Bargaining over endowments produced by joint activity: Experimental evidence*

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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: C72; C91; C92

JEL Classification Codes: Bargaining; joint production; team reasoning; focal points; experiment.

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

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campaign, they were successful in deposing the Qin, before falling into contention with each other. In 203BC 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.

The Hong Canal may have served 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)

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.

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. As such, the Chu-Han negotiations were a dissolution of a partnership. In dissolving a partnership, 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) and therefore be more likely to coordinate successfully, in particular on 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;[2] however, in their experiment there is still a substantial probability that bargaining fails.[3] 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 notion of "aggressive" bargaining: a bargaining claim is aggressive not because a player demands a larger surplus, but because they claim objects which the focal point recommendation assigns to the other player. It is the reduction in these aggressive claims which improves the bargaining outcomes.

The laboratory setting is useful to isolate the role of prior interaction from other potentially confounding factors. For example, not all partnerships end for reasons which 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

[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 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)

[2] In fact, the focal cues all involve recognising a divide between the objects which recalls the representation of the Hong Canal as the "river" on the Chinese chessboard.

[3] See our re-analysis of their data in Section 4.

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.

Even absent such acrimonious disputes, the details of how prior interaction occurs have been shown to influence bargaining behaviour. 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 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. The most 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.

The rest of this paper is structured as follows. Section 2 formally introduces the framework of the bargaining games we use. Section 3 describes the experimental design. Section 4 enumerates and motivates the main research hypotheses our design is intended to address. Section 5 presents our data and results. Section 6 concludes with a discussion.

2 Theory

2.1 A simultaneous-claim bargaining game

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:

- 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 the sense that all of the possible surplus is realised between the two players.

- The strategy pairs $(\Omega, \emptyset)$ and $(\emptyset, \Omega)$ are weak Nash equilibria that result in agreement and are efficient.

- The strategy pair (Ω, Ω) is a weak Nash equilibrium that results in disagreement.

2.2 Equilibrium selection via focal points

Schelling's theory of focal points accounts for the fact that people often are quite successful at coordination in games with many equilibria, by positing that they look at the instantiation of a coordination problem and determine their strategy based on some of the problem's payoff-irrelevant features which standard game-theoretic analysis discards.

If we restrict attention to the set of outcomes of the efficient Nash equilibria, informally we can think of the players' selection problem as one in which they are attempting to agree on an assignment of the objects between them. Mehta et al. (1994) informally proposed two rules, closeness and accession, for constructing such assignments. Both presuppose that the players recognise a measure "of proximity, or closeness of association" (Mehta et al., 1994, p. 169) which can be applied between a player and an object, and also between pairs of objects. We represent this measure by endowing the set of players and objects $\Omega \cup N$ with a metric $d : (\Omega \cup N) \times (\Omega \cup N) \to \mathbb{R}_+$. We can then state Mehta et al.'s rules more formally.

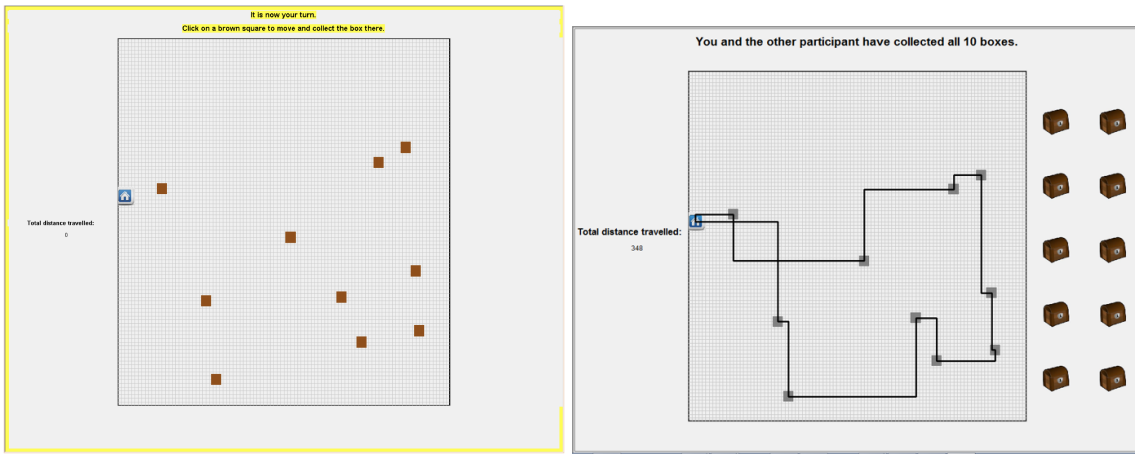
Closeness A straightforward way to construct a candidate focal solution is to divide the objects into based on their distance from the respective players,

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

We say a strategy profile (s_1, s_2) is selected by the rule of *closeness* if it assigns to each player the objects that are closer to that player than to the other player, $(s_1, s_2) = (\sigma_1^C, \sigma_2^C)$.[4]

Accession Closeness can also be applied hierarchically: first the objects can be clustered by closeness to each other, and then those clusters of objects assigned to the players. 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. We say a strategy profile (s_1, s_2) is selected by the

[4]If there is an object $\omega \in \Omega$ such that $d(1,\omega) = d(2,\omega)$, an allocation (σ_1^C, σ_2^C) determined by closeness is not a Nash equilibrium. We avoid this case in selecting scenarios in our experiment.



(a) At the start of the stage (b) A completed route

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

rule of *accession* if it assigns to each player the group closest to that player,

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

3 Experimental design

The experiment consisted of 12 periods. Each period had two stages. Stage 1 was an instance of a *shortest route task* (SRT), followed in Stage 2 by an instance of an (augmented) bargaining scenario.[5] We conducted three treatments, which we label *separate activity* (**SA**), *joint activity* (**JA**), and *joint enterprise* (**JE**). Across treatments, we varied whether the participants in a pair interacted in Stage 1, and whether the Stage 1 and Stage 2 activities were linked.

Each experimental cohort was exposed to only one treatment. Participants in a given cohort were rematched at random in pairs each period. Participant IDs were not used on-screen in the experiment, so the rematching was fully anonymous, and a participant had no way of conditioning their decisions in a period on any previous history of the other participant with whom they were paired.

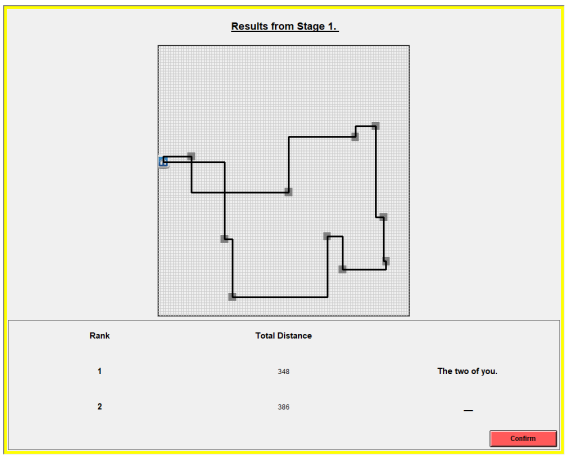


Figure 2: The feedback screen showing how the length of the route found compared to the routes of others in the cohort. Participants saw this at the end of the round, after the bargaining decisions were made.

3.1 Stage 1: The shortest route task (SRT)

Figure 1a shows a typical instance of the shortest route task. There are 10 boxes placed around a map, indicated by the brown squares. The objective is to construct a path to "collect" all 10 boxes. The path starts at the location marked by 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 1b shows the screen after completing the task.

Across treatments we vary how this task is completed. In **SA**, participants completed the task on their own; for each instance the participant constructed their own path to collect all the boxes. In **JA** and **JE**, the participants in each pair completed the task *jointly*, taking turns deciding which box to collect next. One participant in the pair was chosen at random to collect the first box; the other participant then collected the second box, and so on until all the boxes were collected.

The SRT was not incentivised. However, participants were encouraged to find the shortest possible path to collect all the boxes. 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." At the end of the period, after the participants chose their bargaining claims in Stage 2, each participant saw a feedback screen, as in Figure 2, showing the length of the path they (or their pair) followed, and how it compared to the length of the paths taken by the other participants/pairs in their cohort.

The optimisation problem of finding the shortest path to collect all the boxes is commonly

[5]We provide full instructions in Appendix A. The instructions include several screenshots which illustrate some of the mechanical details of both stages.

known as the traveling salesman problem. Previous studies of individual performance on the traveling 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 significantly in skill at the task.

