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Comments

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Abstract

In this experimental paper, the author investigates the framing effect of different representations of multiple strategic settings or games on a player's strategic behavior. Two representations of the same environment are employed, wherein a player engages in two infinitely repeated prisoner's dilemma games. In the first representation (termed Split), the stage games are shown separately. In contrast, the second representation (termed Linked) displays a combined stage game. The choice bracketing, distinguishing between Narrow and Broad bracketing, is considered a potential cause behind any disparity in behavior between the two representations. The Split representation does not necessitate broad bracketing, whereas the Linked representation compels it. Each type of bracketing has its own equilibrium implications. The author employs both a between-subject design (Study 1), where each subject observes only one representation, and a within-subject design (Study 2), where each subject is shown both the Linked and Split representations. In Study 1, significant differences in average behavior between the two representations are observed for both symmetric and asymmetric payoffs, albeit only after conditioning for session fixed effects. Study 2 reveals a more prominent effect of representation, and a sequence effect is observed, wherein the tendency to defect in both games is higher in the Linked representation if administered after the Split representation. In Study 2, for individuals who cannot be categorized as broad bracketers, the effect of seeing the Linked representation instead of the Split representation is economically significant. It increases the probability of choosing to cooperate in both games by more than 20% and decreases the probability to defect in both games by more than 25%.

Keywords: Framing effect, Choice bracketing, Infinitely Repeated Prisoner's Dilemma Game, Asymmetry, Between-subject, Within-subject

JEL Codes: C72, C91, D91

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1 Introduction

Economic agents can interact with each other in multiple simultaneous strategic situations involving the same fellow agents. These diverse strategic settings can then be aggregated and theoretically treated as a single strategic setting. Even if, theoretically, the settings are pooled together to provide a single combined game, the question remains whether decision-makers treat them as such. It would not matter from an economic point of view unless treating the settings as a single setting was beneficial to the decision-maker or society. In many circumstances, the latter is indeed the case. This fuels the endeavor to study how individuals assimilate the multiple strategic settings and exploit the synergy. In this paper, I use laboratory experiments to study how individuals make their decisions when participating in multiple infinitely repeated games with the same opponent, especially when treating these games as a single game, which can introduce strategies that benefit players. For this purpose, I use two infinitely repeated prisoner's dilemma (IRPD, henceforth) games. From the literature, we know that in the IRPD games, cooperation can be enforced by punishments in the form of defection in future periods of a supergame in the face of defection by the opponent. But when players engage in multiple IRPD games simultaneously with the same opponent, cooperation in one game can be enforced by punishment in other games. Therefore, the decisions in the two games in the experiment are interdependent.

In an environment where individuals are engaged in multiple strategic interactions, there are different ways to communicate the situation to the decision-makers. I use two representations of the two IRPD games in my simple environment. In the first representation (I call this *Split* representation), the stage games of the two IRPD games are shown separately as two 2×2 prisoner's dilemma (PD, henceforth) games maintaining the premise that it is indeed two strategic situations they are involved in. When shown this representation, a player can treat the games separately or perform the mental exercise of consolidating them into one combined game. This exposition examines whether players can generate the combined game and exploit their interdependent nature. In the second representation (I call this *Linked* representation), they are shown the combined 4×4 stage game made from the two 2×2 stage games. So, any decision under this exposition is how a player would behave if they could accurately generate the combined game and take the decisions accordingly.

The deliberate choice to combine these strategic situations and make decisions can be interpreted as *broad bracketing*. Broad bracketing is a type of choice bracketing, and choice bracketing is a phenomenon where individuals break down complex problems into smaller parts and group them into sets. When the cardinality of these sets is small (even one, in the extreme case), the bracketing is termed *Narrow*, and when the cardinality is large (including all sets, in the extreme case), it is termed *Broad* (Read et al. 1999). Broad bracketing can lead to changes in the agents' available strategies, sometimes introducing unavailable strategies when the interactions are considered in isolation. My environment leads to the possible different implications under narrow and broad bracketing. IRPD games can allow many cooperative equilibria depending on the discount factor. Suppose the two IRPD games are considered separately (narrow bracketing) in one of the IRPD games I use in the experiment. In that case, the discount factor can support cooperative equilibria, but not in the other. However, by combining the two IRPD games (broad bracketing), players can pull together the payoffs of both games, which allows cooperation in both games to be an equilibrium outcome.

The environment with multiple IRPD games is made particularly difficult to analyze due to the presence of multiple equilibria. Any difference in behavior can be easily distributed to subjects choosing different equilibria. Therefore, I utilize both between-subject and within-subject design. Both designs have positives and negatives (see Charness et al. 2012). In Study 1, I use a 2×2 factorial between-subject design. This study mainly retrieves the unconfounded treatment effect, where I consider the Split representation, the control and the Linked representation, the treatment. This is the first dimension of the factorial design. The second one involves different payoffs – *Symmetric* and *Asymmetric*. In the *Symmetric* treatments, the stage games (two 2×2 games and the combined 4×4 game) are symmetric across the two players. In contrast, all the stage games are asymmetric in the *Asymmetric* treatments. The two types of bracketing have different implications for the two types of games. For the symmetric games, if subjects narrowly bracket, they can cooperate in only one game and defect in the other, whereas with asymmetric games, they should not cooperate in either game. However, with broad bracketing under each type of payoff (Symmetric or Asymmetric), subjects can sustain cooperation in both games. The problem with the between-subject design is that the differences between the behavior under the two representations can be attributed to individuals favoring a certain strategy over others, assuming that the individuals shown the game separately can accurately broadly bracket.

I endeavor to solve this issue partially by using a within-subject design in Study 2 with only Asymmetric payoffs. I chose to work with asymmetric payoffs as broad bracketing these games provides the maximum benefit by making cooperation a possible equilibrium as defection is the only equilibrium for each component asymmetric IRPD game. In the within-subject design, subjects are introduced to both representations one after the other. To account for the sequence effect, I use two sequences: Sequence 1, where Split representation is followed by Linked representation, and Sequence 2, where Sequence 1 is reversed. This design allows me to compare each subject's reaction to each representation. I operate under the assumption that if a subject can successfully combine the two games, then their behavior in both representations will be the same. I use this assumption to categorize subjects into *Broad Bracketers* and *Non-Broad Bracketers*.

The primary purpose of this paper is to find if different representations of the same game can elicit different behaviors. Concisely, I do find differences in behavior under the two representations. In Study 1, using the joint decisions in the two games and the decisions in the combined game, I find that Linked representation lowers the tendency to choose to cooperate in both games irrespective of the type of payoffs. In the case of symmetric payoffs, I find an increase and decrease in the frequency of choosing CD and DC, respectively, with Linked representation, while with asymmetric payoffs, both choices of CD and DC see an uptick. However, this difference is only observable after conditioning for the session fixed effects. This result is counterintuitive as broad bracketing cooperation in both games is a possible equilibrium while not under narrow bracketing, which is only possible in Split representation. The results I get from Study 2 align with the theory. The Linked representation improves the odds of cooperating in both games, whereas subjects choosing to defect in both games lessens. This presents a dilemma of why the two designs provide two different effects. I further tried to categorize the subjects in Study 2 by comparing the empirical distributions of choices and found that a third of the population can be classified as broad bracketers. In terms of payoff, I do not find any significant difference between the payoffs of the categories. This probably is due to mixed population interacting with each other in the sessions.

Framing of games is a common topic of research. Research on the valence effect and the order effect is more commonplace in the context of framing in strategic or non-strategic settings. This paper delves into a different type of framing question. A separate literature in experimental game theory deals with individuals playing multiple games simultaneously. Papers on this topic usually present the games without considering what other ways of framing would imply for the players' decisions if that is not one of the questions of concern. This paper is complementary to Modak (2021), which studies the effect of multiple contacts on subjects' behavior in IRPD games. The most closely related paper in this regard is Ert et al. (2019). It deals with a very similar question with similar design as my paper, however, the games they use (finitely repeated prisoner's dilemma game – FRPD, henceforth). My paper complements this paper because I study multiple IR games and symmetric and asymmetric games. A subsequent query one can make when using the design of experiments in this paper and Ert et al. (2019) is regarding bracketing, which both papers address. Due to the finitely repeated nature of the game in Ert et al. (2019), there are no equilibrium implications under the two types of bracketing. Under either type of bracketing, using backward inductions in the FRPD games, players should find defection to be the optimum action in each period in each game. In my setting, due to the infinite nature of the repeated game, under broad bracketing, some strategies become subgame perfect Nash equilibrium (SPNE, henceforth) – for example, the Strong Grim (SGrim, henceforth) Strategy – which are not SPNE with narrow bracketing. This difference makes answering the question regarding bracketing more difficult for my setting. Unlike Ert et al. (2019), I find that the effect of representation depends on the design of the experiment – between-subject or within-subject. As stated above, in case of between-subject design, I find an increase in defection under Linked representation, while the opposite true for within-subject design.

The other papers consider other games or a combination of a game and a decision-making task. In most papers, linking the games has possible consequences on the optimal or equilibrium choices. Bland (2019) studies bracketing with Volunteer's Dilemma games, which finds that on an individual level, most subjects bracket narrowly. Narrow and broad bracketing, in some of the papers that study them, are referred to as sequential and simultaneous decision-making, respectively (Simonson 1990). Ding (2012) works along the same line as Ert et al. (2019) in the sense that there are no equilibrium implications of the type of bracketing and looks at how presentation (simultaneous vs sequential) of the multiple trust games changes the behavior of subjects. The paper finds that representation affects the behavior of both the trustor and the trustee. Finally, bracketing can also be an issue in intertemporal decision-making, which is studied in Stracke et al. (2017).[1] My paper adds to this literature by studying bracketing in IRPD games. These games differ from those mentioned above as IRPD games allow multiple strategies to be equilibria. Therefore, they pose more technical difficulties in tracking the type of bracketing used by subjects. They can use any strategy, and multiple strategies can be shared between either type of bracketing.

The rest of the paper is organized in the following way: in section 2, I introduce the treatments and hypotheses, followed by the details regarding the experiment in section 3; in section 4, I discuss the data and results; finally, I conclude in section 5.

[1] Repeated games can also have an issue with sequential choice bracketing, but that is not the focus of the current paper, and all treatments use repeated games.

2 Treatments and Hypothesis Development

I employ two types of treatments to test whether representation affects subjects' behavior. Theoretically, the players engage in an IR game with a stage game with four available actions. This stage game is constructed from two PD games. But stage game can be either represented in the 4×4 normal form (*Linked* representation) or two 2×2 normal form (*Split* representation). The two PD stage games I use are shown in Figure 1 for the symmetric and asymmetric treatments. The 4×4 normal form stage games for the symmetric and asymmetric treatments are shown in Figure 2. I name them High Payoff Game and Low Payoff Game for PD stage games as in the former, the payoffs from cooperation are higher than the latter. Note that for the asymmetric games, the names are given with respect to Player 1 for brevity. The actions shown in the normal forms of the 4×4 stage games are constructed in the following way: if xy is the action, then x is the action from the High Payoff Game and y is the action from the Low Payoff Game. These actions should be different for the asymmetric games for Player 1 and Player 2 since the High and Low payoff games are different for the two players. But for simplicity, I stick to Player 1's perspective throughout the paper. For each of the treatments, I use a discount factor of 0.75. I employ between-subject (Study 1) and within-subject (Study 2) designs. In Study 1, I have a 2×2 factorial design, as shown in Table 1, with two main treatment variables: representation (Linked versus Split) and type of game (Symmetric versus Asymmetric). In Study 2, I only use the asymmetric payoff stage games. There are only two treatments – *Linked Asymmetric* (LA, henceforth) and *Split Asymmetric* (SA, henceforth).

	Symmetric Games	Asymmetric Games
Linked	LS	LA
Split	SS	SA

Table 1: Treatments in Study 1

Symmetric Games

High Payoff Game

Player 1 \ Player 2	C	D
C	48, 48	12, 50
D	50, 12	25, 25

Low Payoff Game

Player 1 \ Player 2	C	D
C	30, 30	8, 50
D	50, 8	25, 25

Asymmetric Games

High Payoff Game

Player 1 \ Player 2	C	D
C	48, 30	12, 50
D	50, 8	25, 25

Low Payoff Game

Player 1 \ Player 2	C	D
C	30, 48	8, 50
D	50, 12	25, 25

Figure 1: Stage Games in the Experiment – Split Representation

Notes: In the experiment, the actions are named "A", "B" for the "Red Game" (name used for the High Payoff Game) and "X", "Y" for the "Blue Game" (name used for the Low Payoff Game) in place of "C", "D" respectively.

I first look at equilibrium strategy as if the subjects narrowly bracket and choose strategies separately for the two IRPD games in the *Split* treatments. In the IRPD games, one equilibrium strategy is Always Defect

(AD, henceforth). However, given the discount factor, they can have a cooperative strategy as an equilibrium. Let us first consider the *Symmetric Games.* For the IRPD game with High Payoff stage game, the minimum discount factor required to sustain some level of cooperation is 0.08 (8%), which is much lower than the discount factor I use in the experiment.[2] Therefore, one can expect to observe some level of cooperation in this game with narrow bracketing. However, for the Low Payoff stage game, the same threshold discount factor is 0.8 (80%) which is higher than 0.75 (75%). Therefore, with narrow bracketing, subjects should not cooperate in the IRPD with Low Payoff stage game. To summarize, if subjects narrowly bracket in the *Split-Symmetric* (SS, henceforth) treatment, subjects can be expected to cooperate in the High Payoff game but not in the Low Payoff game. [3],[4]

Now, I look at the asymmetric IRPD games. In the High Payoff game, Player 1 gets the high payoffs while her opponent (Player 2) receives the low payoffs.[5] Therefore, in the High Payoff game, Player 1 could cooperate if the discount factor is at least 0.08. However, with asymmetric games, she knows Player 2 is not incentivized to cooperate as they are facing low payoffs (which requires the discount factor to be at least 0.8 to make cooperation profitable). As a result, Player 1 in the High Payoff game will also choose not to cooperate. In the Low Payoff asymmetric IRPD game, Player 1 has no incentive to cooperate, even if Player 2 might. Therefore, with narrow bracketing, subjects should not cooperate in either asymmetric IRPD game.

Symmetric Games

Player 1 \ Player 2	CC	CD	DC	DD
CC	78, 78	56, 98	42, 80	20, 100
CD	98, 56	73, 73	62, 58	37, 75
DC	80, 42	58, 62	55, 55	33, 75
DD	100, 20	75, 37	75, 33	50, 50

Asymmetric Games

Player 1 (Role G) \ Player 2 (Role H)	CC	CD	DC	DD
CC	78, 78	56, 80	42, 98	20, 100
CD	98, 42	73, 55	62, 62	37, 75
DC	80, 56	58, 58	55, 73	33, 75
DD	100, 20	75, 33	75, 37	50, 50

Figure 2: Stage Games in the Experiment – Linked Representation

Notes: In the experiment, the actions are named "K", "L", "M", and "N" in place of "CC", "CD", "DC", and "DD" respectively. In the 4×4 matrices, xy implies x action is chosen in the High Payoff stage game, and y action is chosen in the Low Payoff stage game, where $x, y \in \{C, D\}$.

The 4×4 stage games under symmetric games (combining the symmetric High and Low Payoff stage games) and asymmetric games (combining the asymmetric High and Low Payoff stage games) are shown in Figure 2. The 4×4 stage game from symmetric games is symmetric across players. However, the 4×4 stage game

[2]This minimum level of discount factor is the discount factor that is required for the Grim Trigger strategy (Grim, henceforth) to be an SPNE.

[3]To see the calculation of the minimum discount factors, please refer to Modak (2021).

[4]In the literature of the IRPD game, due to the multiplicity of SPNE, it is a standard practice to look at the basin of attraction (BOA, henceforth) of the Always Defect (AD, henceforth) strategy. I calculate the BOA of AD in the High Payoff game in Appendix A.1.1 and find that it is 0.16, which is low enough to expect high cooperation in this game.

[5]The payoffs are the same as the ones in the symmetric High and Low payoff games, respectively.

from asymmetric games is asymmetric.

For the combined stage game, the Nash equilibrium is DD for both symmetric and asymmetric stage games. Therefore, one SPNE strategy of the IR game with these stage games is to choose DD always (ADD, hereafter). But, following the IRPD games, one can find other equilibria. (DD, DD) is not a Pareto optimal action profile for the stage game. However, the action profile (CC, CC) is Pareto optimal and provides the highest joint payoff. Note that this action profile corresponds to cooperating in both PD games. Again, following the IRPD literature, I use a strong version of the Grim strategy, the SGrim strategy. This strategy was first introduced by Bernheim and Whinston (1990). In the SGrim strategy, a player starts by cooperating in all games. She continues to cooperate in all games until there is a defection in history, whereby she starts defecting in all games. Therefore, if a subject employs this strategy, it can influence her opponent to cooperate in her opponent's Low Payoff stage game with the punishment that the player will defect in the opponent's High Payoff stage game. This strategy can sustain cooperation in combined IRPD games under symmetric and asymmetric payoffs. To sustain cooperation in the combined IRPD game (symmetric and asymmetric payoffs), the minimum required discount factor is 0.44 (44%).[6] This discount factor is lower than 75%, therefore it can be expected that if a subject was broad bracketing, they should cooperate in both games.

