two consecutive scenarios.

Stage 2 of each scenario is represented by a picture like this on your screen.



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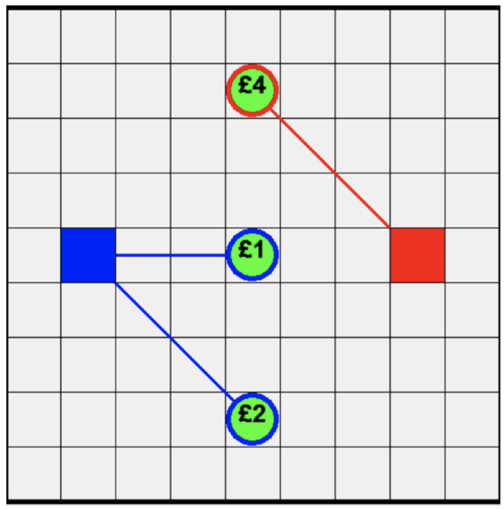

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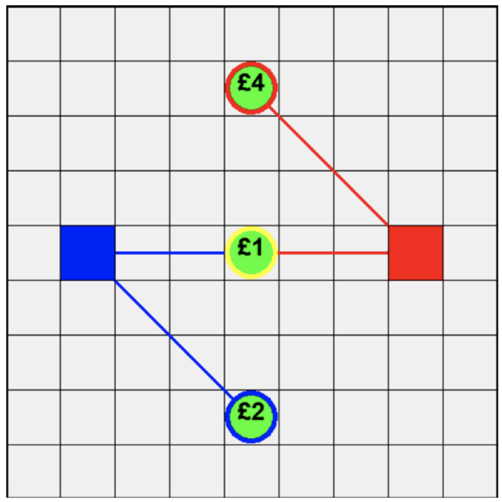

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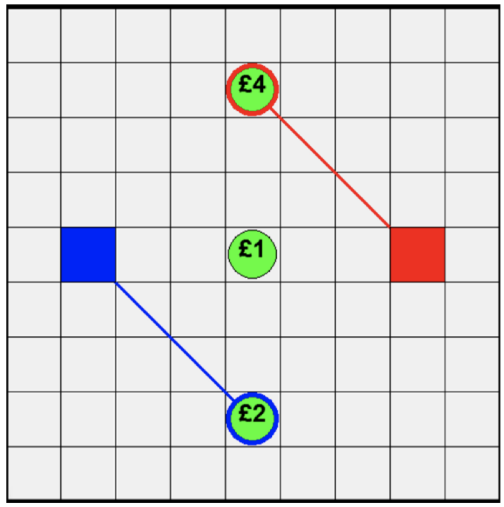

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Your total earnings from the experiment will be given by the earnings from the Scenario selected for payment, as just described, plus a £5 participation payment.

A.4 Post-experiment Questionnaire

For this study, it is helpful for us to know a bit more about you.
Like your decisions in today's session, your responses to these questions will be anonymous.

What is your gender?
- Male
- Female
- Prefer not to say

Your age is:

What is your nationality?

Which school are you registred in?

How many times have you participated in CBESS experiments?:
- Never
- less than 5 times
- 5 to 10 times
- 10 to 20 times
- more than 20 times

Is English your native language?
- Yes
- No
- Prefer not to say

Your current university status is:
- INTO student
- Bachelor student
- PG diploma student
- Master student
- MPhil/PhD student
- Staff
- Other
- Prefer not to say

Please indicate to what extent you would use the term "WE" to characterize you and the person matched with you in each senario.
- not at all
- somewhat inappropriate
- a little inappropriate
- Neutral
- a little appropriate
- somewhat appropriate
- very much so