These characteristics make this task well-suited to our research question and design. We require a task that allows for participants to have an interaction on a nontrivial task. However, as our objective is to study behaviour in the bargaining scenarios, the task itself should not be incentivised. The quality of paths found in the previous studies suggests that the intrinsic motivation to try to find a short path is enough to engage most people. The fact that people do not always find the same path indicates that different people will have different strategies for constructing the paths; this provides a source of potential tension between two participants who are paired to construct a path by taking turns, without other means of communication.

3.2 Stage 2: The bargaining game

We represented the augmented bargaining scenarios using the "bargaining table" format of Isoni et al. (2013). Figure 3 shows the 12 scenarios used in our experiment. We referred to the objects being bargained over as *discs*, which were arranged on a 9-by-9 grid. The players are represented by squares, coloured red and blue respectively, which we referred to as the respective players' *bases*. The colour of a participant's base was the same throughout the session, and the table was always shown from the perspective in which the participant's base is at the left of the screen.

These games were designed by Isoni et al. such that applying the criteria of closeness or accession as previously defined yields a unique selection from the set of efficient pure-strategy equilibria. Following Isoni et al. we refer to the scenarios with a mnemonic system that summarises the layout of the disks and indicates the selected allocation. 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 equilibrium which results

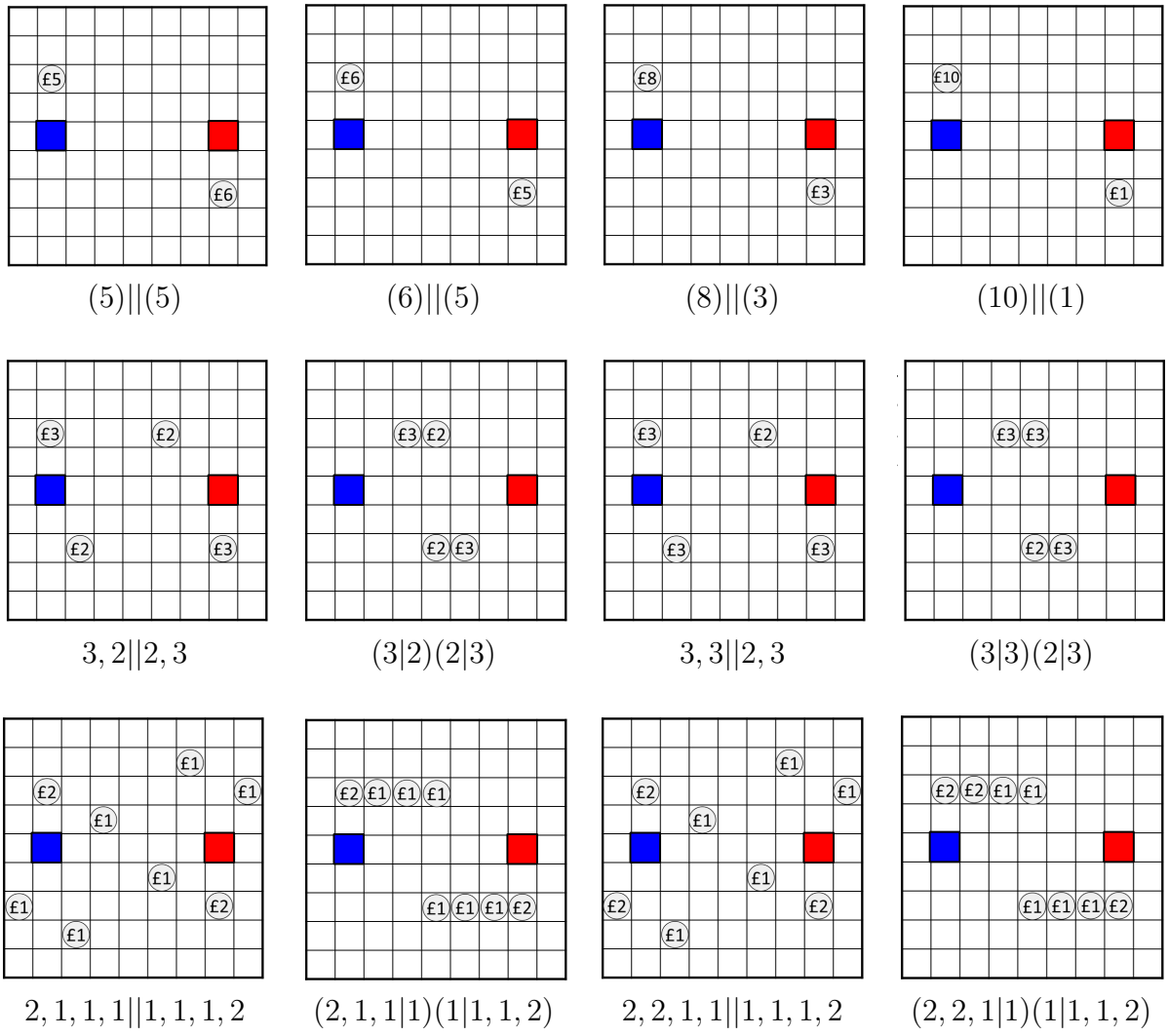


Figure 3: The 12 augmented bargaining scenarios used in the experiment.

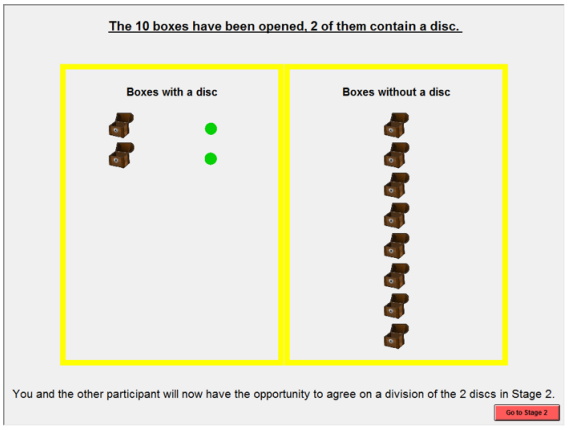


Figure 4: The interstitial screen linking Stage 1 and Stage 2 in **JE** only.

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. In all tables, the focal point recommendation assigns each disc either to one player or to the other.

Participants indicated their claims by clicking on discs in the interface. All discs were initially marked as unclaimed. 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 before confirming. Participants made their claims simultaneously, without seeing the claim being made by the other participant with whom they were paired.

3.3 Connecting the stages

Treatment **SA** differs from **JA** and **JE** in that the pair of participants interacted in both the SRT and the bargaining game in **JA** and **JE**, while in **SA** participants completed the SRT individually prior to the bargaining stage.

Our objective is to isolate the effects of joint activity on bargaining claims. On the one hand, previous research has demonstrated that linking the surplus to be bargaining over to the previous activity can generate entitlement effects, which we want to avoid. On the other hand, people may not make a link between the prior activity and the bargaining if there is no connection between the two.

We use a minimal manipulation to distinguish **JE** from **JA**. The only difference between the treatments is the insertion of a screen, as in Figure 4, between Stages 1 and 2. On this screen, the 10 boxes are "opened"; participants are told that some boxes would contain a disc while the others would be empty. 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 contained a disc; the screen does

not indicate the order in which the boxes were collected, nor by whom. We therefore provided an explicit connection between the activities, while doing so in a way that participants could not propose to divide discs using entitlements based on who collected the box with the disc in it. Because we make this connection more explicit, we expect *a priori* that treatment effects will be stronger in **JE** than **JA**.

3.4 Session details

The experiment was 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, and 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.

Hypothesis 1 (Bargaining success). *Participants will be more successful in bargaining in **JE** than **JA** than **SA**, as measured by higher earnings and lower rates of conflict.*

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 *why* bargaining success rates are not high 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. In Isoni et al., in each scenario the claim indicated by the focal

Scenario	Surplus		% Disagreement
	Available	Realised	
$(5)\|\|(5)$	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.[6] The focal point claim is also almost always the empirical best reply to the distribution of claims in their data.[7] 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 conflict 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 being "aggressive". This notion of aggressiveness is different from a notion based solely on the value of claims; the total value of discs claimed in an aggressive claim need not be larger than the value of those in the focal point claim. Complementary to aggressive claims, we define a claim as "cautious" if it is not aggressive, and also leaves out at least one disc which is present in the focal point claim. A player might be motivated to make a cautious claim if they anticipate an aggressive claim by the other player, as leaving a disc unclaimed eliminates the possibility of bargaining failure based on a conflict on that disc.