However, as in IRPD games, there is a multiplicity of equilibrium strategies at the discount factor of 0.75. Since the full game is made of two component games, the combined equilibrium strategies under Narrow bracketing are also equilibrium under Broad bracketing. For example, the Grim trigger strategy is an equilibrium for High Payoff IRPD game, and the AD strategy is for Low Payoff IRPD game. The combined strategy, Grim-AD, subsequently, can be represented by the following automaton (see the left figure in Figure 3). This strategy is an equilibrium for the symmetric games under broad bracketing. The strategy is important as it might be easier to implement than the SGrim strategy with symmetric payoffs.[7]

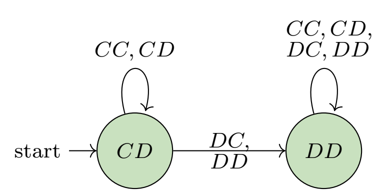

Figure 3: Strong Grim – Always Defect Strategy

In the case of broad bracketing, cooperation in one game can also be an equilibrium action choice with asymmetric payoffs. Consider the Grim-AD strategy. This strategy is not equilibrium with asymmetric stage games, as Player 1 will move to defection in the High Payoff Game if Player 2 defects in Player 1's High Payoff Game. But, an alteration to this strategy can be an equilibrium. Consider the strategy, where each player cooperates in their High Payoff game and Defect in their Low Payoff game. To ensure a player continues to cooperate, there is a punishment. If a player defects in their High Payoff game, the opponent

[6] This discount factor is the required discount factor such that the SGrim strategy is an SPNE of the combined IRPD game.

[7] Following the literature, to judge how likely it is for subjects to choose SGrim strategy, I calculate the BOA of ADD strategy in the combined IRPD game which is also an SPNE of the game. AD-AD is the SPNE where subjects choose the stage game NE in every period. I calculate the BOA of AD-AD in the combined IRPD game in Appendix A.1.2 and find that it is 0.33, which is low enough to expect high compliance of SGrim strategy. Moreover, in the LS treatment, Grim High (Grim Trigger Strategy in the High Payoff IRPD game and AD in Low Payoff IRPD game; Grim-AD, henceforth) strategy is still an equilibrium. I check how likely it would be for a player to choose the SGrim strategy if her opponent is also likely to select the Grim-AD strategy.

switches to defection in both games for all periods. Figure 4 shows the strategy as an automaton. This strategy works because it allows the players to collect the premium from being the 'defector' in High Payoff Game while being the 'sucker' in the Low Payoff Game. This strategy is an SPNE for these payoffs if the discount factor is more than 0.52. Although the above discussion seems to indicate a difference between Narrow and Broad bracketing, these results are under the assumption of rationality, common knowledge, and selfish nature. Below, I state the hypothesis I can test using the current experimental design.

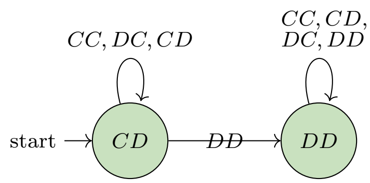

Figure 4: Alternating CD Strategy

Hypothesis 1 *(Broad Bracketing) Under Broad Bracketing, behavior under Split and Linked treatments are identical.*

3 Experimental Details

I conducted experimental sessions at Chapman University's ESI Experimental Laboratory in March, April, and October 2023, recruiting subjects from the undergraduate pool. Study 1 comprised four treatments (LS, LA, SS, and SA) with a between-subject design involving two sessions each. The SA, SS, and LS treatments comprised 12 subjects per session, while the LA treatment involved 22 subjects. In Study 2, featuring a within-subject design, I conducted four sessions with 24 subjects each. The subjects were segregated into sections 1 and 2, each with 12 subjects. The subjects within each section could only be matched with each other. This created two clusters in each session, increasing the number of clusters I can use in my data analysis. In two sessions, the order of the treatments followed Sequence 1 (SA first, then LA), and in the other two sessions, it was reversed (Sequence 2) to check for order effects. Each subject participated in only one session in both studies. I first discuss the common features of the instructions of sessions, then move to the differences (see Appendix A.2.1 for instructions).

In this experiment, I implemented the concept of infinitely repeated interaction, utilizing the random termination protocol introduced by Roth and Murnighan (1978). Each of these infinitely repeated interactions or supergames, a 'round' in the sessions, consisted of one repetition of the stage games, termed a 'period.' The probability of continuation for all treatments was set at 0.75. This was explained to the subjects in the following way. The protocol involved the computer randomly selecting a number between 1 and 8. If the number was less than or equal to 6, an additional period was added to the supergame; otherwise, the supergame concluded. Subjects were rematched randomly at the beginning of each supergame. The number of periods in each supergame was pre-drawn from a Geometric Distribution with a probability of success of 0.75. Supergame lengths remained consistent across all treatments[8]

In each treatment of the experiment, participants interacted with another randomly selected subject, referred to as 'Other.' This was relayed to the participants in the instructions. In the *Split* treatments, subjects

[8]The supergame lengths are shown in Table 8.

simultaneously viewed the two stage games of the IRPD game and were required to choose an action for each game in every period of a supergame. These stage games are denoted as the 'Red Game' (High Payoff) and the 'Blue Game' (Low Payoff) (see Figure 1). In the *Linked* treatments, I combined the payoffs from the High and Low Payoff games in the *Split* treatments, presenting subjects with a unified 4×4 stage game (refer to Figure 2 for the stage games). Study 1 involved 30 supergames for each treatment with a pre-determined number of periods. In Study 2, there were 20 supergames for each treatment, with the same pre-drawn number of periods as the initial 20 supergames from Study 1.

For the LA treatment, payoffs are asymmetrical between players. In Study 1, participants in this treatment were divided into two groups, designated as Role A and Role B. Subjects in Role A were consistently paired with randomly selected participants in Role B, and vice versa, There were 11 subjects in each role.[9] Subjects were informed of their roles at the beginning of the session, and these roles remained constant throughout the session. In Role A, the stage game was presented from the perspective of the Role A player as player 1, while in Role B, it was shown from the perspective of the Role B player as player 1.

In Study 2, adopting a within-subject design, each participant was categorized into one of the two roles, namely Role G and Role H, for both SA and LA treatments. They were informed of their roles at the session's outset and received reminders on each page. Participants understood that their roles would remain unchanged throughout the session. In the SA treatment, Role G players experienced the Red game as their High payoff game, while Role H players had the Blue game as their High payoff game, displayed on the left. This design also facilitates an examination of whether the color of the games influences cooperation levels, independent of the payoff for the SA treatment.[10]

The computerized experimental sessions used oTree (Chen et al. (2016)) to record subject decisions. Each session (Task for Study 2) started with instructions for the treatment to be implemented, followed by an incentivized quiz, and then the experiment. At the end of the session, there was a demographic survey, and finally, subjects were paid individually. Each Study 1 (Study 2) session took about 45 (60) minutes to complete. The instructions were displayed on the screen. The incentivized quizzes had eight questions each. Subjects could earn \$0.25 for each correctly answered question. After submitting the answers to the quiz, the subjects were shown the correct option, the option they chose, and the amount of money they would receive for the quiz. The flow of sessions in Study 2 is in Figure 5.

The subjects were guaranteed a payment of \$7 for appearing for the session. The subjects earned points during the session. At the end of the session, the points were converted into dollar amounts using an exchange rate (declared at the beginning) such that the average earnings in every session would be similar.

[9]In the SA, SS, and LS treatments, there are 12 subjects. Therefore, each subject can be paired with 11 other subjects. In the LA treatments, 11 subjects are in Role A and Role B separately. A subject in Role A can be randomly paired with one of the 11 subjects in Role B and vice versa. Each subject can be paired with 11 other subjects, which is true for each treatment session. This is why the total number of subjects per session in the LA treatment differs from that in the other treatments.

[10]During the data analysis, the choices of Role B/H participants in the LA treatment were manipulated to be consistent with those in Role A/G. The difference in roles is payoff-relevant. I do not calculate payoffs after the change. The manipulation does not impact the results other than ease of analysis.

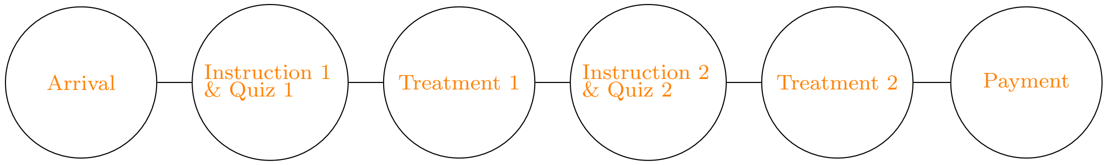

Figure 5: Flow of a session in Study 2

4 Results

This paper endeavors to address two pivotal inquiries. Firstly, it examines the influence of a game's representational format on player behavior. Secondly, it investigates whether bracketing could account for variations in player conduct. The experimental framework utilizes two distinct treatment conditions: Linked and Split. In the Linked treatments, participants are exposed to a combined stage game, whereas the Split treatments present the constituent Prisoners' Dilemma game. This study primarily focuses on participants' choices within these experimental settings, considering the actions available in the combined stage games. To discern behavioral differences between the Linked and Split treatments, the research employs Panel Multinomial Logit Regression alongside χ^2 tests, scrutinizing the distribution patterns of participant choices. In the literature on IRPD games, it is well-known that multiple covariates significantly affect cooperation levels. For the regressions for first-period choices, the considered covariates are supergame (time trend), length of the last supergame, the action of the opponent in the previous supergame, own action in the first period of the first supergame, and finally, cluster fixed effects. In the case of the choices in every period, these covariates are supergame (time trend), length of the last supergame, own and opponent's actions in the previous period of a supergame, and the indicator for the first period of a supergame. Therefore, these covariates had to be considered in the multinomial regressions to estimate the effect of representation. The first column in the tables containing the marginal effects always shows the unconditional treatment effect. These statistical tests are complemented by various data visualizations, enhancing the interpretability of the regression and test outcomes.

The paper also delves into the potential role of bracketing in driving behavioral differences. Participants in the within-subject sessions are classified into three categories: *Broad Bracketers*, *Narrow Bracketers*, and *Uncategorized*. This classification is based on analyzing first-period choice distributions in both Linked and Split treatments, employing the χ^2 test. The null hypothesis posits no significant difference in choice distributions across treatments. Participants are designated Broad Bracketers if the null hypothesis can not be rejected at a 1% α level and as Narrow Bracketers otherwise. To validate the robustness of the categorization, the study implements an additional regression analysis. This analysis aims to ascertain the treatment effect within the established categories, explicitly focusing on determining if the observed differences between the two game representations can be attributed to the behavior of the Narrow Bracketers. By conducting this regression analysis, the study seeks to strengthen the reliability of its conclusions regarding the impact of game representation and bracketing on player behavior in the within-subject design. The aforementioned categorization, however, encounters limitations when distributions lack entries for specific actions, leading to the classification of some participants as Others. Moreover, this procedure can not categorize individuals if they are not subjected to both representations. To allow for the categorization of subjects in the Split treatments of the between-subject sessions, a fuzzy categorization approach is incorporated, wherein subjects are identified as Broad Bracketers if their proportion of cooperative choices (CC) significantly exceeds zero at a 1% α level in the Split treatment.

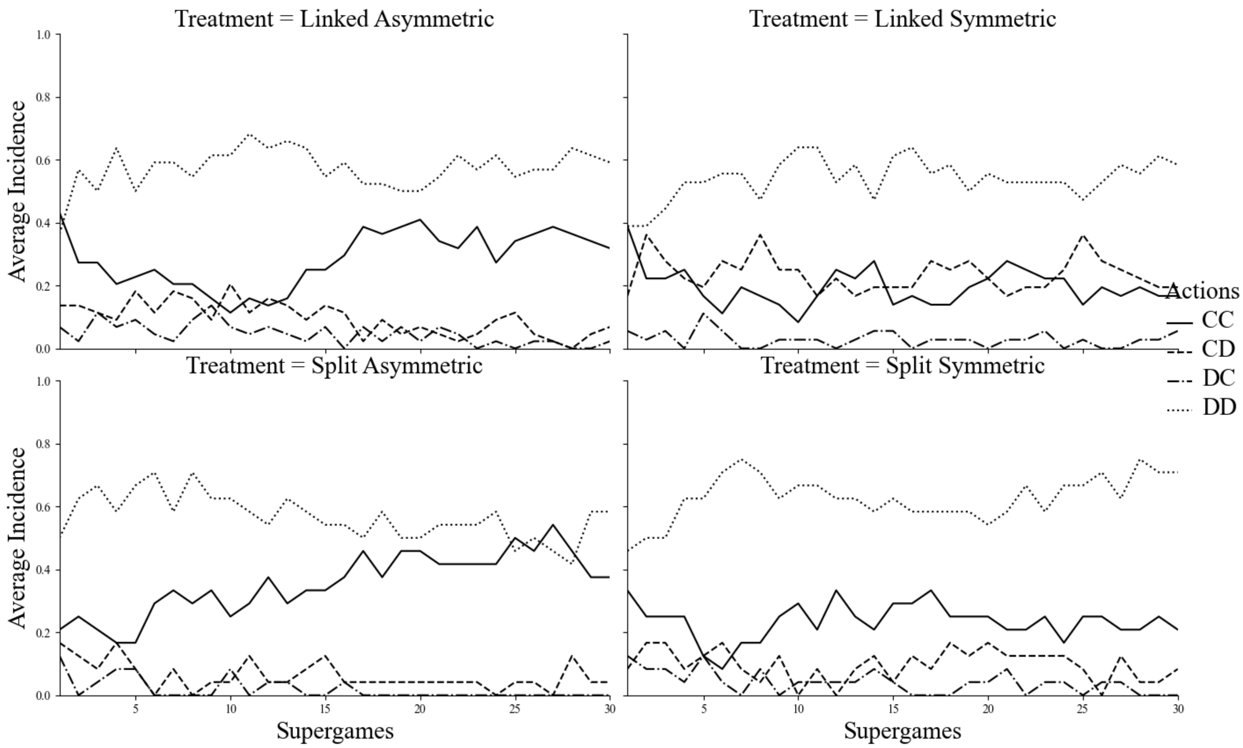

Figure 6: Average Incidence of Actions by Treatment and Supergame (First Period)

Notes: The four graphs show the average frequency of action choices in each treatment. The actions chosen by players are – CC (Cooperation in both High and Low payoff games), CD (Cooperation in High and Defection in Low payoff games), DC (Defection in High and Cooperation in Low payoff games), and DD (Defection in both High and Low payoff games).

I first examine the effect of representation in the between-subject design. I use symmetric and asymmetric payoffs in this design to determine whether representation affects choices. Tables 2 and 3 show the marginal effect of being presented with the linked representation of the game on the first-period choices of subjects with symmetric and asymmetric payoffs simultaneously. For symmetric payoffs, there does not appear to be any unconditional effect of the Linked representation on first-period choices. However, including covariates makes the estimates more precise, resulting in lower standard errors, a higher log-likelihood, and lower AIC/BIC. In the full model (where all covariates are used and have the lowest AIC/BIC), I find that when faced with the linked representation, subjects are less likely to choose CC and DC and more likely to choose CD and DD. When considering choices in every period, the effect is similar for CC and DC, but subjects are more likely to choose CD only. For the asymmetric payoff, the regression results are somewhat different. The linked representation increases the probability of choosing CD and DC even without conditioning on other covariates. When including other covariates (the full model with the lowest AIC/BIC), the effect on CC becomes statistically and economically significant. I find subjects are less likely to choose CC when shown the combined stage game. However, this effect on CC disappears when I use data from every period of a supergame.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CC	0.061	0.061	-0.131***	0.052	0.049	0.057	-0.101***
	(0.122)	(0.122)	(0.003)	(0.111)	(0.107)	(0.087)	(0.002)
CD	0.069	0.069	0.163***	0.071	0.066	0.062	0.141***
	(0.085)	(0.085)	(0.003)	(0.086)	(0.082)	(0.073)	(0.020)
DC	-0.027	-0.027	-0.060***	-0.018	-0.016	-0.016**	-0.020**
	(0.023)	(0.022)	(0.002)	(0.016)	(0.015)	(0.005)	(0.007)
DD	-0.102	-0.102	0.028***	-0.105	-0.099	-0.104	-0.020
	(0.155)	(0.155)	(0.006)	(0.143)	(0.134)	(0.101)	(0.027)
# Observations	1440	1440	1440	1392	1392	1392	1392
# Subjects	48	48	48	48	48	48	48
Clustering	Sessions	Sessions	Sessions	Sessions	Sessions	Sessions	Sessions
# Clusters	4	4	4	4	4	4	4
Log-Likelihood	-1069.78	-1064.605	-1054.425	-991.203	-979.947	-974.142	-959.249
AIC	2147.559	2137.209	2116.85	1990.405	1967.894	1956.284	1926.499
BIC	2168.649	2158.299	2137.939	2011.359	1988.484	1977.238	1947.453
Supergame		✓					✓
Cluster FE			✓				✓
(Supergame Length)$_{(t-1)}$				✓			✓
(Other's Action FP)$_{(t-1)}$					✓	✓	✓
My Action FP FS						✓	✓

Table 2: Marginal Effect of Linked Treatments with Symmetric Stage Payoffs
(First Period, Between Subject)