Confirm

Figure 12: The post-experiment questionnaire

B Maps for the SRT

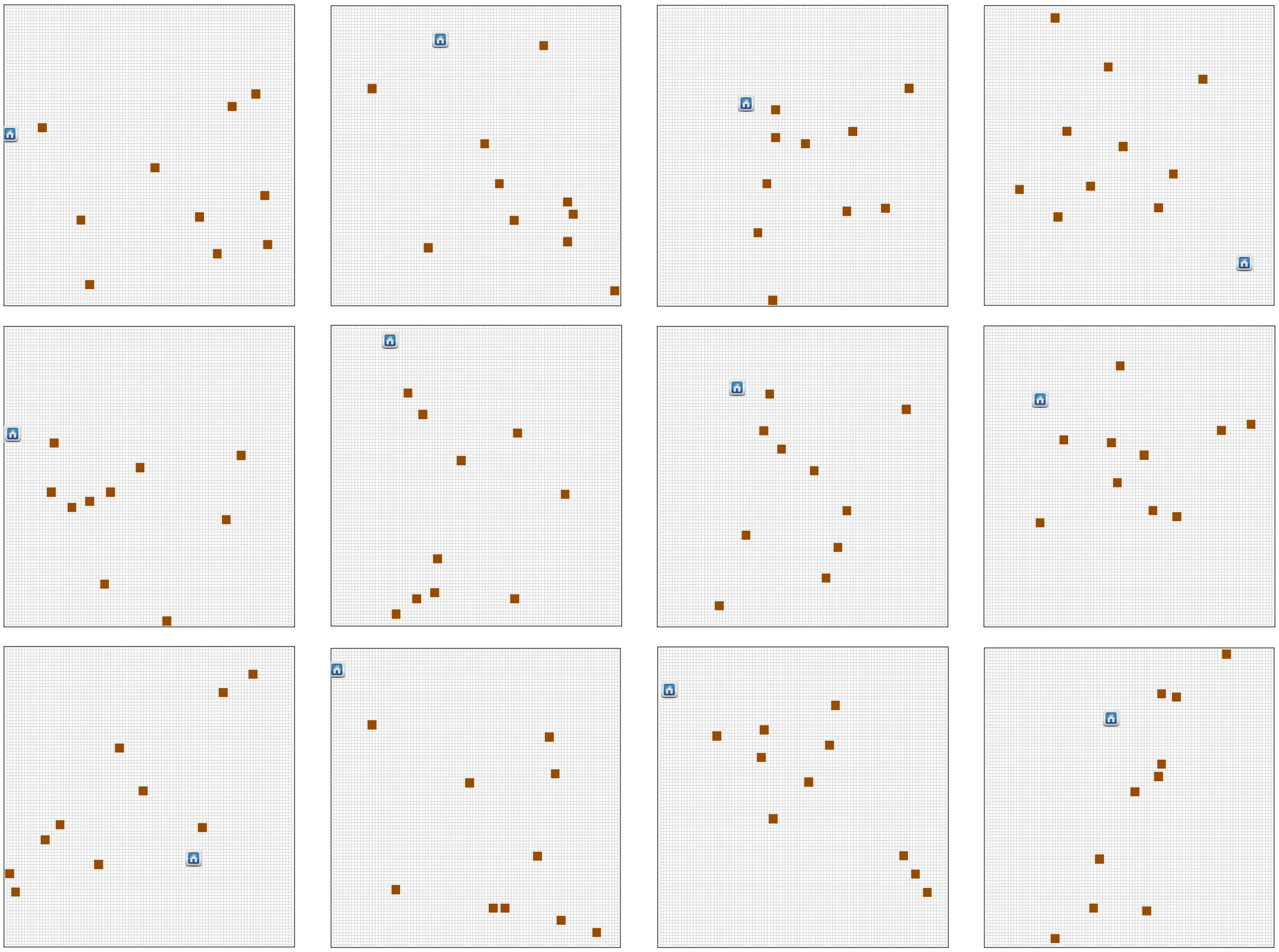

Figure 13: The 12 maps used in the SRT.

C Inequity aversion in the bargaining game

We provide a brief analysis of the set of pure-strategy equilibria in the bargaining game under the assumption that participants are inequity averse. For expositional convenience we will use the functional form proposed by Fehr and Schmidt (1999). However, the qualitative results depend broadly only on the structure of the strategic form of the game, and that players might be averse both to advantageous and to disadvantageous inequity in the material payoffs of the game. The argument and calculations are straightforward and standard.

Let π_i denote the material payoffs of player i. Due to the symmetry of the game, without loss of generality we will focus on the perspective of player 1. A potentially inequity-averse player has a utility function which depends on the material payoffs of the players,

$$v(\pi_1, \pi_2) = \pi_1 - \alpha \max\{\pi_2 - \pi_1, 0\} - \beta \max\{\pi_1 - \pi_2, 0\}.$$

The parameter $\alpha \geq 0$ captures sensitivity to *disadvantageous inequity*, and $\beta \geq 0$ sensitivity to *advantageous inequity*.

We first observe that sufficient aversion to disadvantageous inequity can eliminate any equilibrium with unequal material payoffs. Suppose $\pi_1 < \pi_2 \equiv \Pi - \pi_1$. Note that in this game, starting at a given strategy profile, the only unilateral way to reduce disadvantageous inequity is to make a claim that results in disagreement, and zero material payoffs for both players. Therefore, a strategy profile yielding payoffs $\pi_1 < \pi_2$ can only be an equilibrium if $\pi_1 - \alpha(\Pi - 2\pi_1) \geq 0$, or $\pi_1 \geq \frac{\alpha}{1+2\alpha}\Pi$. Taking the limit as $\alpha \to \infty$, this implies that for sufficiently large inequity aversion only outcomes in which $\pi_1 \geq \frac{1}{2}$ can be an equilibrium. As this applies equally to both players by symmetry, when sensitivity to disadvantageous inequity is strong enough, only strategy profiles leading to material payoffs with $\pi_1 = \pi_2$ survive as equilibria.

Next, we show that sufficient aversion to advantageous inequity can allow inefficient outcomes to become equilibria. Consider an outcome where $\pi_1 \geq \pi_2$ and $\pi_1 + \pi_2 < \Pi$. From this position, if player 1 deviates and claims fewer objects, they lower their material payoff and increase disadvantageous inequity, and so it cannot be a better response to claim fewer objects. Observe that in this situation at least one object must be unclaimed by both players. Suppose player 1 contemplates deviating by claiming additional unclaimed objects worth a total of d in material payoffs. Deviating to this larger claim is not a better response if $\pi_1 - \beta(\pi_1 - \pi_2) > \pi_1 + d - \beta(\pi_1 + d - \pi_2)$, which holds if and only if $\beta > 1$. Therefore, if there is sufficient sensitivity to advantageous inequity, then strategy profiles which "leave money on the table" due to unclaimed objects can be equilibria.