[6]The unfavoured players in $(10)||(1)$ split evenly between the focal point suggestion of claiming the disc worth 1, and the aggressive claim of the disc worth 10. In all other scenarios the focal point strategy is the unique mode.

[7]Again the exception is $(10)||(1)$, in which unfavoured players are actually better off claiming the disc worth 10 than claiming the disc worth 1.

Scenario	Role	Percentage of claims			Claim value	
		Aggressive	Focal point	Cautious	Average	Focal point
$(5)\|\|(5)$		8	91	1	4.95	5
$(6)\|\|(5)$	Favoured	24	76	0	5.44	6
	Unfavoured	20	78	2	5.36	5
$(8)\|\|(3)$	Favoured	36	64	0	5.96	8
	Unfavoured	40	60	0	5.66	3
$(10)\|\|(1)$	Favoured	34	64	2	7.48	10
	Unfavoured	50	50	0	7.50	1
$3,2\|\|2,3$		15	64	21	4.51	5
$3,3\|\|2,3$	Favoured	28	58	14	4.84	6
	Unfavoured	32	52	16	4.72	5
$(3\|2)(2\|3)$		41	43	16	4.37	5
$(3\|3)(2\|3)$	Favoured	54	36	10	4.82	6
	Unfavoured	42	36	22	4.76	5
$2,1,1,1\|\|1,1,1,2$		23	48	29	4.31	5
$2,2,1,1\|\|1,1,1,2$	Favoured	16	50	34	4.54	6
	Unfavoured	32	44	24	4.64	5
$(2,1,1\|1)(1\|1,1,2)$		21	61	18	4.21	5
$(2,2,1\|1)(1\|1,1,2)$	Favoured	34	50	16	4.56	6
	Unfavoured	28	48	24	4.38	5

Table 2: Analysis of claims in Isoni et al. (2013). The first three columns give the percentages of claims which were aggressive, 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.

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 aggressive 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 aggressive claims in **JE** than **JA** than **SA**. The participants' claimed values will be closer to the focal point recommendation in **JE** than **JA** than **SA**.*

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**). ***JA** and **JE** will reduce aggressive 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 an important check as, if it is not refuted, we can attribute variation in team performance on the SRT in **JA** and **JE** principally to the nature of the interaction between team members. Furthermore, the alternating-moves design in **JA** and **JE**, and the absence of a link between specific boxes and the discs on the bargaining table, limit the scope for prior entitlements. Nevertheless, in order for the prior activity to be genuine and meaningful, there must be some chance that a given pair might have a bad experience, for example, if they have two very different conceptions of what the best route is in a given SRT.

There is therefore an aspect of coordination inherent in producing a relatively good solution to the SRT. The participants who completed the SRT in pairs had no means of communication other than via their alternating moves. With no other channels to coordinate, we would expect that pairs will not do as well on average in the SRT as individuals do. However, some pairs are likely to be more successful than others at achieving at least some coordination. If two people start a given SRT map with similar ideas as to what the best route looks like, it is likely that, as they alternate moves, the move each one makes will be compatible with the plan the other has in mind, and therefore the overall performance of the pair will be relatively good. On the other hand, two players who have different ideas as to which route to take may tend to work at cross purposes. A sign of this in the data will be a route that is longer, as one player deviates from the path the other one intends. Longer paths are therefore likely symptomatic of interactions between pairs which go less well. It is plausible that pairs who produce shorter routes are more likely to think of themselves as a team, and therefore be more likely to adapt their bargaining claims accordingly. With this in mind, we use the data from the SRT in **JA** and **JE** to construct a measure of the quality of the prior interaction.

Hypothesis 5 (**Team-building**). *In general, teams (**JA** and **JE**) will perform less well on the SRT than individuals (**SA**). Participants in pairs that perform better in the SRT will be less likely to make aggressive claims.*

5 Results

In **JA** and **JE** there were 20 independent cohorts each, with a total of 80 participants in each treatment. In **SA** there were 17 independent cohorts, with a total of 96 participants. As there was no interaction between participants in different cohorts, when conducting our nonparametric tests we use the cohort as the unit of independent observation. 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.

When conducting Mann-Whitney-Wilcoxon (MWW) tests between two treatments, we report the effect size r. We write a test between treatments x and y as $MWW(x, y)$. For $MWW(x, y)$, r reports 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.

Result 1 (**Bargaining success**). *Prior interaction increases bargaining success. Bargaining scenarios after prior interaction 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 (MWW(**SA**,**JA+JE**), $p = .049$, $r = .33$). Whether the interaction did or did not link the SRT task to the endowment does not make a difference to realised surplus (MWW(**JA**,**JE**), $p = .50$, $r = .56$). The higher realised surplus is driven principally by fewer bargaining games resulting in disagreement after interaction (MWW(**SA**,**JA+JE**), $p = .083$, $r = .65$), and not by changes in the total values of discs being claimed (MWW(**SA**,**JA+JE**), $p = .99$, $r = .50$). □

Following our classification in Section 4, Table 4 summaries across treatments the proportions of claim strategies which are aggressive or cautious. We also report the mean distance from the focal claim. To compute this for a cohort, 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. Figure 6 plots the distribution of these measures cohort-by-cohort.

Result 2 (**Claim characteristics**). *The improved bargaining performance after prior interaction is*

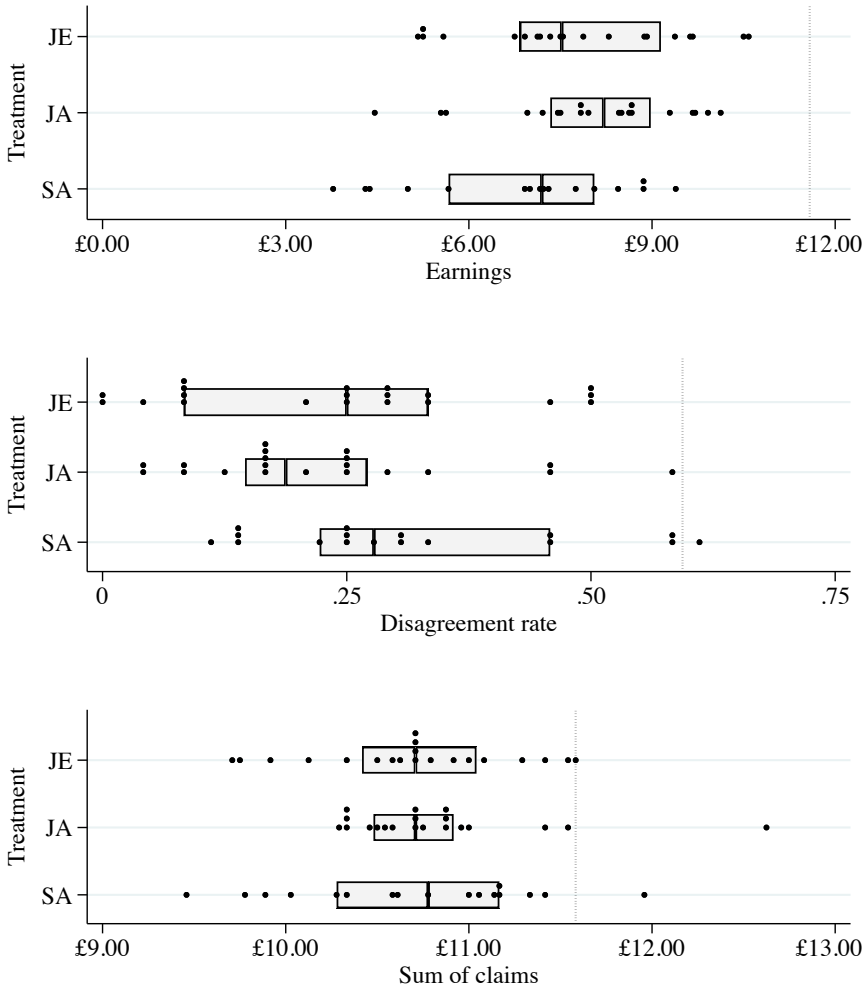


Figure 5: Measures of bargaining performance. Each dot represents a cohort. The boxes represent the interquartile range. The vertical lines in surplus and claims represent the maximum attainable earnings.

driven by a reduction in aggressive claims, and not by changes in the frequency of cautious claims nor of claim values.