Notes: This table shows the marginal effect of the Linked treatment over Split treatment with Symmetric Payoffs. The action choices (CC, CD, DC, DD) are regressed on the treatment dummy (Linked = 1, Split = 0) and the other regressors listed on the lowest panel in the table using a Panel Multinomial Logistic Regression Model. Each observation in the choice made by a subject in a period of a supergame. In this regression $t-1$ implies last supergame. The cluster robust standard errors are shown in the parentheses below the marginal effects.
Short forms: FE – Fixed Effects, FP – First Period, FS – First Supergame
Symbols: p-values $^{***} < 0.001$, $^{**} < 0.01$, $^{*} < 0.05$, $^{+} < 0.1$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CC	-0.018	-0.018	-0.108***	-0.031	-0.026	-0.048	-0.143***
	(0.078)	(0.078)	(0.008)	(0.066)	(0.061)	(0.062)	(0.011)
CD	0.060***	0.059***	0.079***	0.065***	0.065***	0.067***	0.094***
	(0.011)	(0.011)	(0.006)	(0.013)	(0.014)	(0.017)	(0.017)
DC	0.027**	0.026**	0.039***	0.033***	0.032***	0.041***	0.050***
	(0.008)	(0.008)	(0.004)	(0.006)	(0.005)	(0.010)	(0.006)
DD	-0.069	-0.067	-0.010	-0.067	-0.071	-0.060	-0.001
	(0.063)	(0.064)	(0.009)	(0.053)	(0.051)	(0.053)	(0.016)
# Observations	2040	2040	2040	1972	1972	1972	1972
# Subjects	68	68	68	68	68	68	68
Clustering	Sessions	Sessions	Sessions	Sessions	Sessions	Sessions	Sessions
# Clusters	4	4	4	4	4	4	4
Log-Likelihood	-1539.01	-1488.99	-1536.55	-1426.067	-1399.092	-1391.278	-1339.928
AIC	3086.021	2985.98	3081.101	2860.134	2806.185	2790.556	2687.855
BIC	3108.503	3008.463	3103.584	2882.481	2828.532	2812.903	2710.202
Supergame		✓					✓
Session FE			✓				✓
(Supergame Length)$_{(t-1)}$				✓			✓
(Other's Action FP)$_{(t-1)}$					✓	✓	✓
My Action FP FS						✓	✓

Table 3: Marginal Effect of Linked Treatments with Asymmetric Stage Payoffs
(First Period, Between Subject)

Notes: This table shows the marginal effect of the Linked treatment over Split treatment with Asymmetric Payoffs. The action choices (CC, CD, DC, DD) are regressed on the treatment dummy (Linked = 1, Split = 0) and the other regressors listed on the lowest panel in the table using a Panel Multinomial Logistic Regression Model. Each observation in the choice made by a subject in a period of a supergame. In this regression $t-1$ implies last supergame. The cluster robust standard errors are shown in the parentheses below the marginal effects.
Short forms: FE – Fixed Effects, FP – First Period, FS – First Supergame
Symbols: p-values *** < 0.001, ** < 0.01, * < 0.05, $^{+} < 0.1$

If one examines the regressions to assess the importance of covariates, one will find that including cluster fixed effects significantly alters the regression results in both cases. In the case of symmetric payoffs, including these fixed effects renders the treatment effect on choices statistically significant. For asymmetric payoffs, including cluster fixed effects reduces the standard errors for the treatment effects on choices of CD and DC, and the size of the treatment effect increases. In contrast, the standard error decreases for choosing CC. The effect of sessions in laboratory experiments is studied in Fréchette 2012. To account for this, I use fixed effects among different ways of accounting for it. The lack of statistical significance of the treatment effects could be due to a low number of sessions or the variability of behavior across sessions. The importance of cluster fixed effects can be visualized using figures in Appendix A.3, which display the cooperation levels by supergame for each cluster separately. For instance, among the two sessions with the Split Symmetric Treatment (see Figures 13 and 17), one session devolved into full defection by the end of the session. In contrast, subjects chose both CC and DD in significant proportions in the other session. Overall, these results suggest that representation changes the behavior of subjects.

Now, let's turn to the sessions from the within-subject design. In the within-subject design, there are two sequences, and I estimate the treatment effect of Linked representation over the Split representation separately. I do not combine the data from the two sequences as there is a sequence effect on subjects' behavior. Table 14 in Appendix A.4 shows the effect of being the second treatment in the within design. There is a significant effect on the probability of choosing CD and DC even without conditioning on the covariates. However, the effects on CC and DD become more precise after conditioning on the Cluster Fixed Effects. For the Linked treatment, if administered as the second treatment, subjects are more likely to choose DD and less likely to select CC and CD. The effect on DC is ambiguous depending on the covariates. Being the second treatment for Linked representation makes the subjects less cooperative. However, subjects are more likely to choose CC for the Split treatment but less likely to choose CD and DC. I can conclude that subjects are affected by the first treatment that was administered, which is evident in the choices they make, especially in the case of the action CC.

Even if there is a sequence effect on the action choices in the within-subject design, it is pretty evident from Figures 7 and 25 that the probability of choices varies similarly between Split and Linked treatments. Visually, it is evident that with Linked representation, CC is more likely, and DD is less likely to be chosen whether I consider the first-period and all-period choices. This is the first difference between the between and within-subject design. Note that the supergame lengths are the same for the sessions in both designs. Therefore, a plausible explanation for this difference could be the multiplicity of equilibrium in these games. Even when I visualize the average incidence of these actions segregated by the sections, the conclusion does not vary significantly (see Figures 26, 27, 28, and 29). It is surprising that CD and DC are chosen rarely but are chosen less in the second treatment irrespective of which treatment it is. This is also corroborated by the regression results discussed above. In conclusion, it is safe to state that in the within-subject design, the treatment effect is on actions CC and DD and not CD and DC, unlike the between-subject design.

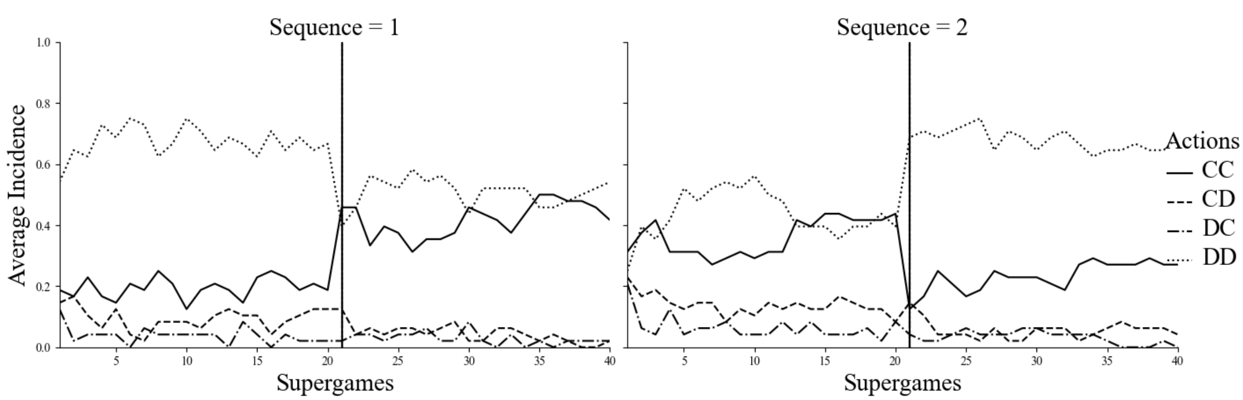

Figure 7: Average Incidence of Actions by Treatment and Supergame (First Period)

Notes: The two graphs show the average frequency of action choices in the *Split Asymmetric* and *Linked Asymmetric* treatment in the two sequences. In sequence 1, *Split Asymmetric* treatment (1 - 20 supergames) is followed by *Linked Asymmetric* (21 - 40 supergames). In sequence 2, the order is reversed. The actions chosen by players are – CC (Cooperation in both High and Low payoff games), CD (Cooperation in High and Defection in Low payoff games), DC (Defection in High and Cooperation in Low playoff games), and DD (Defection in both High and Low playoff games). Here, a supergame implies the supergame the player is playing in the entire session.

To circumnavigate the problem of sequence effect in Study 2, I first discuss the results considering the first treatments of the two sequences. This is a between-subject analysis, and the main difference from Study 1 is that in Study 2, subjects only engage in 20 supergames instead of 30, and the slight differences in the instructions used in the two studies. Table 4 shows the average marginal effect on the first period choices of being shown the Linked representation when the two treatments are the first treatments the subjects faced. There is a significant increase in the choice of CC in the Linked treatment. However, the effects on CD, DC, and DD are ambiguous as they depend on the covariates the regression allows. The unconditional treatment effect is as expected from Figure 7, and I see a significant decrease in the choice of DD. In contrast, when I condition all the covariates mentioned above, the effect becomes statistically insignificant. When I utilize data from every period, the effect of Linked representation on each action choice is indeterminate and depends heavily on the usage of other covariates. The introduction of cluster fixed effects in the regressions is consequential as it changes the sign of the impact on the action choices along with the statistical significant. The full model has the lowest AIC/BIC. Using this regression, I conclude that with Linked representation, the usage of CC, CD, and DC decreases while that of DD increases. These results are different from those from the between-subject design session. Again, this is plausible as these games are plagued by a multiplicity of equilibria. This raises the question of to what causes the discongruity of subjects' behavior between the two representations: the representation or multiplicity of equilibrium. This warrants the Within-subject design, as a subject encounters both representations.

In the case of a Within-subject design, if the subjects realize that both representations are for the same game, then there should not be any significant contrast in behavior between the two treatments that can not be explained away by the history the subjects faced. However, this notion is rendered ineligible from Figure 7. I present the regression results for the two sequences separately as there is a significant sequence effect in Table 5 for first-period actions. For the first-period actions, one can see that the treatment effects are mostly consistent with the between-subject comparison using the data from Study 2 but not with the data from Study 1. There is a statistically significant uptick in the probability of choosing CC and a drop in that of DD for both sequences, even after conditioning for multiple covariates. The observation to note is that the absolute marginal effect on CC and DD is lower in Sequence 2 than their counterpart in Sequence 2. In other words, the subjects are less cooperative in Linked treatment if they face the Split treatment before it. However, when statistically testing the difference between the actions, I do not find the differences for each action choice significant separately. But the joint test (rejects the null hypothesis of equality) is statistically significant for first-period choices (p-value = 0.027).

From the preceding discussion, one can conclude that the representation of the stage game of an IR game can impact a subject's behavior. However, due to the multiplicity of equilibria in these games, it is difficult to predict how such dissimilarities will manifest. Given the structure of this experiment, I can consider bracketing as a source of this discongruity. By the definition of *Broad Bracketing*, any decision made in the Linked treatment has to be made under broad bracketing. Under broad bracketing, a subject follows a distribution of strategies that dictates their first-period choices. Therefore, I use the empirical distribution of these choices for each subject in the within-subject design sessions and compare it to its counterpart in the Split treatment. Therefore, I compare the empirical distribution of choices in the Linked representation versus that in the Split representation of each participant. The distributions are 4×1 vectors. If the distributions are different, I conclude that the subject is not a broad bracketer; otherwise, a broad bracketer. As stated above, due tho the statistical requirements of the χ^2 test, I could not compare the distributions for

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CC	0.163^{***}	0.163^{***}	0.221^{***}	0.160^{***}	0.146^{***}	0.097^{***}	0.165^{***}
	(0.034)	(0.034)	(0.012)	(0.035)	(0.032)	(0.027)	(0.017)
CD	0.013	0.013	-0.120^{***}	0.011	0.011	-0.004^{*}	-0.119^{***}
	(0.045)	(0.045)	(0.005)	(0.042)	(0.044)	(0.041)	(0.007)
DC	0.033^{+}	0.032^{+}	-0.011^{***}	0.031^{+}	0.030^{+}	0.028	-0.003^{***}
	(0.017)	(0.017)	(0.003)	(0.018)	(0.017)	(0.017)	(0.007)
DD	-0.208^{***}	-0.208^{***}	-0.089^{***}	-0.202^{***}	-0.187^{***}	-0.121^{**}	-0.015
	(0.052)	(0.052)	(0.015)	(0.053)	(0.052)	(0.044)	(0.020)
# Observations	1920	1920	1920	1824	1824	1824	1824
# Subjects	96	96	96	96	96	96	96
Clustering	Sections	Sections	Sections	Sections	Sections	Sections	Sections
# Clusters	8	8	8	8	8	8	8
Log-Likelihood	-1487.718	-1478.803	-1475.568	-1342.907	-1337.332	-1326.599	-1306.054
AIC	2991.436	2973.606	2967.136	2701.815	2690.664	2669.199	2628.108
BIC	3035.917	3018.086	3011.617	2745.885	2734.734	2713.269	2672.179
Supergame		✓					✓
Session FE			✓				✓
(Supergame Length)$_{(t-1)}$				✓			✓
(Other's Action FP)$_{(t-1)}$					✓	✓	✓
My Action FP FS						✓	✓

Table 4: Marginal Effect of Linked Treatments with Asymmetric Stage Payoffs
(First Period, Within Subject, First Treatment)

Notes: This table shows the marginal effect of the Linked treatment over Split treatment with Asymmetric Payoffs. The data is from the first treatment administered in each session of Within-Subject design. Each observation is the action taken in the first period of each supergame by a subject. The action choices (CC, CD, DC, DD) are regressed on the treatment dummy (Linked = 1, Split = 0) and the other regressors listed on the lowest panel in the table using a Panel Multinomial Logistic Regression Model. The cluster robust standard errors are shown in the parentheses below the marginal effects.
Short forms: FE – Fixed Effects, FP – First Period, FS – First Supergame
Symbols: p-values $^{***} < 0.001$, $^{**} < 0.01$, $^{*} < 0.05$, $^{+} < 0.1$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Sequence 1				
CC	0.212**	0.212**	0.210***	0.213***	0.198***	0.146***	0.148***
	(0.061)	(0.061)	(0.042)	(0.058)	(0.052)	(0.009)	(0.013)
CD	-0.043*	-0.043*	-0.043*	-0.039+	-0.040	-0.051*	-0.053+
	(0.020)	(0.020)	(0.019)	(0.021)	(0.026)	(0.025)	(0.028)
DC	-0.005	-0.005	-0.005	0.001	0.002	-0.003	-0.004
	(0.011)	(0.011)	(0.012)	(0.008)	(0.008)	(0.003)	(0.005)
DD	-0.164*	-0.164*	-0.161*	-0.175*	-0.160*	-0.091**	-0.090**
	(0.075)	(0.075)	(0.063)	(0.071)	(0.065)	(0.030)	(0.029)
Log-Likelihood	-1277.941	-1271.225	-1269.103	-1197.897	-1184.668	-1123	-1108.454
AIC	2563.883	2550.45	2546.206	2403.794	2377.336	2254	2224.907
BIC	2586.123	2572.69	2568.447	2425.933	2399.475	2276.139	2247.046
			Sequence 2				
CC	0.114**	0.114**	0.116**	0.113**	0.098*	0.093*	0.090*
	(0.051)	(0.057)	(0.049)	(0.048)	(0.047)	(0.040)	(0.039)
CD	0.086	0.086	0.084+	0.080	0.079	0.031	0.032
	(0.057)	(0.057)	(0.050)	(0.056)	(0.059)	(0.058)	(0.056)
DC	0.038*	0.038*	0.039*	0.031+	0.028+	0.019	0.021
	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.020)	(0.020)
DD	-0.238***	-0.238***	-0.238***	-0.224***	-0.206***	-0.143**	-0.143**
	(0.052)	(0.052)	(0.052)	(0.054)	(0.050)	(0.050)	(0.050)
Log-Likelihood	-1494.151	-1480.204	-1487.299	-1416.989	-1405.713	-1385.456	-1366.009
AIC	2996.302	2968.409	2982.597	2841.978	2819.426	2778.911	2740.018
BIC	3018.542	2990.649	3004.837	2864.117	2841.565	2801.05	2762.157
# Observations	1920	1920	1920	1872	1872	1872	1872
# Subjects	48	48	48	48	48	48	48
Clustering	Sections	Sections	Sections	Sections	Sections	Sections	Sections
# Clusters	4	4	4	4	4	4	4
Supergame		✓					✓
Session FE			✓				✓
(Supergame Length)$_{(t-1)}$				✓			✓
(Other's Action FP)$_{(t-1)}$					✓	✓	✓
My Action FP FS						✓	✓

Table 5: Marginal Effect of Linked Treatments with Asymmetric Stage Payoffs
(First Period, Within Subject)

Notes: This table shows the marginal effect of the Linked treatment over Split treatment with Asymmetric Payoffs. The action choices (CC, CD, DC, DD) are regressed on the treatment dummy (Linked = 1, Split = 0) and the other regressors listed on the lowest panel in the table using a Panel Multinomial Logistic Regression Model. The cluster robust standard errors are shown in the parentheses below the marginal effects.
Short forms: FE – Fixed Effects, FP – First Period, FS – First Supergame
Symbols: p-values *** < 0.001, ** < 0.01, * < 0.05, + < 0.1

each subeject due to the statistical considerations. These subjects are labeled *Uncategorized*.