Support. Aggressive claims are more frequent in **SA** than in cohorts with prior interaction (MWW(**SA**,**JA+JE**), $p = .014$, $r = .71$), while the frequency of cautious claims is unchanged (MWW(**SA**,**JA+JE**), $p = .28$, $r = .61$). There are no differences between **JA** and **JE** in the frequency of either aggressive (MWW(**JA**,**JE**), $p = .79$, $r = .48$) or cautious (MWW(**JA**,**JE**), $p = .90$, $r = .49$) claims.

We have two ways of quantifying differences in claim values. We can look at absolute claim sizes overall, as reported in Table 3; there is no difference between individual and prior interaction treatments (MWW(**SA**,**JA+JE**), $p = .99$, $r = .50$). Alternatively, using the distance from

	Claim types		Distance from focal
Treatment	% Aggressive	% Cautious	Mean
SA	22.3%	7.0%	£1.18
JA	14.2%	5.0%	£1.08
JE	14.5%	7.3%	£1.17

Table 4: Properties of claim strategies, by treatment.

focal measure reported in Table 4, there is no difference between individual and prior interaction treatments (MWW(**SA**,**JA+JE**), $p = .42$, $r = .66$). □

	Realised surplus			% Disagreement			% Aggressive		
	Symmetric			Symmetric			Symmetric		
Treatment	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.

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 aggressive 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 aggressive 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 aggressive 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 aggressive claims (MWW(**SA**,**JA+JE**), $p = .71$, $r = .47$), the disagreement rate (MWW(**SA**,**JA+JE**), $p = .97$, $r = .50$), nor the realised surplus (MWW(**SA**,**JA+JE**), $p = .92$, $r = .49$). □

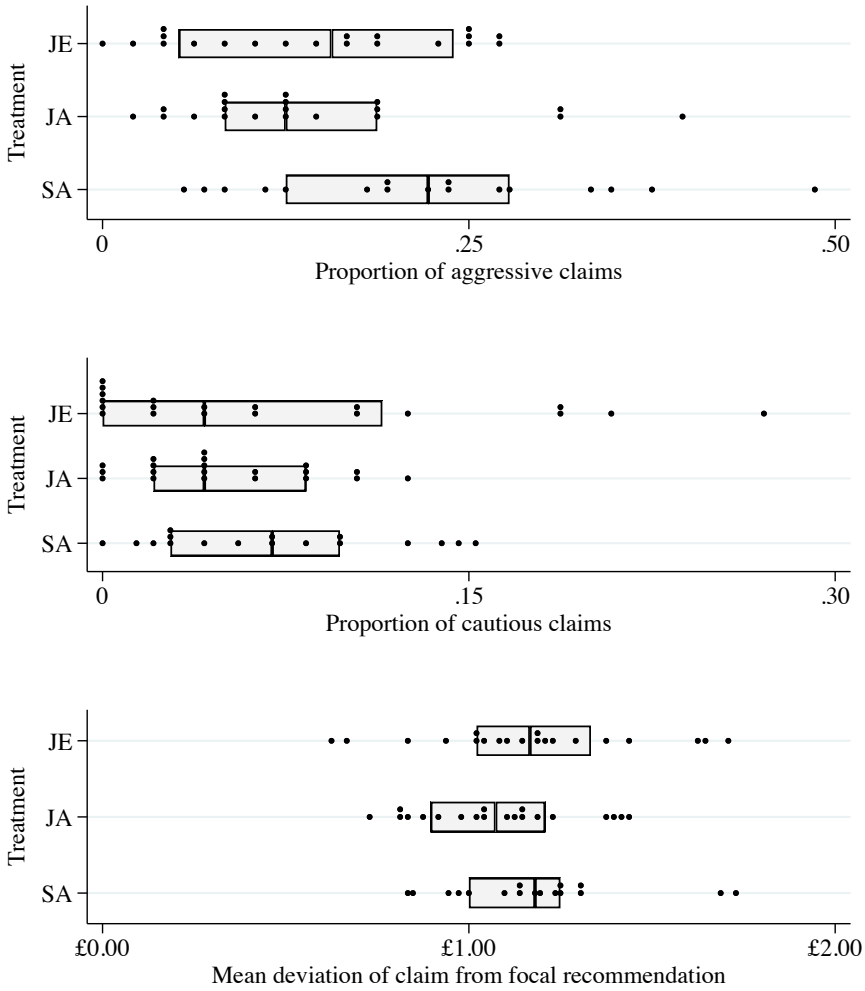


Figure 6: Properties of claim strategies. Each dot represents a cohort. The boxes represent the interquartile range.

We note that this result seems particularly surprising given that in Isoni et al. and in our **SA** data, there were more aggressive 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 an analysis of the SRT task, with a specific interest in whether performance on the task predicts the likelihood of following the focal point suggestion. The shortest path in each of the 12 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 of the three treatments. For each map we measure performance by the additional distance taken beyond the shortest route;

	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**.

therefore, 0 is the best possible score and lower scores are better.

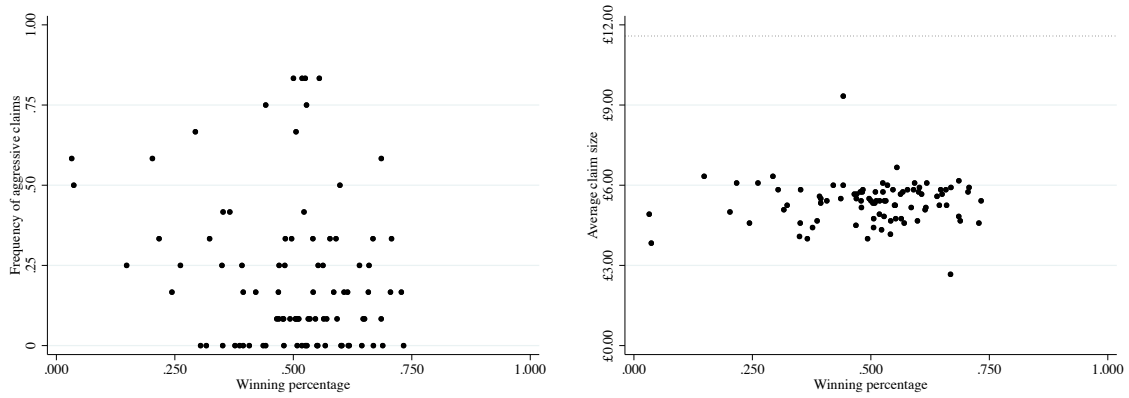
The possible scores on each map are discrete, and are distributed differently, in that some maps have several routes which are close to the optimal length while others do not. Therefore comparisons of the magnitudes of path lengths across different maps do not have a straightforward interpretation. We 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

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

The overall winning percentage for participant p is then the average across all maps,[8]

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

[8]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 $q \neq p$.



(a) Correlation with aggressive claims

(b) Correlation with claim size

Figure 7: Correlation between participant winning percentage, and aggressive claims and claim size, in **SA**. Each dot represents one participant. The solid line is the simple linear regression fit of the data. The dashed line in claims represents the maximum possible, achieved by claiming all discs in all scenarios.

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 aggressive claim. Figure 7 provides a scatterplot of the data. We find no correlation between participants' ranking by $W(p)$ and their count of aggressive claims (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 $\rho = 0.07$, $p = 0.50$). □

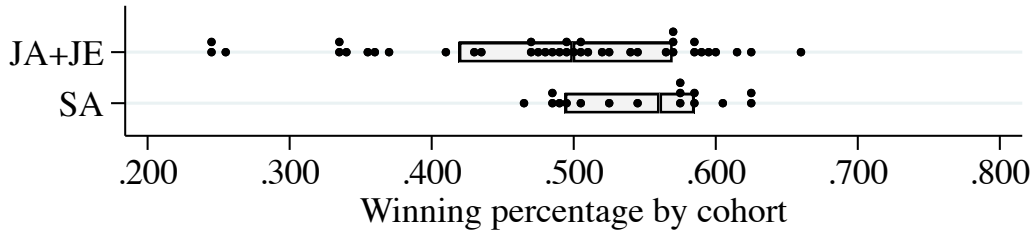


Figure 8: Dotplot of cohort winning percentages. Each dot represents one cohort; winning percentages are stacked in bins of width .005. The boxes show the median and interquartile range.