		All Periods Actions			
		Broad	Non-Broad	Uncategorized	Total
First Period Actions	Broad	27	5	2	34
	Non-Broad	9	32	2	43
	Uncategorized	2	11	6	19
	Total	38	48	10	96

Table 6: Categorization of Types

I show the count for each category in Table 6. I mainly categorize using data from the first periods. I also use choices from all periods to investigate if the categorization is consistent across the two conditions. Therefore, Table 6 shows a contingency table. I find that most participants retain their category under both conditions. However, I move forward with the labels using the first-period actions. The reason behind this choice is that action in every period other than the first period depends on the history of the supergame, which I am not accounting for in this exercise. In the table, one can see that 34 out of 96 participants are labeled as *Broad Bracketers* while 48 of them are *Non-Broad Bracketers*. The rest could not be categorized using my method. Now, using the labels, I look at the treatment effect on the probability of choosing each action. For first period actions, I run the same panel multivariate regression as (3) in Table 5. The regression results are in Table 7. Note that the χ^2 test and the panel multinomial regression are not equivalent. First, I implement the test on each participant individually, whereas the regression on data from all participants simultaneously. Second, the regression accommodates section effects as fixed effects and by using cluster robust standard errors, the latter taking care of the interdependency of choices in each section. To visualize the difference in behavior under the two treatments by labels, see the average incidences of the four actions in Tables 32 and 33 for first period choices and Tables 34 and 35 for all period choices. One observation from the figures is that non-broad bracketers are more cooperative in Linked treatment compared to broad brackerters.

For broad bracketers, the treatment effect on the first-period choices is economically minimal, with at most an absolute difference of 5% in the probability of choosing an action (CC, CD, DC, DD), and the only statistically significant change was for the action CD in sequence 1. The effects on choices in every period are also small, even after conditioning on section fixed effects and the last period action profile. However, there is some statistically significant effect on the probability of choosing CD and DD. This result for choices in all periods is not unexpected as they are history-dependent, and I only accounted for last-period choices. As expected, for participants labeled as broad bracketers, the Linked representation has no marginal effect. Looking at the non-broad bracketers, I find significant, both economically and statistically, marginal effects on choices of CC and DD for first-period choices in both sequences. There are marginal effects on all period choices as well. The effect on first-period choices for these participants is almost double and consistent with what I found in the earlier regression where labels were not considered. This is expected as the non-broad bracketers and uncategorized participants must have driven the treatment effects found in uncategorized data. There is no ex-ante hypothesis on how the marginal effects for uncategorized participants would look. However, one should note that the number of participants with this label is much lower than the other two. This leads to high standard errors in the regression with first-period choices. As a result, for Sequence 2, even if numerically the marginal effects are large, they are not statistically significant. For Sequence 1, there are large and statistically significant marginal effects on actions CC, CD, and DD. The effects on CC and

		First Period		All Periods	
		Sequence 1	Sequence 2	Sequence 1	Sequence 2
Broad	CC	0.027	-0.008	-0.016	-0.003
		(0.064)	(0.029)	(0.016)	(0.012)
	CD	-0.050**	0.020	-0.031*	0.031***
		(0.019)	(0.070)	(0.014)	(0.006)
	DC	-0.010	0.015	-0.001	0.030
		(0.009)	(0.004)	(0.005)	(0.011)
	DD	0.034	-0.027	0.049*	-0.058***
		(0.072)	(0.041)	(0.024)	(0.009)
Non-broad	CC	0.303***	0.210**	0.040**	0.026
		(0.045)	(0.067)	(0.013)	(0.029)
	CD	-0.043	0.094	-0.008	0.066*
		(0.029)	(0.070)	(0.016)	(0.028)
	DC	-0.005	0.059+	-0.021**	0.040+
		(0.035)	(0.036)	(0.006)	(0.022)
	DD	-0.255***	-0.364**	-0.011	-0.133***
		(0.056)	(0.113)	(0.025)	(0.033)
Uncategorized	CC	0.417***	-0.090	0.072**	-0.130*
		(0.073)	(0.155)	(0.023)	(0.060)
	CD	-0.103+	0.280	-0.015	0.138+
		(0.054)	(0.234)	(0.034)	(0.072)
	DC	0.005	-0.034	-0.001	0.017*
		(0.020)	(0.043)	(0.005)	(0.006)
	DD	-0.319**	-0.156	-0.057**	-0.025
		(0.095)	(0.125)	(0.018)	(0.018)
Observation		1920	1920	6048	6048
Subjects		48	48	48	48
Clustering		Sections	Sections	Sections	Sections
Clusters		4	4	4	4

Table 7: Marginal Effect of Linked Treatments with Asymmetric Stage Payoffs (Within-Subejct, By Category)

Notes: This table shows the marginal effect of the Linked treatment over Split treatment with Asymmetric Payoffs. The action choices (CC, CD, DC, DD) are regressed on the treatment dummy (Linked = 1, Split = 0) and the other regressors listed on the lowest panel in the table using a Panel Multinomial Logistic Regression Model. Each observation in the choice made by a subject in a period of a supergame. For regressions using first period data section fixed effects are used besides treatment indicator. For regressions using data from all periods, section fixed effects and own and other's last period actions are used besides treatment indicator. Symbols: p-values $^{***} < 0.001$, $^{**} < 0.01$, $^{*} < 0.05$, $^{+} < 0.1$

DD are consistent with the unlabelled effects. The marginal effects are also significant for all period choices.

5 Conclusion

In this study, I aimed to investigate the effect of the representation of infinitely repeated games on strategic behavior. Employing both between-subject and within-subject designs, I explored differences in behavior when players were presented with two component 2×2 stage games versus one combined 4×4 stage game. Given the multiplicity of equilibria in infinitely repeated games, elucidating the reasons behind any behavioral discrepancies proves challenging. Using the between-subject design, I sought to isolate independent treatment effects. However, the effect could be due to subjects resorting to different equilibrium strategies. Therefore, the within-subject design, assuming stability of preferences, proved essential.

Results indicated a significant difference in cooperative behavior on average between the two representations, although these effects varied across the two designs. In the case of between-subject design, I find simultaneous cooperation in both games less prevalent under Linked representation, while it is the opposite for within-subject design. However, in the within-subject design, I do not find a statistically significant increase in payoffs under Linked representation (see Figure 30 and 31). Exploiting the within-subject design, I categorized subjects as *Broad Bracketers*, *Non-broad Bracketers* or *Uncategorized*. Non-broad bracketers exhibited a considerable marginal effect when shown the combined game, demonstrating a propensity for increased cooperation compared to broad bracketers. They are 30% more likely to cooperate and 25% less likely to defect in both component games. However, relevant payoff improvements were not evident, likely due to subjects not interacting with their types (see Figure 36 and 37). Future research could explore this dynamic further, particularly in interactions with others of the same category.

Despite the study's contributions, there are a few shortcomings to acknowledge. Firstly, the assumption that subjects do not alter their underlying preference for strategies after experiencing a treatment introduces potential bias. Second, I use the empirical distribution of first-period choices and not strategies. Even if the distribution of first-period choices is the same, that does not imply that the distribution of strategies would be the same. Addressing these limitations represents avenues for future investigation.

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A Appendix

A.1 Theory

A.1.1 Risk Dominance in Narrow Bracketing

Following the literature on IRPD games, I calculate the basin of attraction of the Always Defect (AD) strategy in the IRPD game with the High Payoff stage game. I only consider the Grim and AD strategy. The basin of attraction (BOA) of the AD strategy is the probability with which an opponent must choose the Grim trigger (Grim) strategy to make a player indifferent between Grim and AD strategies. The higher this probability, the higher the basin of attraction of AD.

		Player 2	
		Grim	AD
Player 1	Grim	$192, 192$	$87, 125$
	AD	$125, 87$	$100, 100$

Figure 8: Payoff Matrix for Grim and AD strategies

Let ρ be the probability of an opponent choosing the Grim strategy.

$$\begin{aligned} & E(\pi(\text{Grim})) \geq E(\pi(\text{AD})) \\ \Rightarrow & 87 + 105\rho \geq 100 + 25\rho \end{aligned}$$

Given the payoffs in Figure 8, I find that BOA of AD is 0.1625, which is lower than 0.5. Again, following the literature, this BOA is low enough to expect subjects to cooperate in the High payoff IRPD game under narrow bracketing.

A.1.2 Risk Dominance in Broad Bracketing

I now calculate the basin of attraction of the Always Defect in Both Games (AD-AD) strategy in the IRPD game against the Strong Grim (SGrim) strategy under broad bracketing. First, I only consider the SGrim and AD-AD strategy. The basin of attraction (BOA, also called *SizeBAD*) of the AD-AD strategy is the probability with which an opponent must choose the SGrim strategy to make a player indifferent between SGrim and AD strategies. The higher this probability, the higher the basin of attraction of AD-AD.

		Player 2	
		SGrim	AD-AD
Player 1	SGrim	$312, 312$	$170, 250$
	AD-AD	$250, 170$	$200, 200$

Figure 9: Payoff Matrix for Strong Grim and AD-AD strategies

Let ρ be the probability of an opponent choosing the SGrim strategy.

$$
\begin{aligned}
&E(\pi(\text{SGrim})) \geq E(\pi(\text{AD-AD})) \\
\Rightarrow &87 + 105\rho \geq 100 + 25\rho
\end{aligned}
$$

Given the payoffs in Figure 9, I find that *sizeBAD* of AD-AD is 0.33, which is lower than 0.5. Again, following the literature, this BOA is low enough to expect subjects to cooperate in both games under broad bracketing and for both Symmetric and Asymmetric cases.

However, subjects can use another possible strategy in the symmetric case – Grim High strategy (Grim-H, subjects use Grim in the High Payoff IRPD game and AD in the Low Payoff IRPD game) – which is also an SPNE under broad bracketing. I extend this analysis for the symmetric stage games, using the extension of risk dominance selection criterion by Haruvy and Stahl (2004), to the symmetric 3×3 games formed using the three strategies SGrim, Grim-H, and AD-AD strategies, shown in Figure 10.

		Player 2		
		SGrim	Grim-H	AD-AD
Player 1	SGrim	$312, 312$	$206, 248$	$170, 250$
	Grim-H	$248, 206$	$292, 292$	$187, 225$
	AD-AD	$250, 170$	$225, 187$	$200, 200$

Figure 10: Payoff Matrix for Strong Grim, Grim-H, and AD-AD strategies

Let ρ_S and ρ_{GH} be the probability of an opponent choosing the SGrim and Grim-H strategies, respectively. First, I compare the expected payoffs SGrim and Grim-H strategies.

$$\begin{aligned}
&E(\pi(\text{SGrim})) = E(\pi(\text{Grim-H})) \\
\Rightarrow &142\rho_S + 36\rho_{GH} + 170 = 61\rho_S + 105\rho_{GH} + 187 \\
\Rightarrow &81\rho_S - 69\rho_{GH} = 17
\end{aligned}$$

Now, I compare the expected payoffs from SGrim and AD-AD strategies.

$$\begin{aligned}
&E(\pi(\text{SGrim})) = E(\pi(\text{AD-AD})) \\
\Rightarrow &142\rho_S + 36\rho_{GH} + 170 = 50\rho_S + 25\rho_{GH} + 200 \\
\Rightarrow &92\rho_S + 11\rho_{GH} = 30
\end{aligned}$$

Finally, I compare the expected payoffs from Grim-H and AD-AD strategies.

$$\begin{aligned}
&E(\pi(\text{Grim-H})) = E(\pi(\text{AD-AD})) \\
\Rightarrow &61\rho_S + 105\rho_{GH} + 187 = 50\rho_S + 25\rho_{GH} + 200 \\
\Rightarrow &11\rho_S + 80\rho_{GH} = 13
\end{aligned}$$

Following Haruvy and Stahl (2004), I calculate the relative proportion q_j^{RD} of the simplex of three NE of the repeated game – (SGrim, SGrim), (Grim-H, Grim-H), and (AD-AD) – such that j is the best response to any given belief $(\rho_S, \rho_{GH}, \rho_{AD})$. Given the prior $q^{RD} = (0.316, 0.5946, 0.0898)$, the expected payoffs of SGrim, Grim-H, and AD-AD are 236.35, 268.78, and 230.75, respectively. Therefore, Grim-H strategy should be the prediction according to the Risk Dominance principle in the symmetric treatments under broad bracketing.

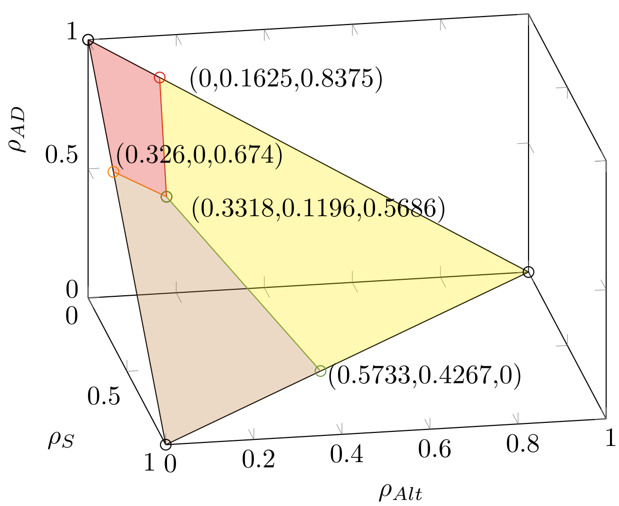


Figure 11: Risk Dominance Calculation for the three strategies Strong Grim, Grim-High, and AD-AD strategies

Notes: ρ_S is in x-axis, ρ_{GH} is in y-axis, and ρ_{AD} is in z-axis.

A.2 Experiment

Round → Sessions ↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Average Periods	Points per $
Session 1	3	3	1	2	10	9	5	1	1	1	4	9	4	8	3	4	5	2	1	1	1	8	1	6	8	1	7	7	2	1	3.97	760
Session 2	4	12	3	2	1	6	1	2	2	4	9	2	10	6	2	4	10	2	4	3	2	1	2	3	3	8	5	2	2	1	3.93	760

Table 8: Supergame Lengths and Conversion Rates (Study 1)

Round → Sessions ↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average Periods	Points per $
Session 1	3	3	1	2	10	9	5	1	1	1	4	9	4	8	3	4	5	2	1	1	3.85	800 and 775
Session 2	4	12	3	2	1	6	1	2	2	4	9	2	10	6	2	4	10	2	4	3	4.45	775

Table 9: Supergame Lengths and Conversion Rates (Study 2)

A.2.1 Instructions – Study 1

The following instructions are from the *Linked Asymmetric* treatment. The *Linked Symmetric* treatment has similar instructions except the use the roles.

Welcome

- Today's session is expected to last for about 60 minutes.
- You will start with the instructions and a quiz.
- There are **six (6)** pages in the instructions. You have **15 minutes** to read the instructions.
- You will **NOT** be able to go back to earlier pages from any page.
- You can raise your hand to notify an experimenter if you need any help.

Start Instructions

Time remaining on Instructions: **14:57**

Session Overview (Page 1 of 6)

- You are about to participate in an experiment in the economics of decision-making.
- If you read the instructions carefully, you can earn a large amount of money that will be paid to you using PayPal after you complete the session.
- During the experiment, do not talk, laugh or exclaim out loud and be sure to keep your eyes on your screen only.
- In this session you will receive at least the participation payment of $7.
- The participants in the session are divided into **two (2) roles: Role A and Role B**. The role will be fixed for the entirety of the session.
- **Your role is Role B.**
- The session will follow the timeline shown below. Every participant will go through the same timeline.

Session Timeline

Details about Quiz

- There will be **8** questions in the quiz. You can earn $0.25 for each question you answer **correctly**.
- After submitting the quiz, you can review every question with its correct answer and the answer you have chosen. You can also see the amount of money you get from the quiz.
- You can then proceed to the experiment.

Go to Page 2

Time remaining on Instructions:
14:37

How Rounds Work (Page 2 of 6)

- **Your role is Role B.**
- There will be **30 Rounds** in the experiment.
- Each round will last for a random number of **Periods**. The number of periods in each round will be determined randomly using the following procedure:
  - At the end of each period the computer will generate a random number between 1 and 8 ({1, 2,..., 8}) with each number being equally likely.
  - If the computer generates a number less than 7, then the **Round continues** for at least one more period (**75% Probability**).
  - If the computer generates a number equal to 7 or greater, then the **Round ends** (**25% Probability**).
- At the **start of each round**, you will be paired with **a randomly chosen Role A participant**. We will refer to the participant you will be paired with as **Other**.
- In each period of a round you will participate in only **one game** with **Other**.

Go to Page 3

Time remaining on Instructions:
14:00

Games, Actions and Points (Page 3 of 6)

- **Your role is Role B. Other's role is Role A.**
- In the **Game**, you can choose between four **Actions**: Action K, Action L, Action M and Action N.
- In the experiment, you will work with **Points**. At the end of the experiment, points will be converted to Dollars. Today's exchange rate is **760.0 Points = $1**.
- Your points in each period will be decided by your action and Other's action in the game you play.
- You, and Other need to choose your actions in each period in a timely manner.
- The table below show the points corresponding to your actions and Other's actions in the game and they will remain unchanged across all the rounds and periods in the experiment.

The Points Table you will see in each period of each round --

Points Table

You are in **Role B** and Other is in **Role A**.																
My Action (**Role B**)	K	L	M	N	K	L	M	N	K	L	M	N	K	L	M	N
Other's Action (**Role A**)	K	K	K	K	L	L	L	L	M	M	M	M	N	N	N	N
My Points	78	80	98	100	42	55	62	75	56	58	73	75	20	33	37	50
Other's Points	78	56	42	20	98	73	62	37	80	58	55	33	100	75	75	50

Cosider the Points Table above:

- If you choose Action K and Other chooses Action N, then you will receive 20 points, and Other will receive 100 points.
- If you choose Action L and Other chooses Action M, then you will receive 58 points, and Other will receive 58 points.
- If you choose Action M and Other chooses Action K, then you will receive 98 points, and Other will receive 42 points.
- If you choose Action N and Other chooses Action L, then you will receive 75 points, and Other will receive 37 points.

Go to Page 4

Time remaining on Instructions: **13:47**

How History is Recorded and Displayed (Page 4 of 6)

- **Your role is Role B. Other's role is Role A.**

The history of all variables in a Round will be recorded in a history table, like in the figure below. In the following tables, you can see an example of history of a Round in which the computer picked actions at random.

History Table

Period Number	1	2	3	4	5	6
My Action (**Role B**)	K	K	L	N	M	?
Other's Action (**Role A**)	K	L	N	M	L	?
My Points	78	42	33	75	62	?
Other's Points	78	98	75	33	62	?
Random Number	1	5	4	3	1	

The recorded variables include:

- Period -- Period number (6 is the current Period number in this example)
- My Action -- Your action in every period of the current round. In this example, in period 2, your action is K.
- Other's Action -- Action of Other in every period of the current round. In this example, in period 3, Other's action is N.
- My Points -- Your points in each period of the current round.
- Other's Points -- Points received by Other in each period of the current round.
- Random Number -- Random number generated by the computer at the end of the period to decide if the round continues for another period. A random number is drawn from {1,2,..., 8} with each number being equally likely.

There are ?s for "My Action", "Other's Action", "My Points", and "Other's Points" in Period 6 because that period is in progress in this example.

Go to Page 5

Time remaining on Instructions: **13:34**

Taking Actions (Page 5 of 6)

- On the page where you take actions, there will be buttons for the actions for each game as you can see in the figure below.
- When you choose an action, it will submit that action and you will progress to the next page.

Please Choose Your Action

K

L

M

N

You can see the Points table and the History table when you take actions in each period of each round.

Go to Page 6

Time remaining on Instructions: **13:19**

Payment (Page 6 of 6)

You will be paid in the following way:

- Total Points in a Round = Sum of Points over all periods in the round
- Total Points in Experiment = Sum of Total Points in every round. (At the end of the experiment, you can see the total points that you earned in the experiment and its dollar equivalent.)
- Total Payment from Session = Participation payment + Quiz payment + Dollar equivalent of total points from experiment
- At the end of the experiment, you will be shown the payment details. Please write down "Total Payment from Session" on the "Sticky Note" given to you.

Please press the "Start Quiz" button below to proceed to the Quiz.

Start Quiz

A.2.2 Quiz – Study 1

The following quiz questions are from the *Linked Asymmetric* treatment.

Time remaining on Quiz: **4:52**

Quiz

A Round is in the 4th Period. What is the probability that the Round will move to the next Period?

- ○ 100%
- ○ 75%
- ○ 25%
- ○ 0%

How many Periods is a Round made up of?

- ○ 30 periods
- ○ 4 periods
- ○ 1 period
- ○ Random number of periods

Points Table

You are in **Role B** and Other is in **Role A**.																
My Action (**Role B**)	K	L	M	N	K	L	M	N	K	L	M	N	K	L	M	N
Other's Action (**Role A**)	K	K	K	K	L	L	L	L	M	M	M	M	N	N	N	N
My Points	78	80	98	100	42	55	62	75	56	58	73	75	20	33	37	50
Other's Points	78	56	42	20	98	73	62	37	80	58	55	33	100	75	75	50

In a Period, if you choose Action K and Other chooses Action L, then how many points will you receive? (Refer to the Points Table above)

- ○ 78
- ○ 42
- ○ 56
- ○ 20

Time remaining on Quiz: **4:37**

In a Period, if you choose Action K and Other chooses Action L, then how many points will Other receive? (Refer to the Points Table above)

- ○ 98
- ○ 73
- ○ 62
- ○ 37

History Table

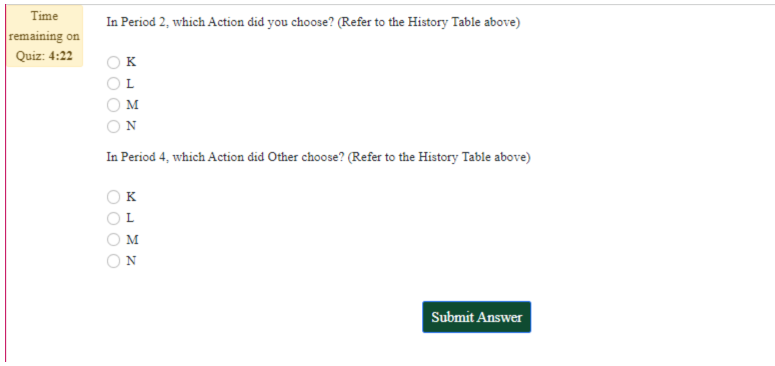
Period Number	1	2	3	4	5	6
My Action (**Role B**)	K	K	L	N	M	?
Other's Action (**Role A**)	K	L	N	M	L	?
My Points	78	42	33	75	62	?
Other's Points	78	98	75	33	62	?
Random Number	1	5	4	3	1	

In Period 3, how many points did you receive? (Refer to the History Table above)

- ○ 78
- ○ 42
- ○ 33
- ○ 75
- ○ 62

In Period 5, how many points did Other receive? (Refer to the History Table above)

- ○ 78
- ○ 98
- ○ 75
- ○ 33
- ○ 62



A.2.3 Instruction – Study 2 (Within Design)

A.2.4 Quiz – Study 2

A.3 Results – Study 1

A.3.1 All Periods

	Asymmetric		Symmetric	
	Linked	Split	Linked	Split
CC	0.003	0.005	0.001	0.001
	(0.001)	(0.002)	(0.003)	(0.004)
CD	-0.004	-0.001	0.0001	-0.002
	(0.0003)	(0.002)	(0.003)	(0.002)
DC	-0.002	-0.001	-0.002	-0.002
	(0.0002)	(0.001)	(0.0002)	(0.0003)
DD	0.004	-0.004	0.001	0.003
	(0.002)	(0.001)	(0.006)	(0.005)
N	5214	2844	2844	2844
i	44	24	24	24
# of Clusters	2	2	2	2

Table 10: Marginal Effect of Supergame on Joint Choices in Study 1 (All Periods)

	(1)	(2)	(3)	(4)	(5)	(6)
CC	0.086	0.086	-0.066***	0.052	0.040	-0.030***
	(0.094)	(0.094)	(0.003)	(0.051)	(0.033)	(0.001)
CD	0.058	0.058	0.090***	0.051	0.043	0.086***
	(0.081)	(0.081)	(0.001)	(0.052)	(0.040)	(0.001)
DC	-0.002	-0.002	-0.057***	0.002	-0.002	-0.049***
	(0.035)	(0.032)	(0.010)	(0.033)	(0.029)	(0.007)
DD	-0.142	-0.142	0.033***	-0.105	-0.081	-0.008
	(0.160)	(0.159)	(0.006)	(0.103)	(0.069)	(0.005)
# Observations	5688	5688	5688	4248	4248	4248
# Subjects	48	48	48	48	48	48
Clustering	Sessions	Sessions	Sessions	Sessions	Sessions	Sessions
# Clusters	4	4	4	4	4	4
Log-Likelihood	-4387.333	-4359.25	-4362.34	-2827.251	-2662.048	-2727.602
AIC	8782.667	8726.501	8732.68	5662.502	5332.096	5457.204
BIC	8809.251	8753.085	8759.264	5687.919	5357.513	5482.621
$I_{P=1}$	✓	✓	✓			
Supergame		✓				✓
Cluster FE			✓			✓
(Other's Action)$_{(t-1)}$				✓	✓	✓
(My Action)$_{(t-1)}$					✓	✓

Table 11: Marginal Effect of Linked Treatments with Symmetric Stage Payoffs
(All Periods, Between Subject)

Notes: This table shows the marginal effect of the Linked treatment over Split treatment with Symmetric Payoffs. The action choices (CC, CD, DC, DD) are regressed on the treatment dummy (Linked = 1, Split = 0) and the other regressors listed on the lowest panel in the table using a Panel Multinomial Logistic Regression Model. Each observation in the choice made by a subject in a period of a supergame. In this table, $I_{P=1}$ is the indicator that period of the supergame is 1 and $t-1$ implies last period in a supergame. The cluster The cluster robust standard errors are shown in the parentheses below the marginal effects.
Short forms: FE – Fixed Effects, FP – First Period, FS – First Supergame
Symbols: p-values $^{***} < 0.001$, $^{**} < 0.01$, $^{*} < 0.05$, $^{+} < 0.1$

	(1)	(2)	(3)	(4)	(5)	(6)
CC	-0.021	-0.022	-0.022***	-0.022	-0.032	0.001
	(0.078)	(0.078)	(0.008)	(0.021)	(0.061)	(0.059)
CD	0.070**	0.069***	0.042***	0.062*	0.061*	0.027***
	(0.020)	(0.018)	(0.002)	(0.026)	(0.025)	(0.001)
DC	0.043**	0.043**	0.056***	0.048***	0.045**	0.051***
	(0.015)	(0.015)	(0.002)	(0.013)	(0.014)	(0.002)
DD	-0.092***	-0.090***	-0.076***	-0.087***	-0.075***	-0.079***
	(0.020)	(0.019)	(0.004)	(0.014)	(0.021)	(0.004)
# Observations	8058	8058	8058	6018	6018	6018
# Subjects	68	68	68	68	68	68
Clustering	Sessions	Sessions	Sessions	Sessions	Sessions	Sessions
# Clusters	4	4	4	4	4	4
Log-Likelihood	-6029.258	-5932.884	-6027.651	-3941.095	-3715.82	-3679.5
AIC	12066.52	11873.77	12063.3	7890.191	7439.641	7367
BIC	12094.49	11901.75	12091.28	7917.001	7466.451	7393.81
$I_{P=1}$	✓	✓	✓			
Supergame		✓				✓
Cluster FE			✓			✓
(Other's Action)$_{(t-1)}$				✓	✓	✓
(My Action)$_{(t-1)}$					✓	✓

Table 12: Marginal Effect of Linked Treatments with Asymmetric Stage Payoffs
(All Periods, Between Subject)

Notes: This table shows the marginal effect of the Linked treatment over Split treatment with Asymmetric Payoffs. The action choices (CC, CD, DC, DD) are regressed on the treatment dummy (Linked = 1, Split = 0) and the other regressors listed on the lowest panel in the table using a Panel Multinomial Logistic Regression Model. Each observation in the choice made by a subject in a period of a supergame. In this table, $I_{P=1}$ is the indicator that period of the supergame is 1 and $t-1$ implies last period in a supergame. The cluster robust standard errors are shown in the parentheses below the marginal effects.
Short forms: FE – Fixed Effects, FP – First Period, FS – First Supergame
Symbols: p-values *** < 0.001, ** < 0.01, * < 0.05, $^{+} < 0.1$

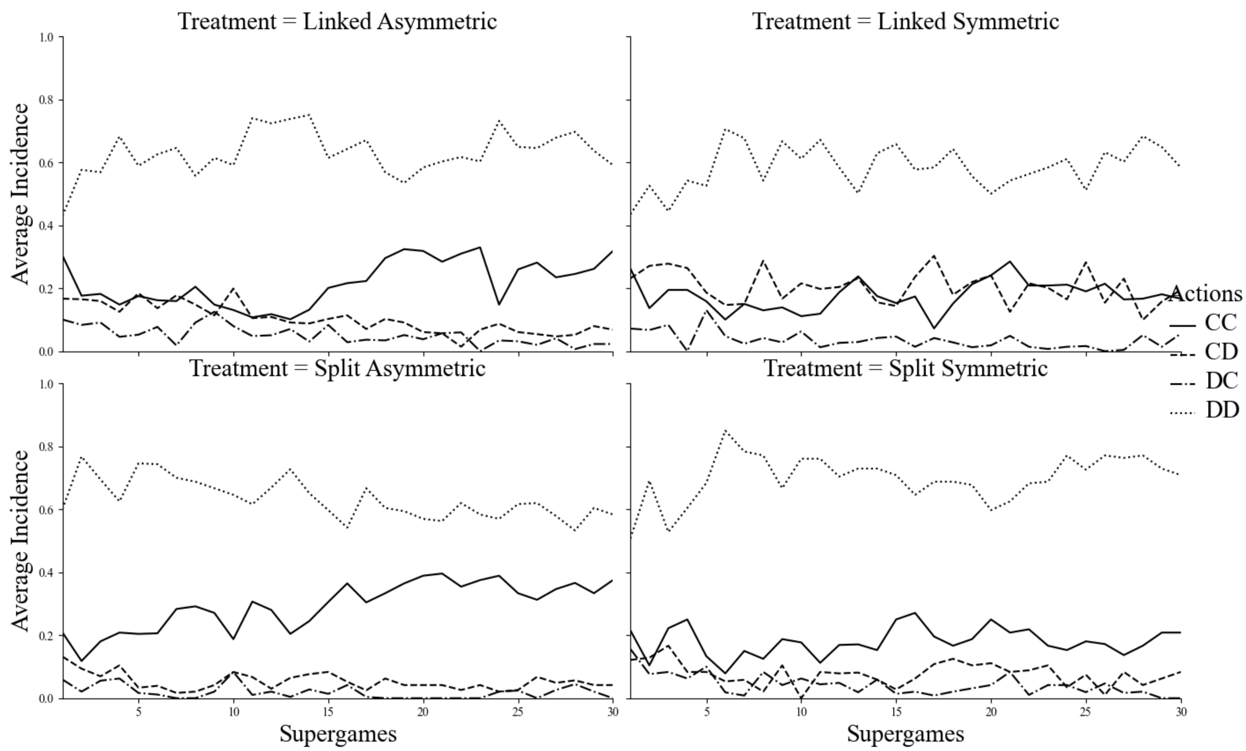


Figure 12: Average Incidence of Actions by Treatment and Supergame (All Periods)

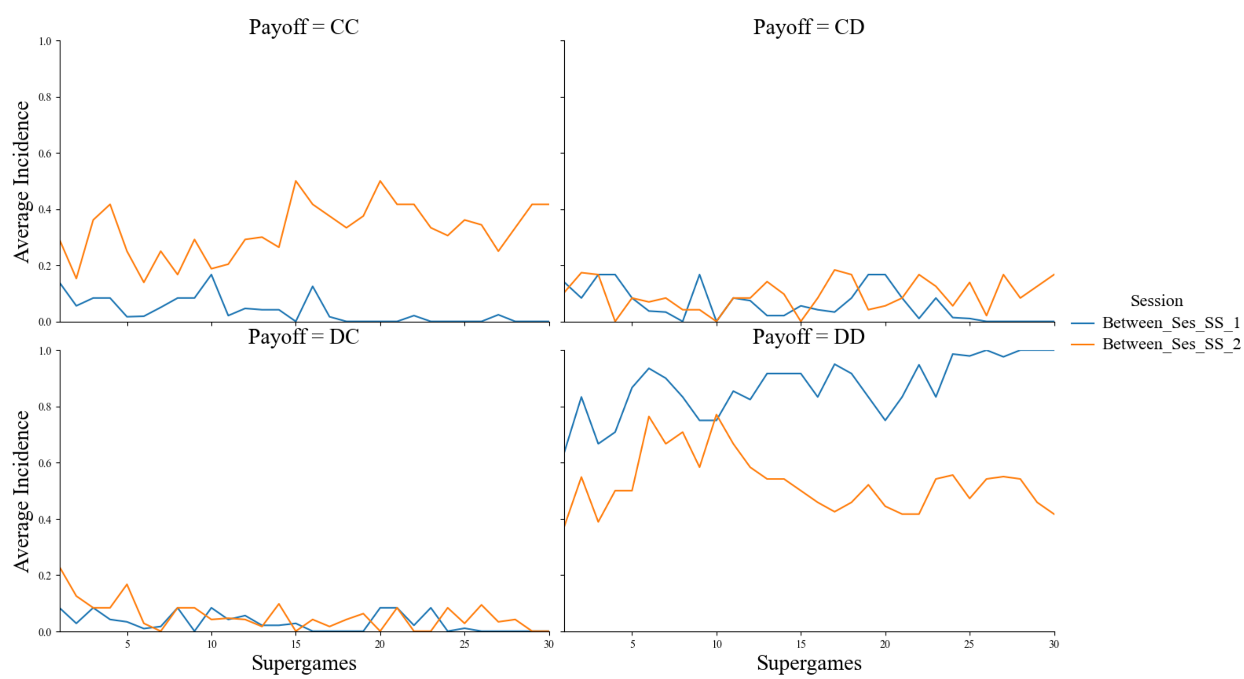


Figure 13: Average Incidence of Actions by Session and Supergame in Split Symmetric Treatment (All Periods)