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

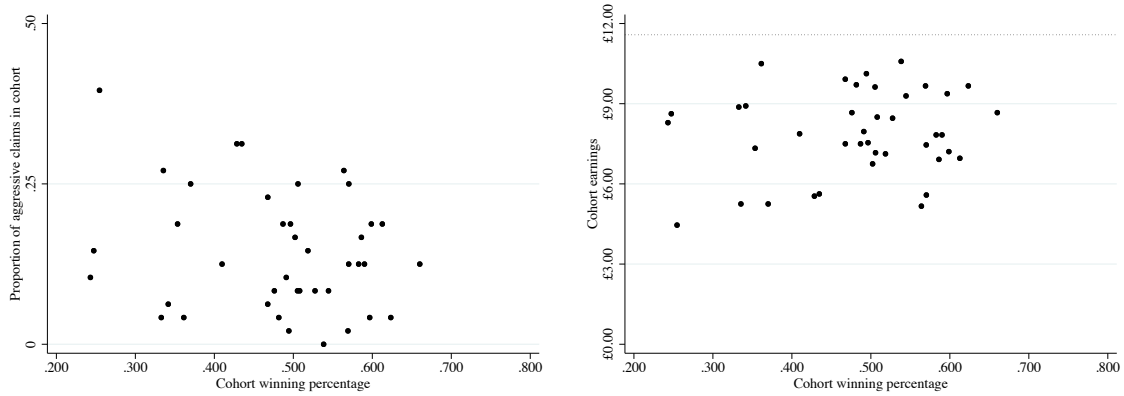
SA and the treatments with prior interaction, we modify the round-robin winning percentage idea from (2) to respect the cohort as the unit of independent observation. Let $R(m, c)$ denote the set of paths constructed on a map m in a cohort c. Then, we write the winning percentage of a cohort c against a cohort d as

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

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,

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

Figure 8 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, or lack thereof, on the SRT influences bargaining performance.



(a) Correlation with aggressive claims

(b) Correlation with earnings

Figure 9: Correlation between cohort winning percentage, and aggressive claims and earnings, by cohort in **JA** and **JE**. Each dot represents one cohort. The solid lines are the simple linear regression fits of the data. The dotted line in earnings represents the maximum feasible earnings for a cohort.

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 aggressive claims nor its earnings.*

Support. To show that paths in **SA** are shorter, for each cohort c we compute $W(c)$ as in (4). We find that $W(c)$ values are higher in **SA** than in treatments with prior interaction (MWW(**SA**,**JA+JE**, $p = .040$, $r = .677$).

Focusing on treatments with prior interaction, in Figure 9 we provide scatterplots comparing a cohort's winning percentage with its proportion of aggressive claims and with its earnings. We cannot reject the null hypothesis of no correlation between winning percentage and the proportion of aggressive claims (Spearman's $\rho = -.13$, $p = .41$) not the null hypothesis of no correlation between winning percentage and earnings (Spearman's $\rho = .054$, $p = .74$). □

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 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.

Our design highlights the *coordinating* aspect of the prior interaction on the bargaining claims. In the bargaining table scenarios, the principal reason for bargaining failure – both in **SA** and in Isoni et al. (2013) – is not that people claim *too much*, but that they claim the *wrong things*. With prior interaction, aggressive claims decrease. Our preferred explanation for this is that people are more likely to identify as a team after the prior activity. Our experimental design allows us to rule out some competing explanations.

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.

Standard game-theoretic reasoning would account for the decrease in aggressive claims after prior interaction by positing people more frequently have (more) correct beliefs about the claims others will make. The observed claims then would imply that people are more likely to anticipate that others in their cohort are likely to play the focal point. Participants in **JA** and **JE** have no interaction within their cohort except via the SRT; in particular they receive no feedback on any of the bargaining games during the course of the experiment. If people are in fact more likely to believe others will make the claim recommended by the focal point strategy, this must be arising because people believe the person they are matched with is more likely to be thinking of the pair as a team.

Theories of other-regarding preferences might posit that after a team-building exercise, people are more likely to care about the earnings of the other person, and that this channel would result in a greater probability of bargaining success. The bargaining table framework is useful because of the distinction it allows us to draw between claims which are aggressive in monetary terms versus those which are aggressive in territorial terms. Our data show that the difference arising after prior interaction are attributable primarily to which discs are claimed and not the total value of those discs. It is not the case that people claim less of the surplus for themselves after prior interaction, as would be suggested by other-regarding preferences.

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.

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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.

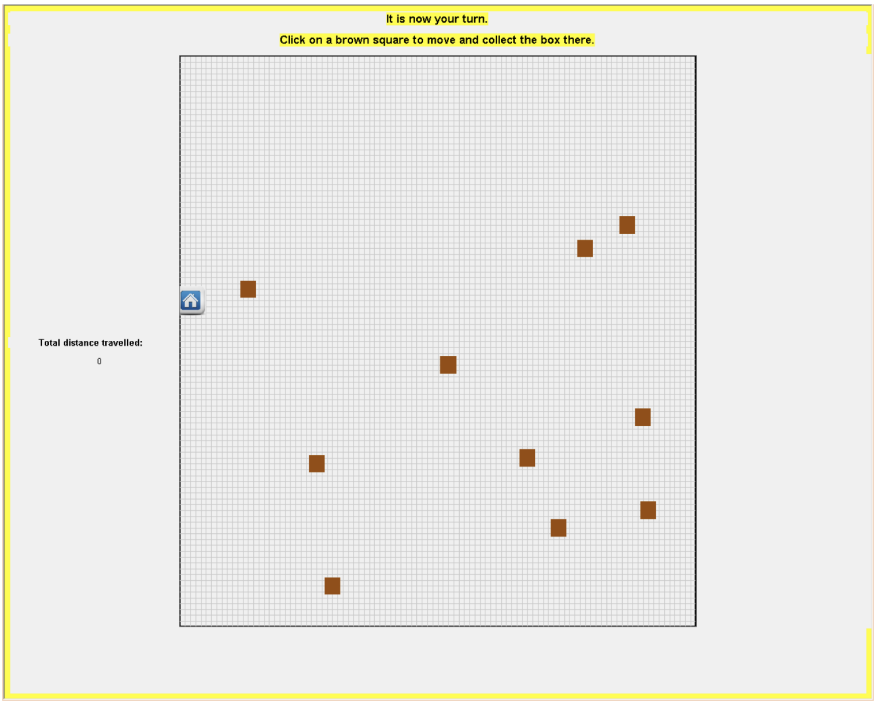
The scenario

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

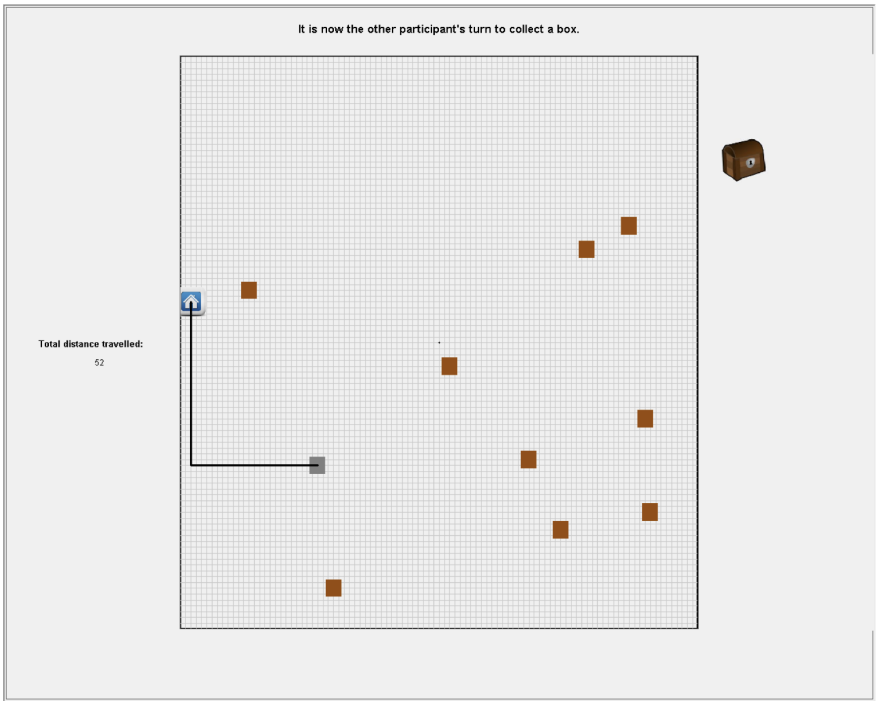
In Stage 1, you and the other participant with whom you are matched will collect ten (10) boxes. Each box either contains one disc, or is empty. Discs are worth various amounts of money. In Stage 2 of the scenario, you and the other participant will have the opportunity to agree on a division of the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

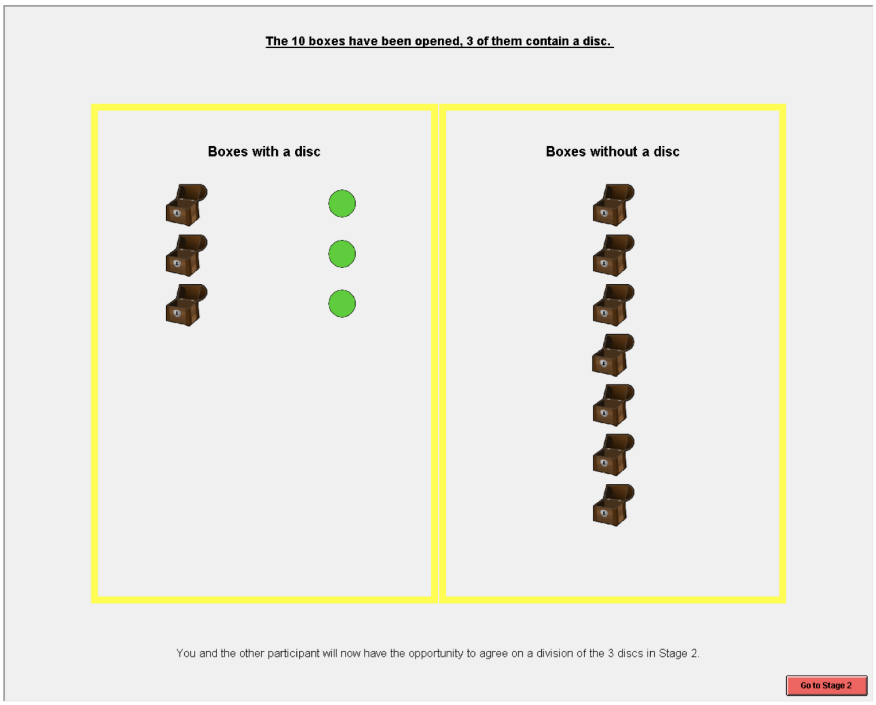


As the two of you move around the map collecting boxes, the computer will draw the path the two of you take. The locations of boxes which have already been collected will be shown as grey squares; the

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.

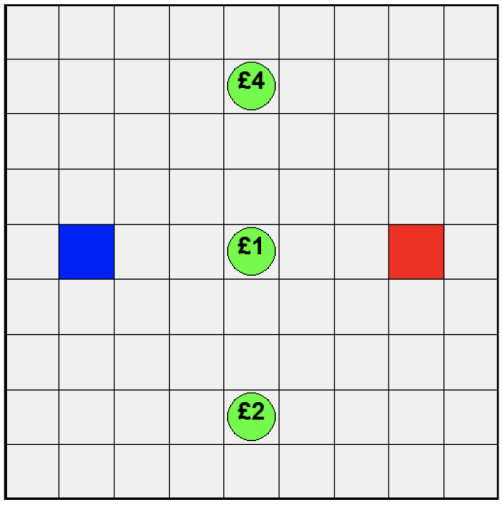
After the two of you have collected all 10 boxes, the boxes will be opened. Some boxes will be empty, and some will contain a disc.



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.

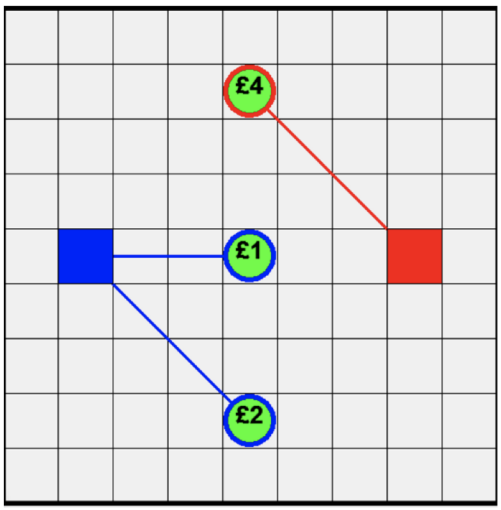
How much you earn depends on these claims. Remember the rules that determine your earnings:

- 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

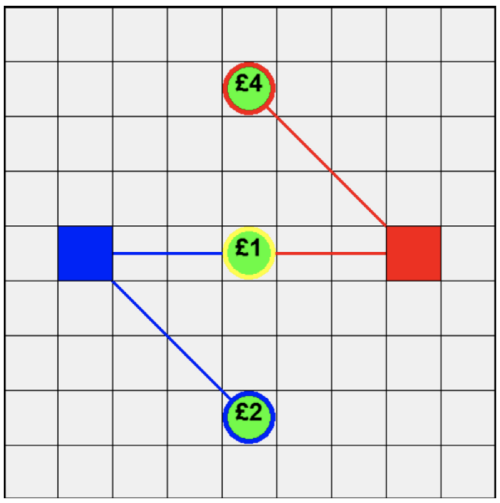
Suppose the Table in the selected Scenario is the one displayed on the screen, and that the Red participant's and the Blue participant's claims are as shown.



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

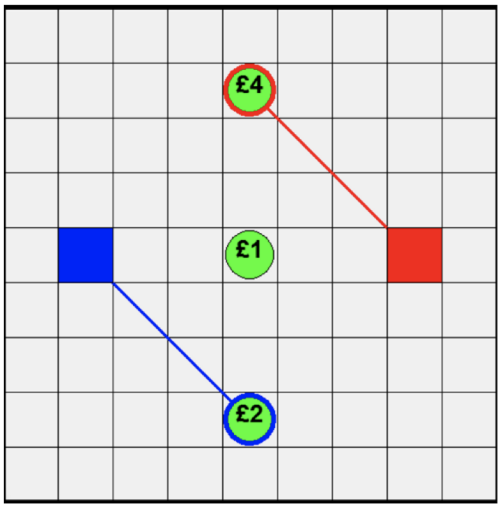
Suppose instead the claims are as now shown. The £1 disc, which is outlined in yellow on the screen, has been claimed by both Red and Blue.



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

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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.