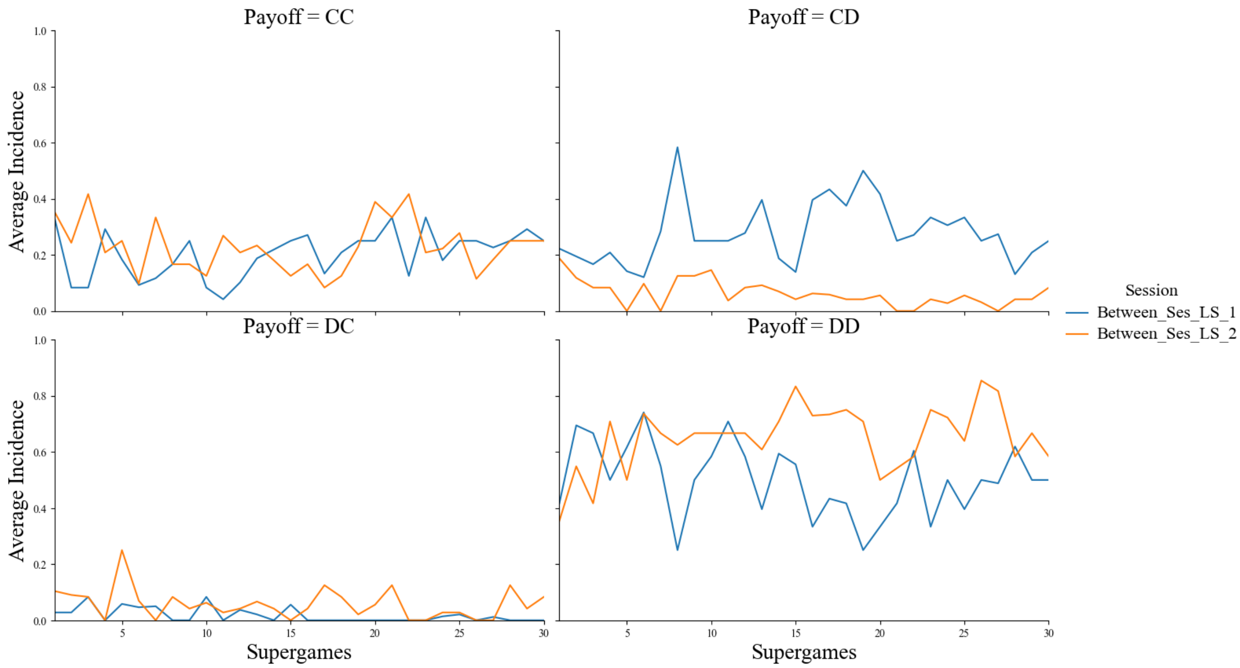


Figure 14: Average Incidence of Actions by Session and Supergame in Linked Symmetric Treatment (All Periods)

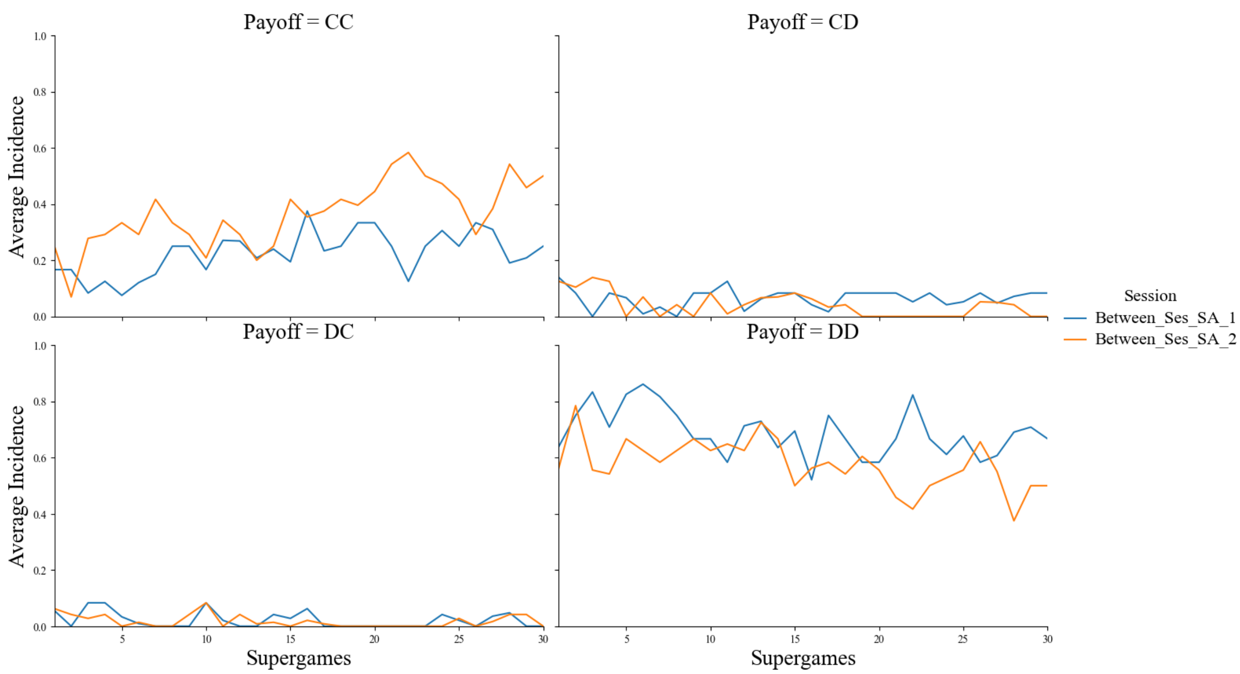


Figure 15: Average Incidence of Actions by Session and Supergame in Split Asymmetric Treatment (All Periods)

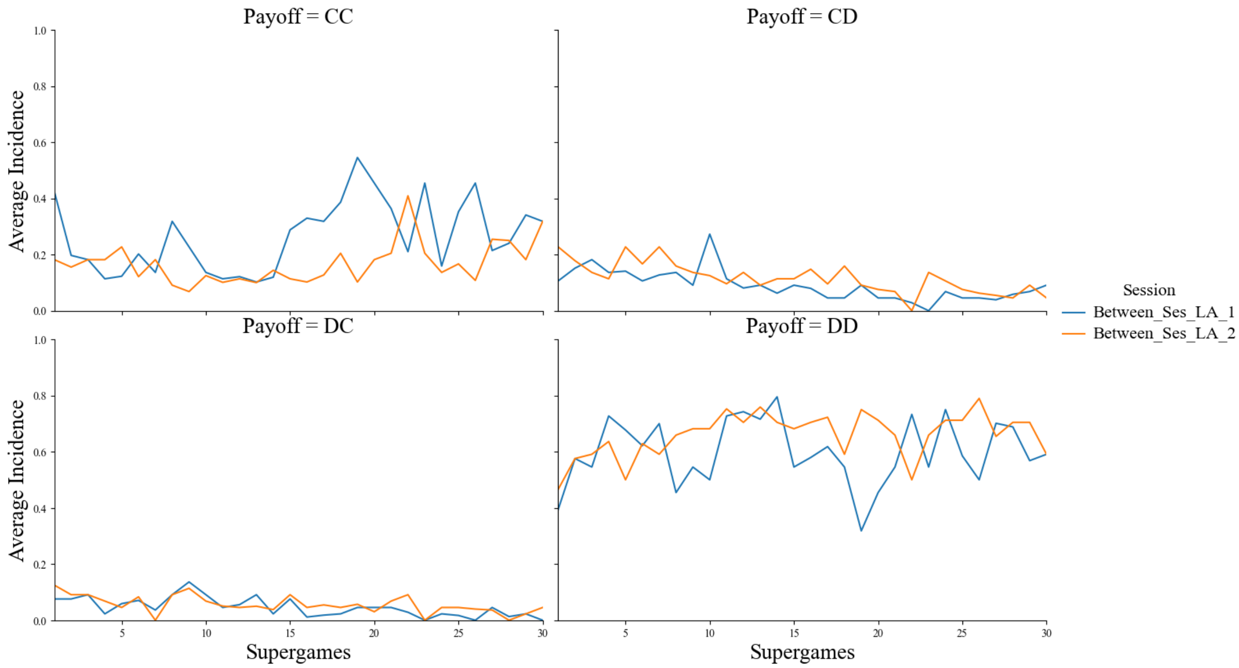


Figure 16: Average Incidence of Actions by Session and Supergame in Linked Asymmetric Treatment (All Periods)

A.3.2 First Period

	Asymmetric		Symmetric	
	Linked	Split	Linked	Split
CC	0.005^{***}	0.007^{*}	-0.001	-0.0003
	(0.001)	(0.003)	(0.001)	(0.003)
CD	-0.004^{***}	-0.002	0.0002	-0.001
	(0.0002)	(0.002)	(0.004)	(0.003)
DC	-0.002^{*}	-0.002^{+}	-0.001^{***}	-0.003^{*}
	(0.001)	(0.001)	(0.0001)	(0.001)
DD	0.002^{***}	-0.002	0.001	0.004
	(0.0004)	(0.002)	(0.005)	(0.005)
N	1320	720	720	720
i	44	24	24	24
# of Clusters	2	2	2	2

Table 13: Marginal Effect of Supergame on Joint Choices in Study 1 (First Period)

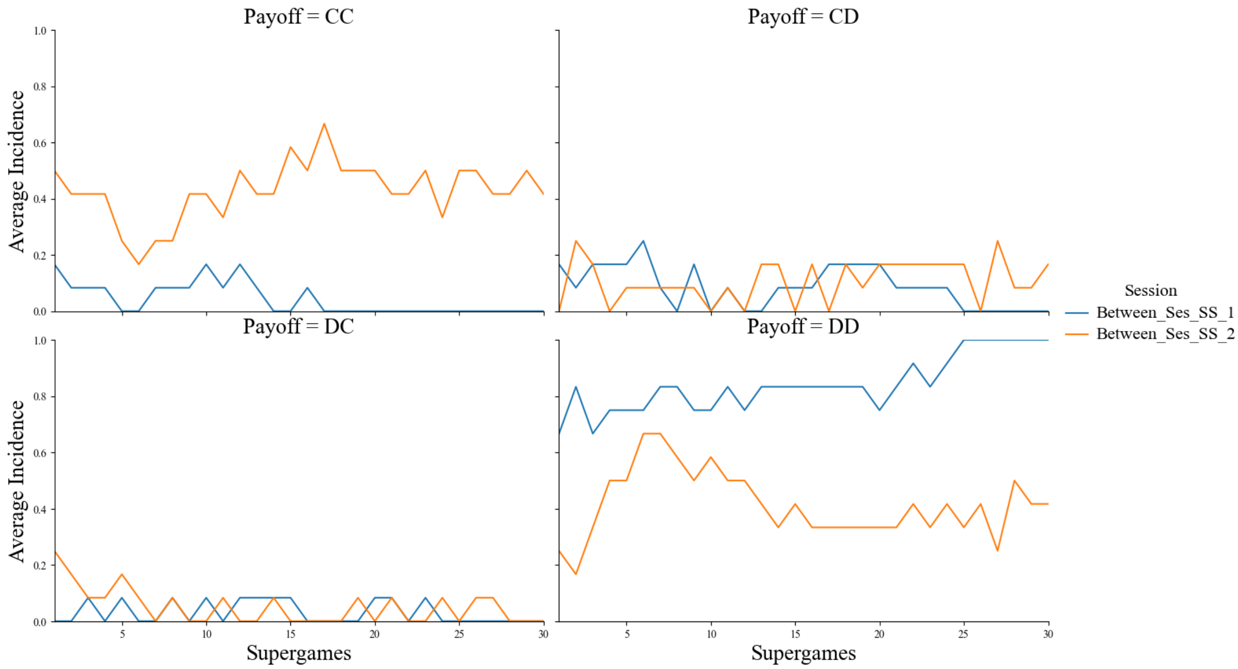


Figure 17: Average Incidence of Actions by Session and Supergame in Split Symmetric Treatment (First Period)

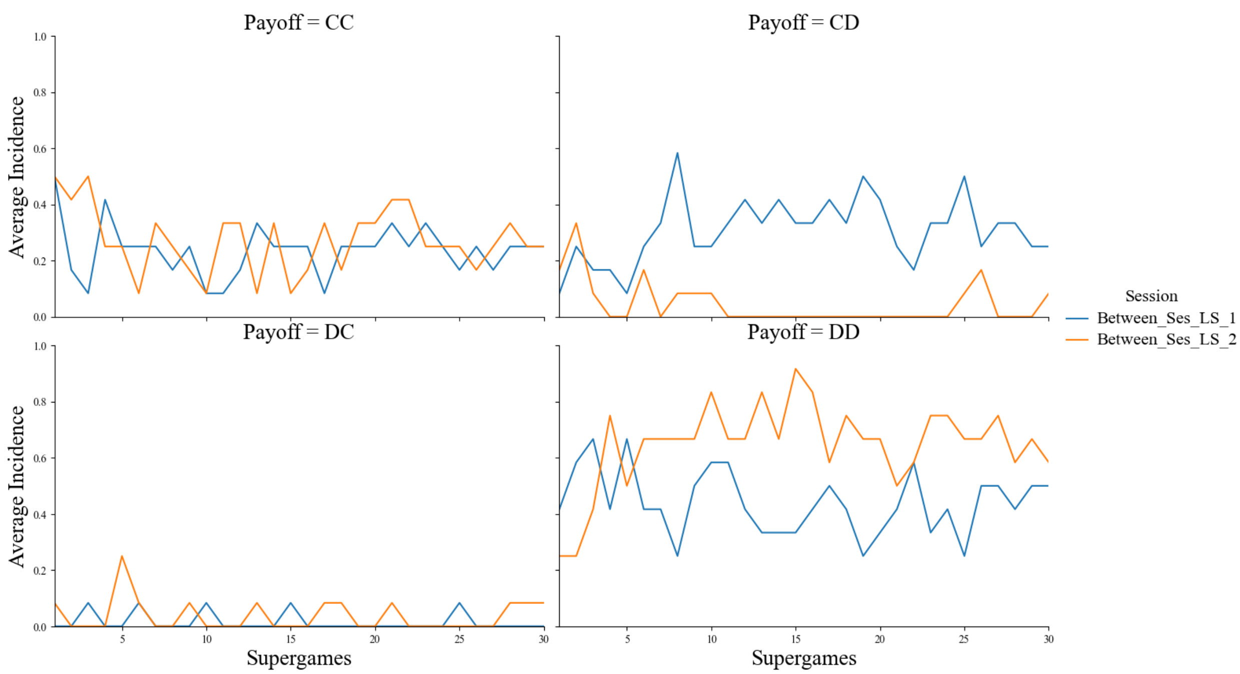


Figure 18: Average Incidence of Actions by Session and Supergame in Linked Symmetric Treatment (First Period)

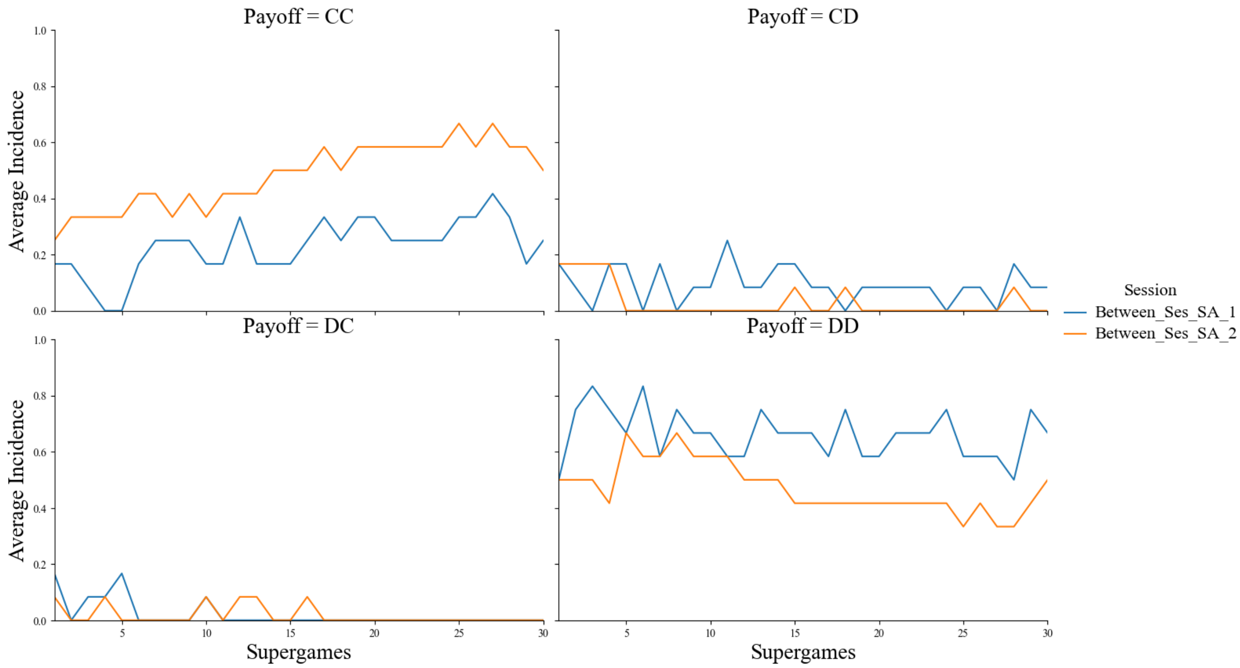


Figure 19: Average Incidence of Actions by Session and Supergame in Split Asymmetric Treatment (First Period)