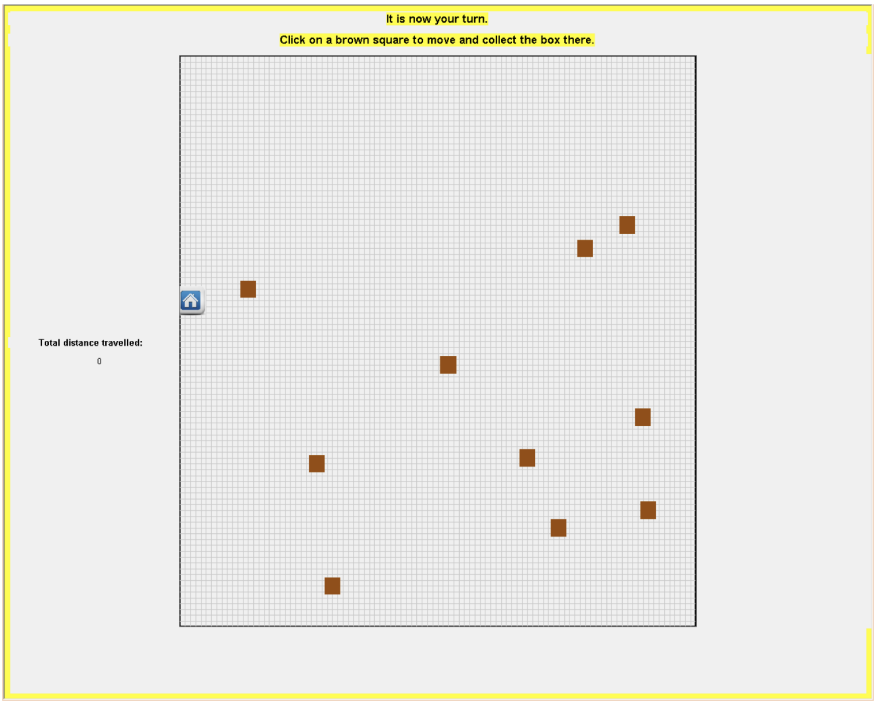
The scenario

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

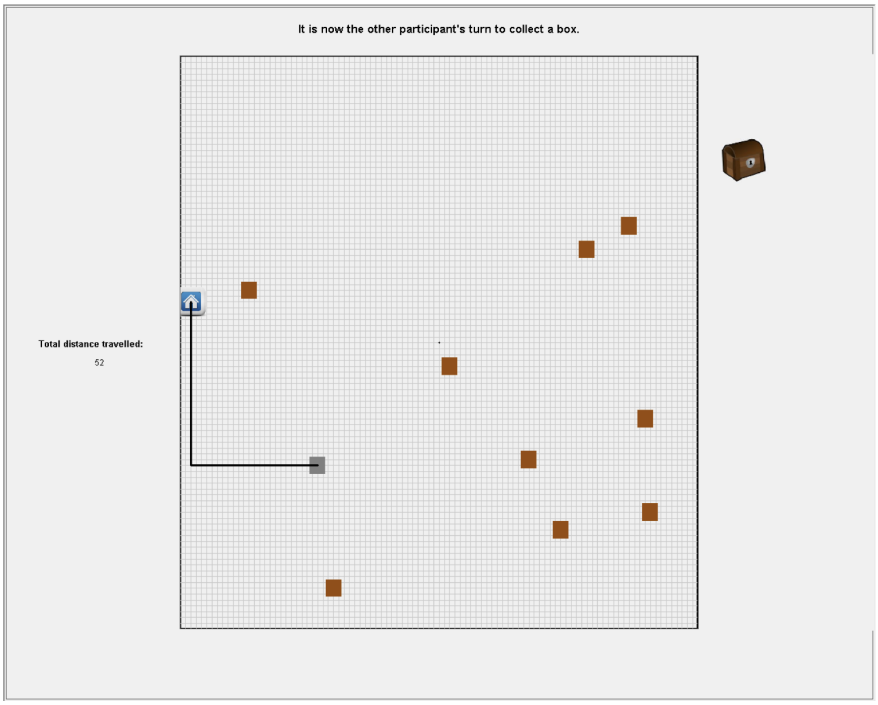
In Stage 1, you and the other participant with whom you are matched will collect ten (10) boxes. These boxes will be placed at 10 different points on a map. Each box is represented by a square. The locations of the 10 boxes will be different in each scenario.

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

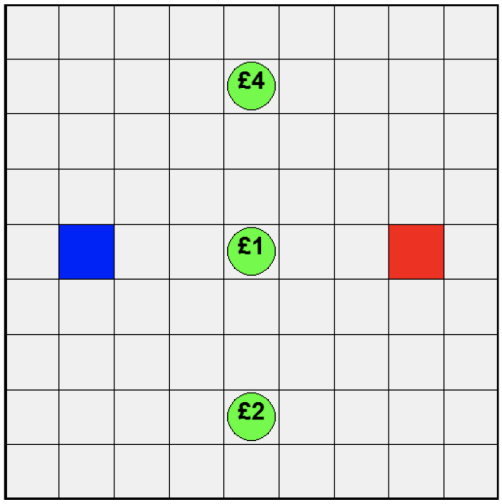
locations of boxes which still have to be collected will be shown as brown squares. As there are 10 boxes to be collected, you and the other participant will each collect 5 boxes.

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.



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

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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.

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

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Your earnings

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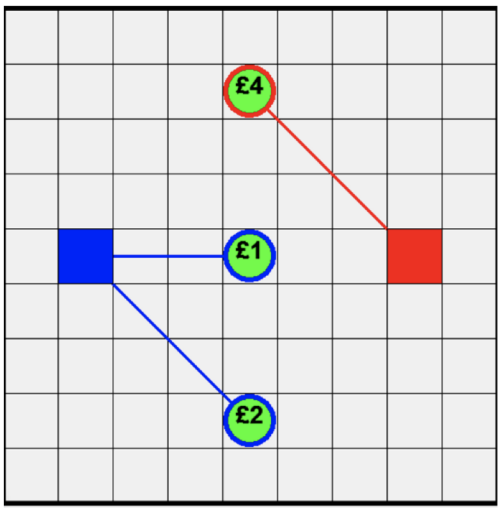

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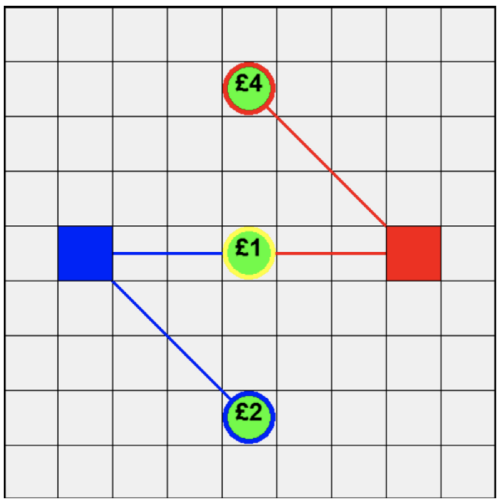

In this case, because the £1 disc has been claimed by both Red and Blue, there is no agreement. So neither participant gets any discs, and so they both earn nothing from the Scenario.

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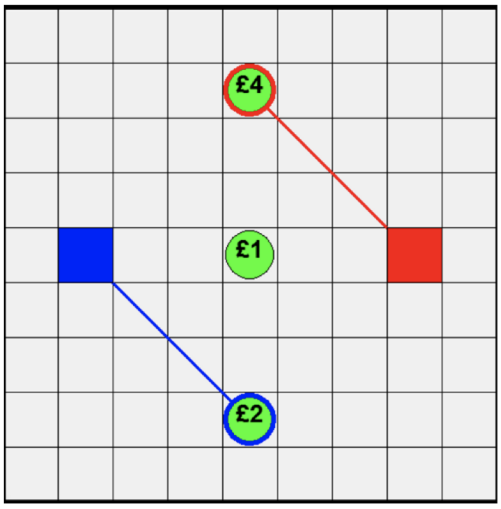

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A.3 Treatment SA

Introduction

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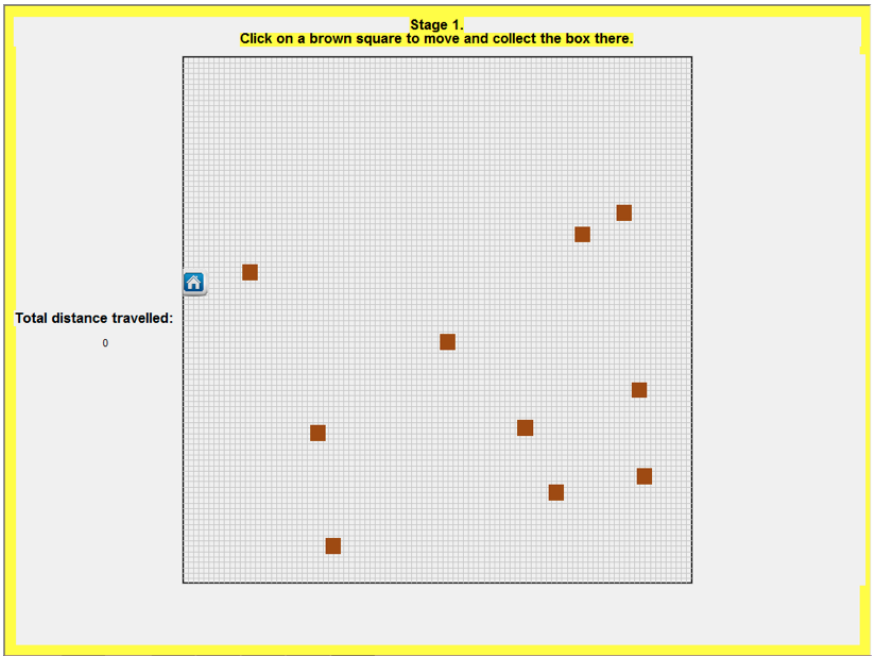
The scenario

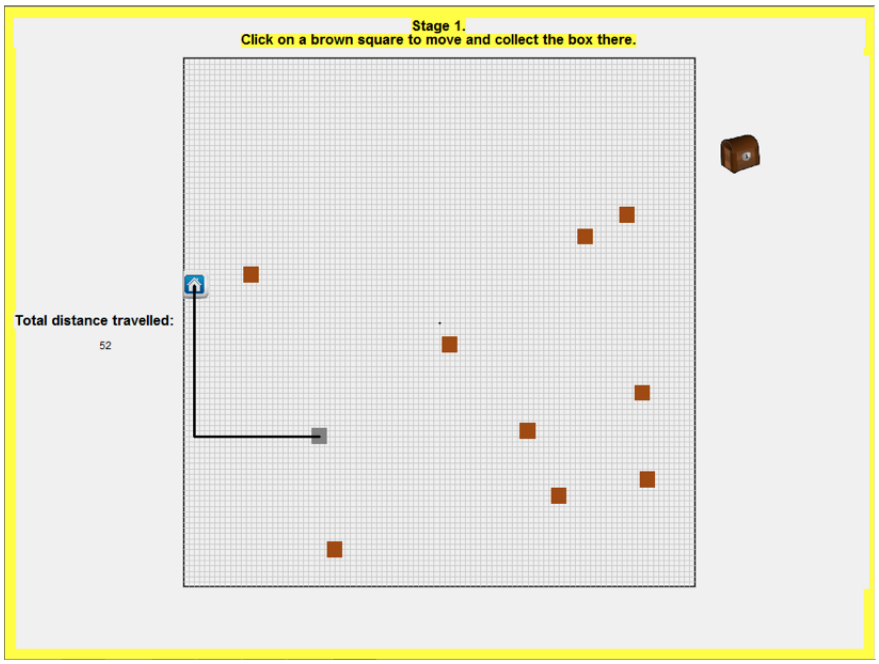
Each scenario consists of 2 stages.