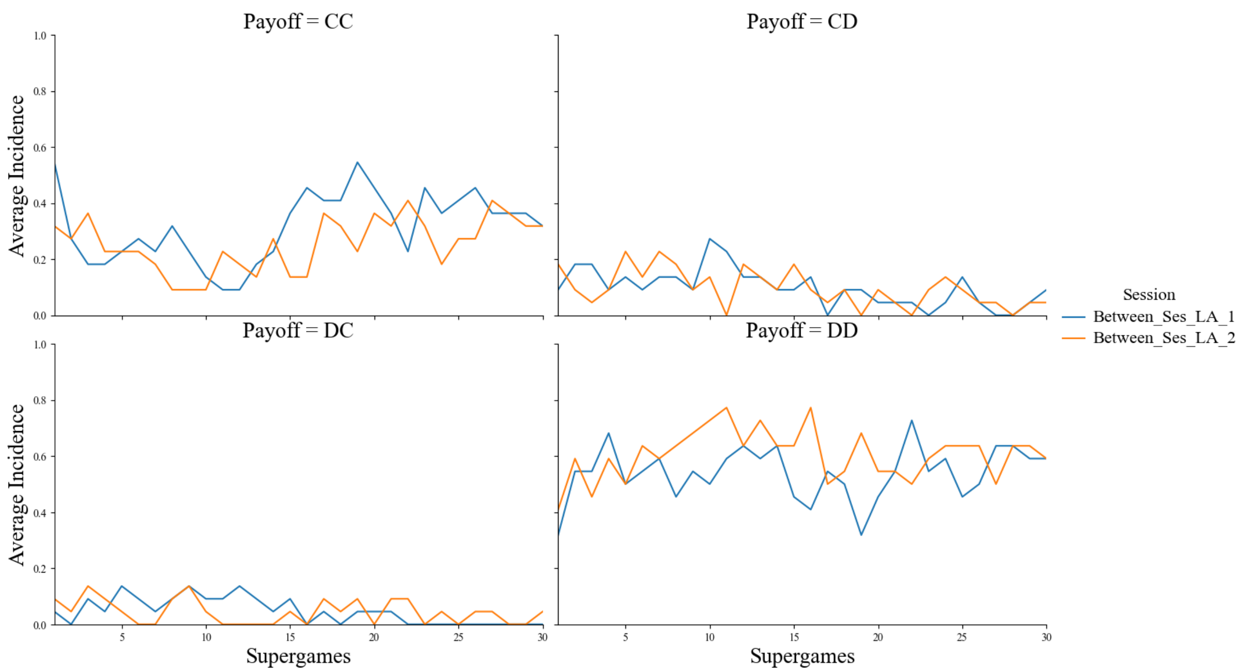


Figure 20: Average Incidence of Actions by Session and Supergame in Linked Asymmetric Treatment (First Period)

A.3.3 Clustering

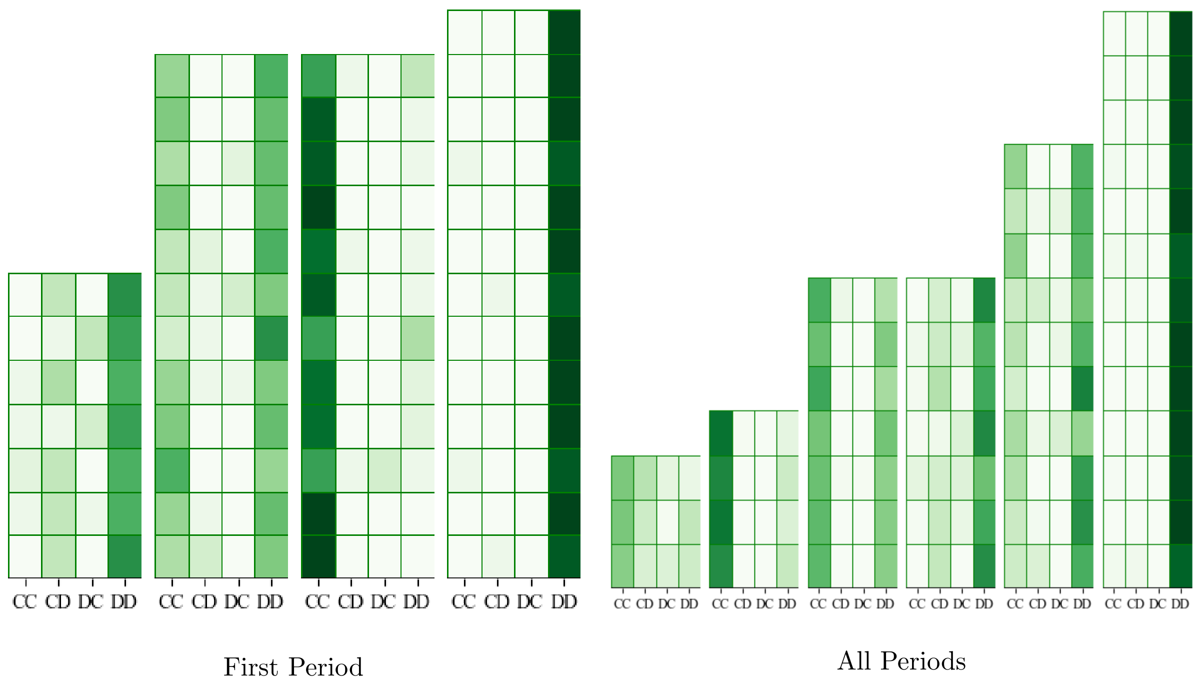


Figure 21: Clusters from Fitting Affinity Propagation Algorithm on Choices from Linked Asymmetric Treatment (Last 15 supergame)

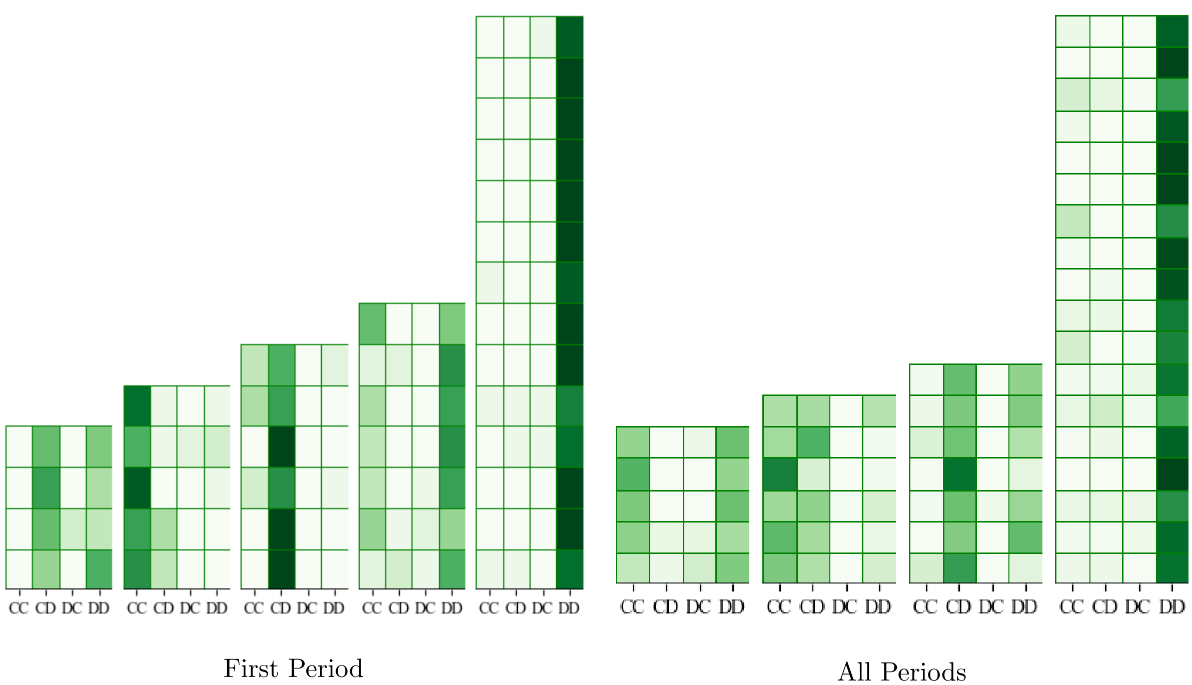


Figure 22: Clusters from Fitting Affinity Propagation Algorithm on Choices from Linked Symmetric Treatment (Last 15 supergame)

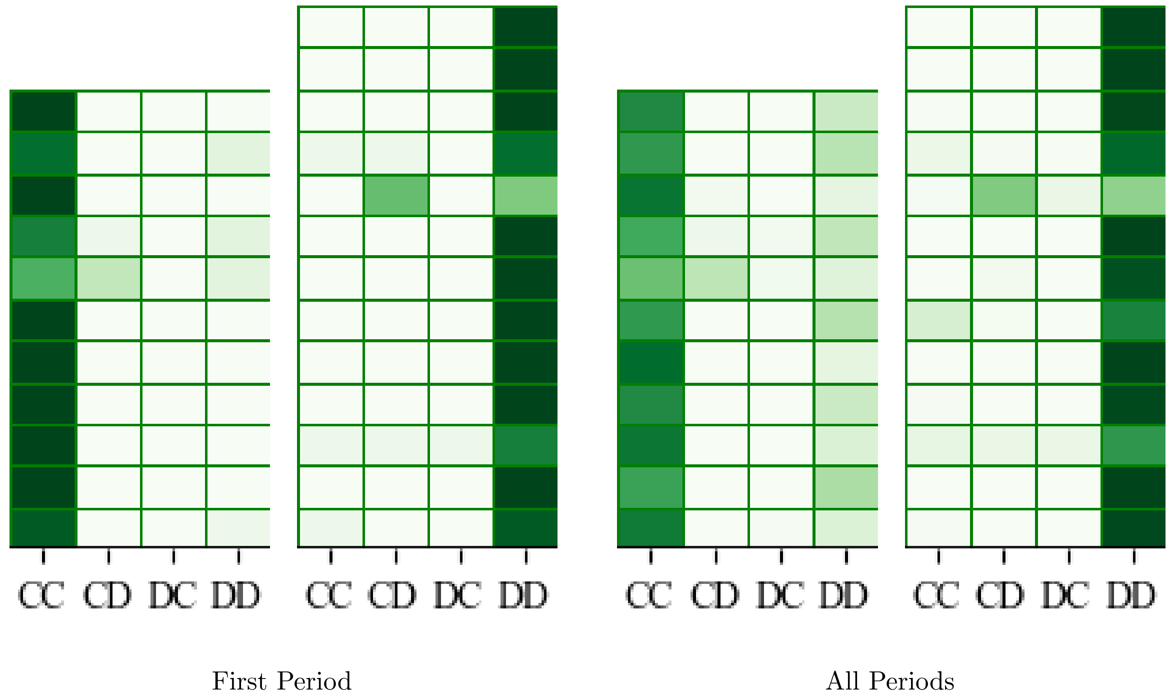


Figure 23: Clusters from Fitting Affinity Propagation Algorithm on Choices from Split Asymmetric Treatment (Last 15 supergame)

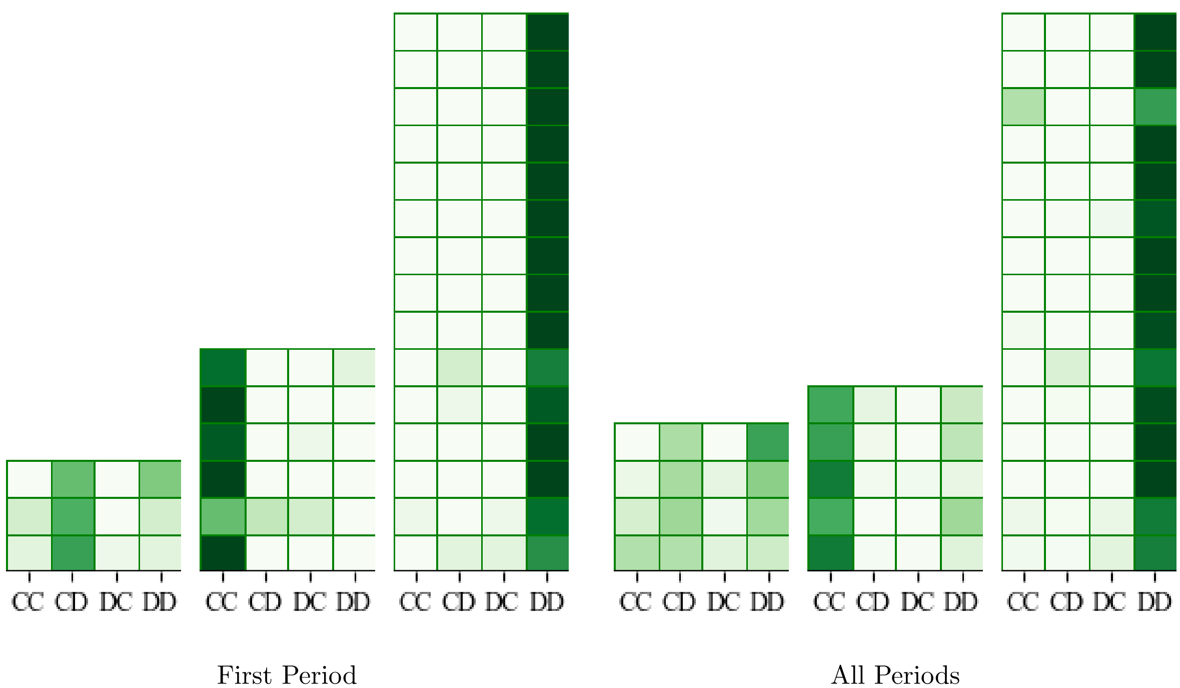


Figure 24: Clusters from Fitting Affinity Propagation Algorithm on Choices from Linked Symmetric Treatment (Last 15 supergame)

A.4 Results – Study 2

	(1)	(2)	(3)	(4)
	Split			
CC	0.029	0.095^{***}	0.057	0.154^{***}
	(0.026)	(0.006)	(0.037)	(0.010)
CD	-0.058^{*}	-0.09^{***}	-0.057^{*}	-0.089^{***}
	(0.025)	(0.004)	(0.024)	(0.010)
DC	-0.023^{+}	-0.117^{***}	-0.014	-0.085^{***}
	(0.014)	(0.007)	(0.012)	(0.011)
DD	0.053	0.112^{***}	-0.014	0.019
	(0.04)	(0.009)	(0.048)	(0.018)
	Linked			
CC	0.089^{+}	-0.075^{***}	0.071^{+}	-0.083^{***}
	(0.053)	(0.004)	(0.039)	(0.004)
CD	-0.091^{*}	-0.013^{***}	-0.088^{**}	-0.033^{***}
	(0.036)	(0.001)	(0.033)	(0.005)
DC	-0.063^{***}	-0.011^{***}	-0.048^{**}	0.005^{*}
	(0.015)	(0.002)	(0.016)	(0.002)
DD	0.065	0.099^{***}	0.065	0.111^{***}
	(0.072)	(0.004)	(0.052)	(0.005)
N	1920	1920	1824	1824
Supergame		✓		✓
Cluster FE		✓		✓
(Other's Action)$_{(t-1)}$			✓	✓
My Action FP FS			✓	✓

Table 14: Marginal Effect on Incidence Rates of Actions in Split Asymmetric and Linked Asymmetric Treatment of being in Second Treatment (First Period)

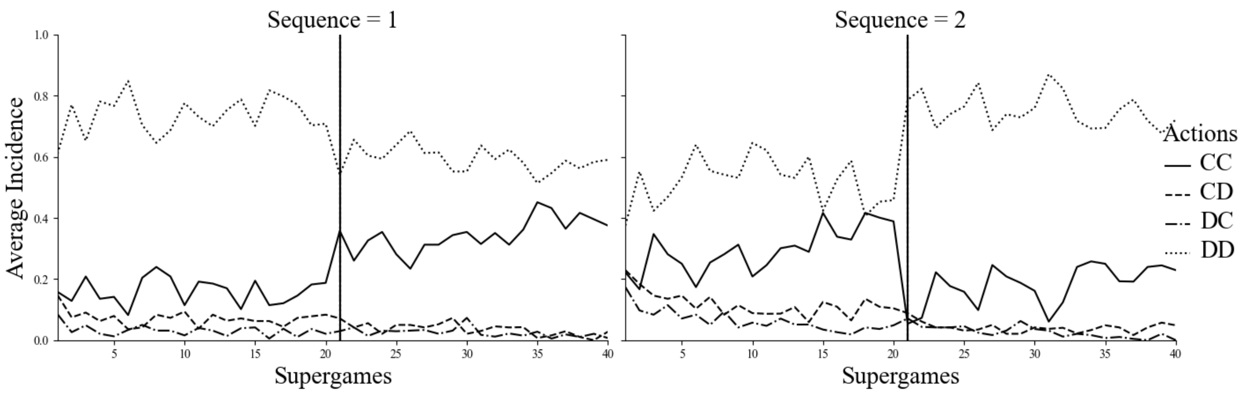


Figure 25: Average Incidence of Actions by Treatment and Supergame (All Periods)
Notes: The actions chosen by players are – CC (Cooperation in both High and Low payoff games), CD (Cooperation in High and Defection in Low payoff games), DC (Defection in High and Cooperation in Low payoff games), and DD (Defection in both High and Low payoff games).