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

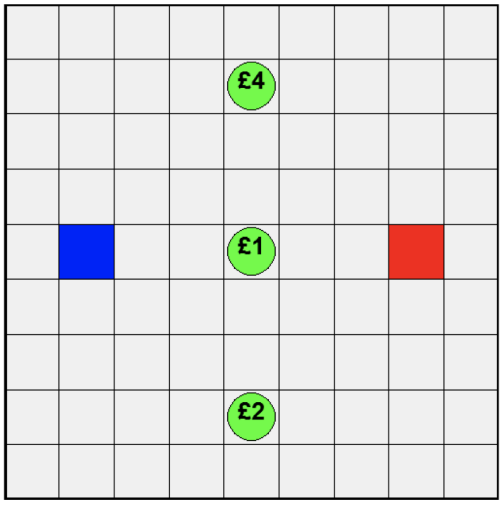
other participants in the session. The route with the shortest distance will receive the top rank. You may be able to improve your ranking by thinking ahead. The route with the shortest total distance is not necessarily the one which always moves to the next closest box. Instead, it may sometimes be 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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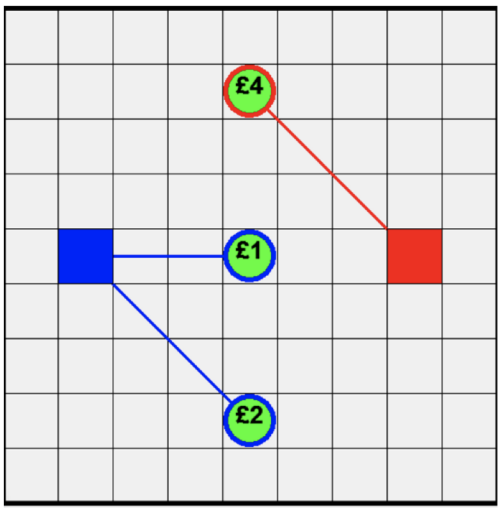

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Example 2

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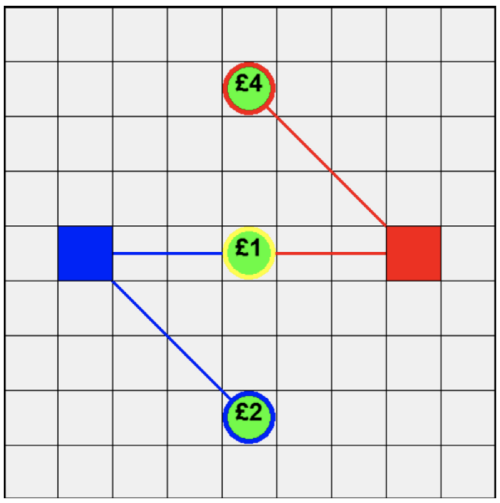

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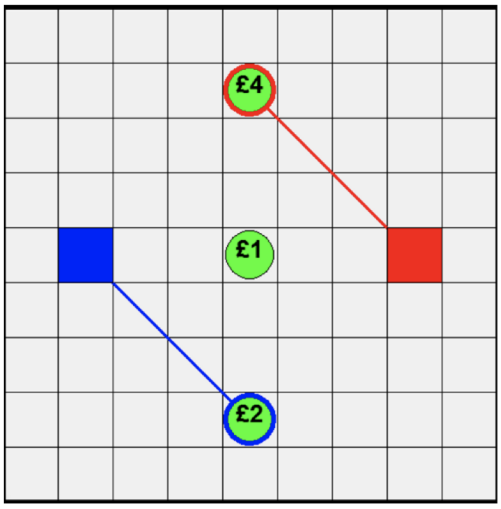
Example 3

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.

B Maps for the SRT

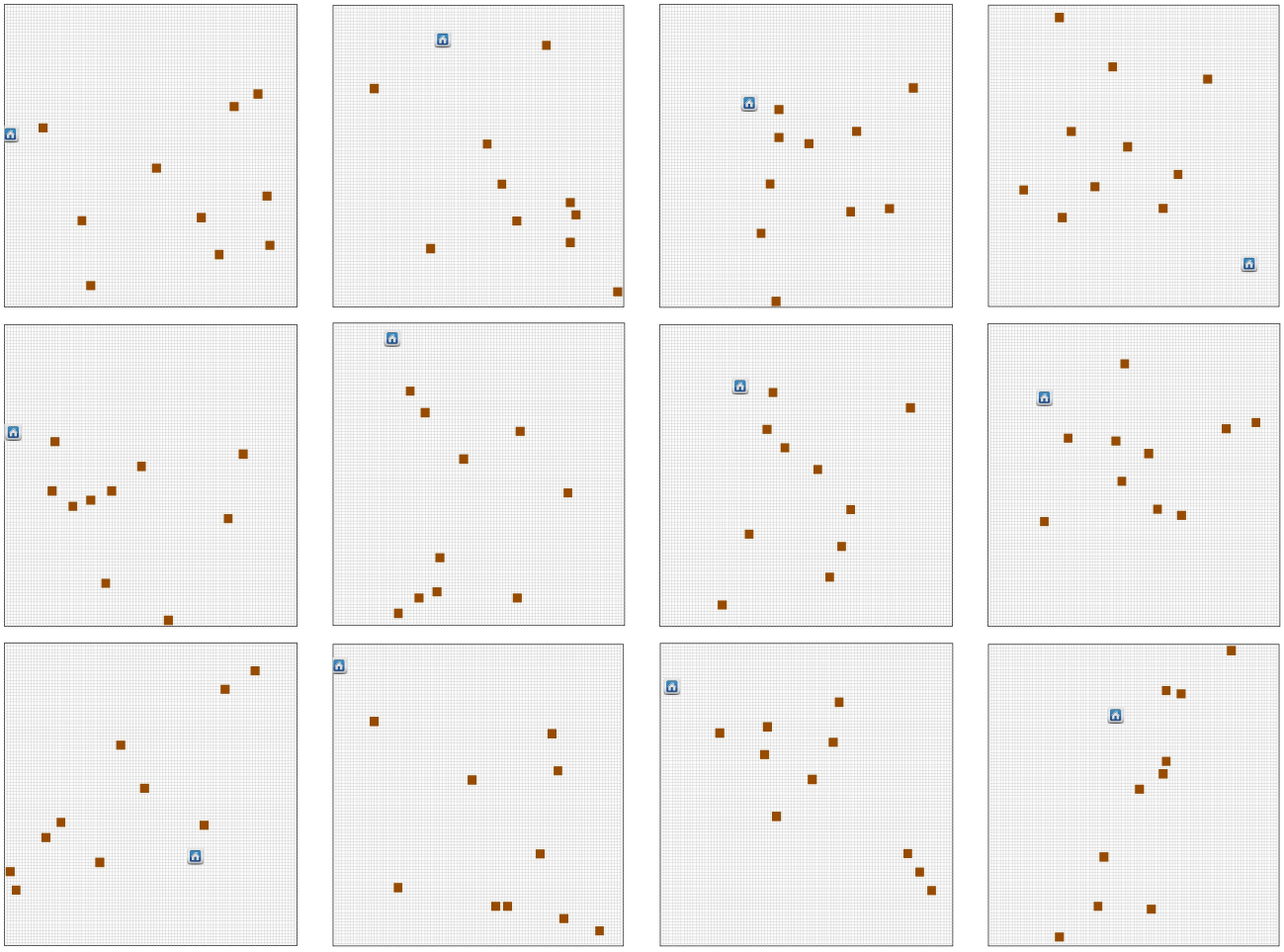


Figure 10: The 12 maps used in the SRT.