Notes: The two graphs show the average frequency of action choices in the *Split Asymmetric* and *Linked Asymmetric* treatment in the two sequences. In sequence 1, *Split Asymmetric* treatment (1 - 20 supergames) is followed by *Linked Asymmetric* (21 - 40 supergames). In sequence 2, the order is reversed. The actions chosen by players are – CC (Cooperation in both High and Low payoff games), CD (Cooperation in High and Defection in Low payoff games), DC (Defection in High and Cooperation in Low playoff games), and DD (Defection in both High and Low playoff games). Here, a supergame implies the supergame the player is playing in the entire session.

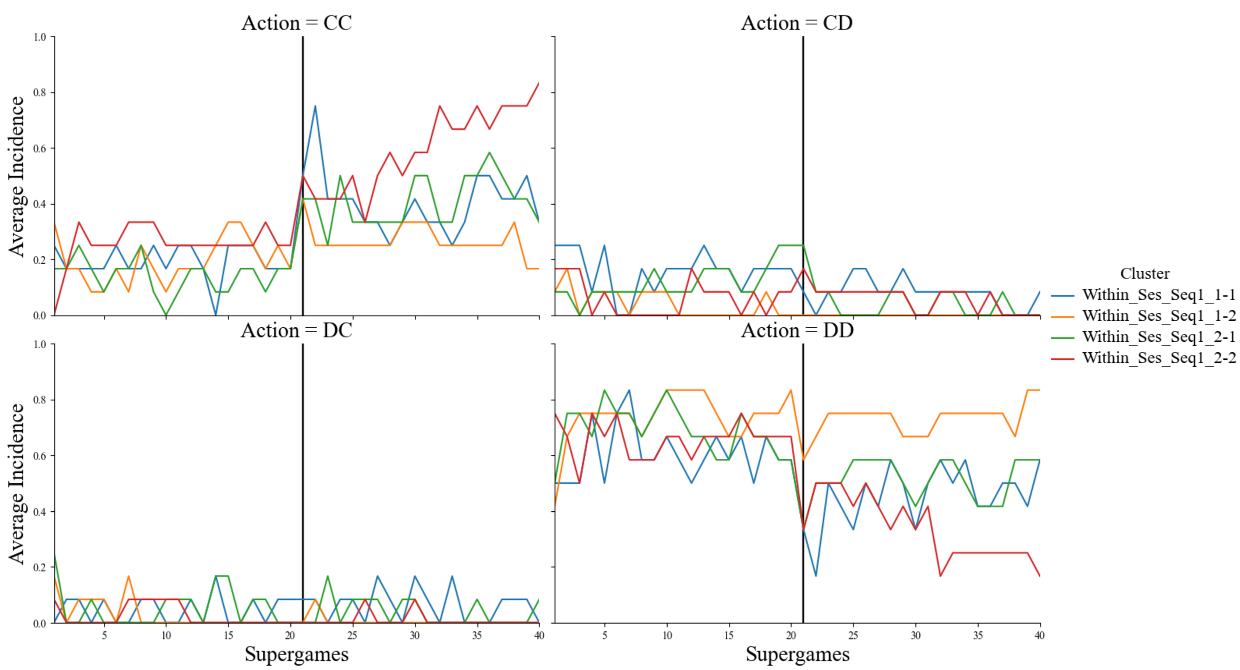


Figure 26: Average Incidence of Actions by Section and Supergame in Sequence 1 (First Period)

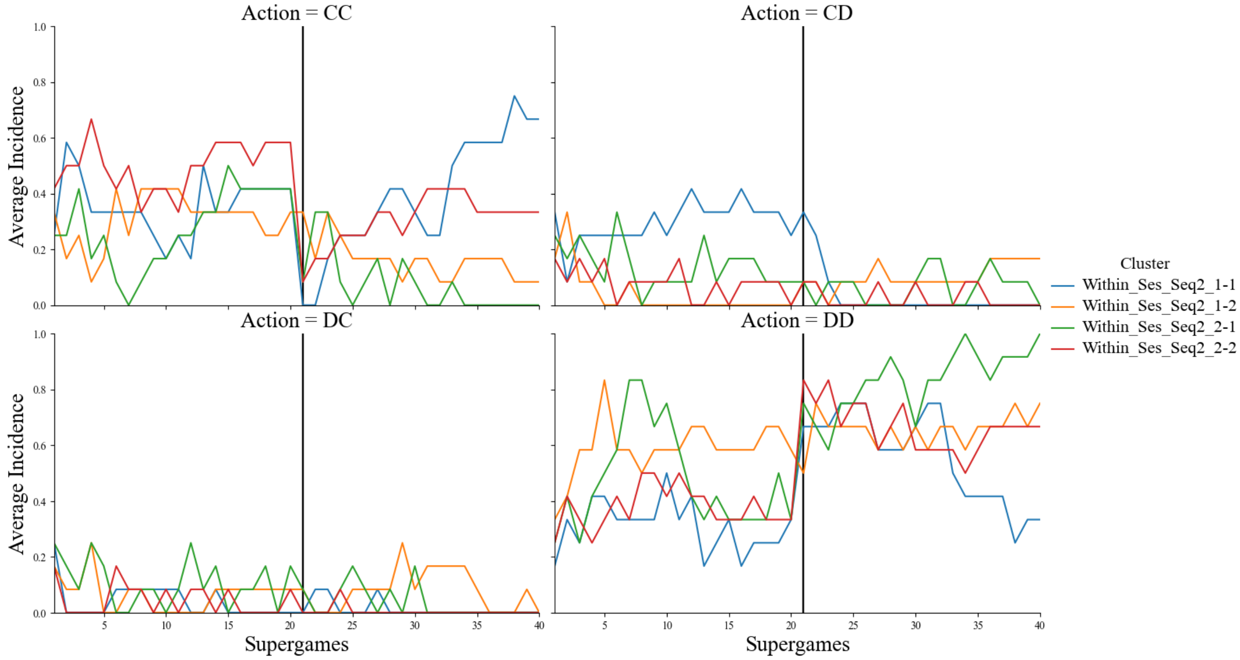


Figure 27: Average Incidence of Actions by Section and Supergame in Sequence 2 (First Period)

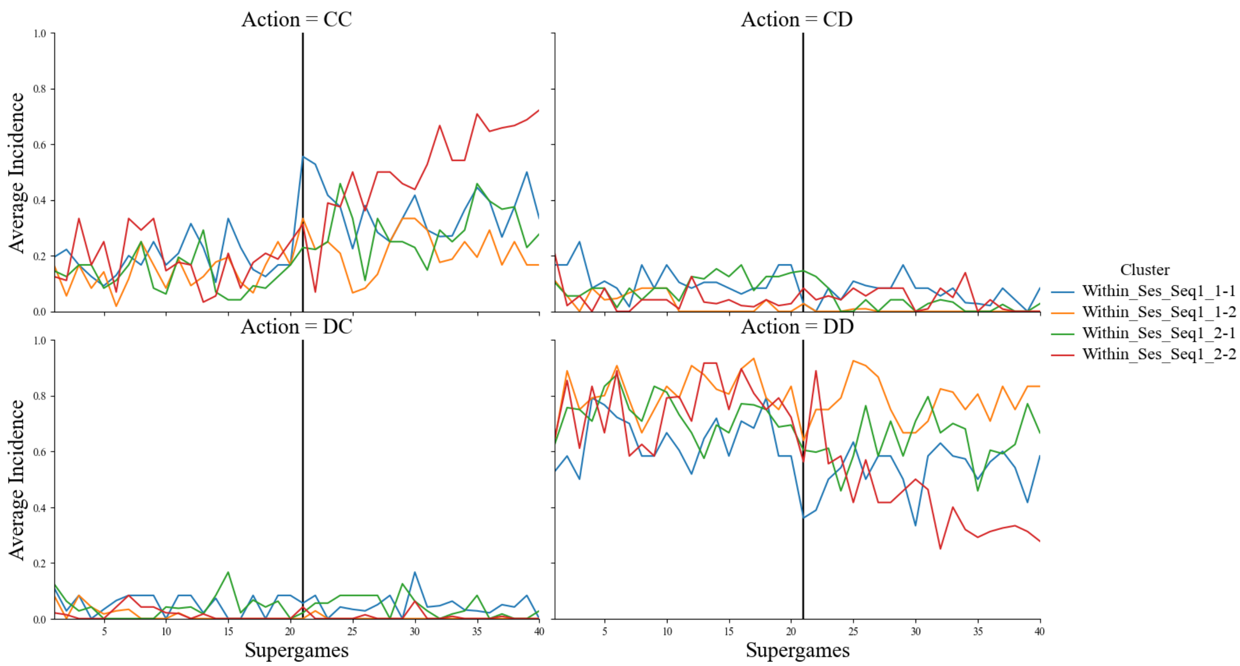


Figure 28: Average Incidence of Actions by Section and Supergame in Sequence 1 (All Periods)

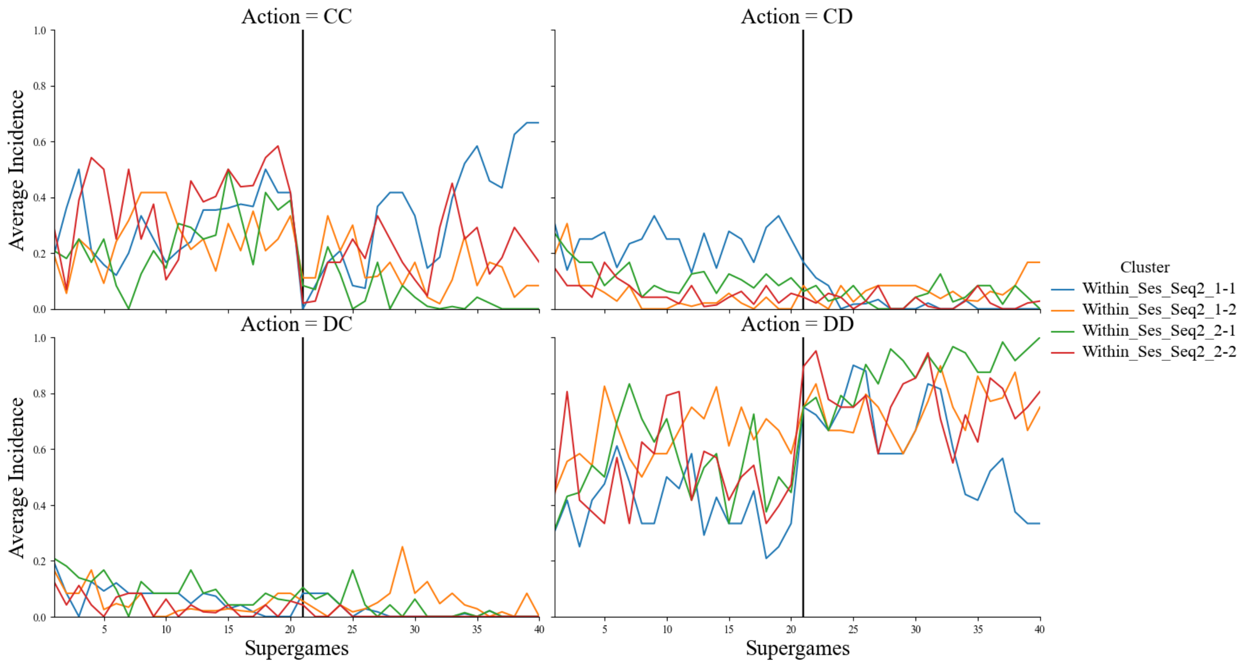


Figure 29: Average Incidence of Actions by Section and Supergame in Sequence 2 (All Periods)

	Sequence 1		Sequence 2	
	Linked	Split	Linked	Split
CC	0.004	0.001	0.006	0.005
	(0.006)	(0.001)	(0.0025)	(0.009)
CD	-0.004^{***}	-0.0002	-0.003	-0.001
	(0.0005)	(0.0027)	(0.003)	(0.004)
DC	-0.0016^{***}	-0.002	-0.003^{***}	-0.002
	(0.0002)	(0.0015)	(0.0004)	(0.0014)
DD	0.001	0.001	0.0004	-0.002
	(0.006)	(0.003)	(0.003)	(0.005)
N	960	960	960	960
i	48	48	48	48
# of Clusters	4	4	4	4

Table 15: Marginal Effect of Supergame on Joint Choices in Study 2 (First Period)

A.4.1 Categorization

A.4.2 Clustering

	Sequence 1		Sequence 2	
	Linked	Split	Linked	Split
CC	0.009	0.001	0.010^{***}	0.006
	(0.005)	(0.001)	(0.002)	(0.006)
CD	-0.003^{+}	-0.001	-0.006^{***}	-0.002^{+}
	(0.0016)	(0.002)	(0.001)	(0.001)
DC	-0.001^{+}	-0.0013^{+}	-0.006^{***}	-0.0025^{*}
	(0.0007)	(0.0007)	(0.001)	(0.001)
DD	-0.005	0.001	-0.004	-0.002
	(0.007)	(0.002)	(0.003)	(0.006)
N	3984	3984	3984	3984
i	48	48	48	48
# of Clusters	4	4	4	4

Table 16: Marginal Effect of Supergame on Joint Choices in Study 2 (All Periods)

	(1)	(2)	(3)	(4)	(5)	(6)
CC	0.110^{***}	0.110^{***}	0.076^{***}	0.043^{+}	0.007	-0.012^{*}
	(0.031)	(0.030)	(0.002)	(0.022)	(0.014)	(0.005)
CD	0.040	0.040	-0.073^{***}	0.042	0.040	-0.042^{***}
	(0.036)	(0.036)	(0.004)	(0.029)	(0.030)	(0.002)
DC	0.035	0.034	-0.033^{***}	0.035	0.030	-0.026^{***}
	(0.023)	(0.023)	(0.002)	(0.023)	(0.022)	(0.002)
DD	-0.185^{*}	-0.184^{*}	0.030^{***}	-0.120^{+}	-0.077	0.081^{***}
	(0.072)	(0.072)	(0.004)	(0.065)	(0.057)	(0.005)
# Observations	7968	7968	7968	6048	6048	6048
# Subjects	96	96	96	96	96	96
Clustering	Sessions	Sessions	Sessions	Sessions	Sessions	Sessions
# Clusters	8	8	8	8	8	8
Log-Likelihood	-6003.465	-5923.57	-5975.715	-3934.716	-3693.366	-3617.636
AIC	12022.93	11863.14	11967.43	7885.432	7400.732	7251.271
BIC	12078.8	11919.01	12023.3	7939.092	7447.684	7304.931
$\mathrm{I}_{P=1}$	✓	✓	✓			
Supergame		✓				✓
Cluster FE			✓			✓
$(\text{Other's Action})_{(t-1)}$				✓	✓	✓
$(\text{My Action})_{(t-1)}$					✓	✓

Table 17: Marginal Effect of Linked Treatments with Asymmetric Stage Payoffs
(All Periods, Within Subject, First Treatment)

Notes: This table shows the marginal effect of the Linked treatment over Split treatment with Asymmetric Payoffs. The data is from the first treatment administered in each session of Within-Subject design. Each observation is the action taken in each period of each supergame by a subject. The action choices (CC, CD, DC, DD) are regressed on the treatment dummy (Linked = 1, Split = 0) and the other regressors listed on the lowest panel in the table using a Panel Multinomial Logistic Regression Model. The cluster robust standard errors are shown in the parentheses below the marginal effects.
Short forms: FE – Fixed Effects, FP – First Period, FS – First Supergame
Symbols: p-values $^{***} < 0.001$, $^{**} < 0.01$, $^{*} < 0.05$, $^{+} < 0.1$

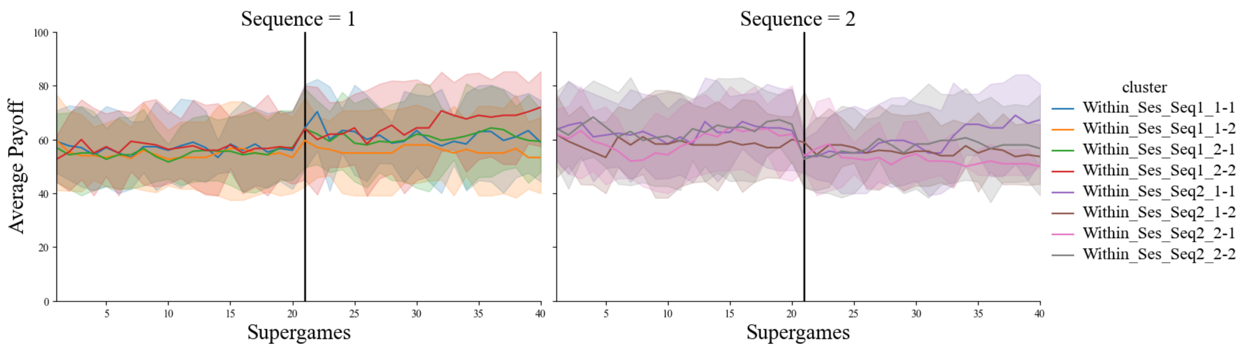


Figure 30: Average Payoff by Section and Supergame (First Period)

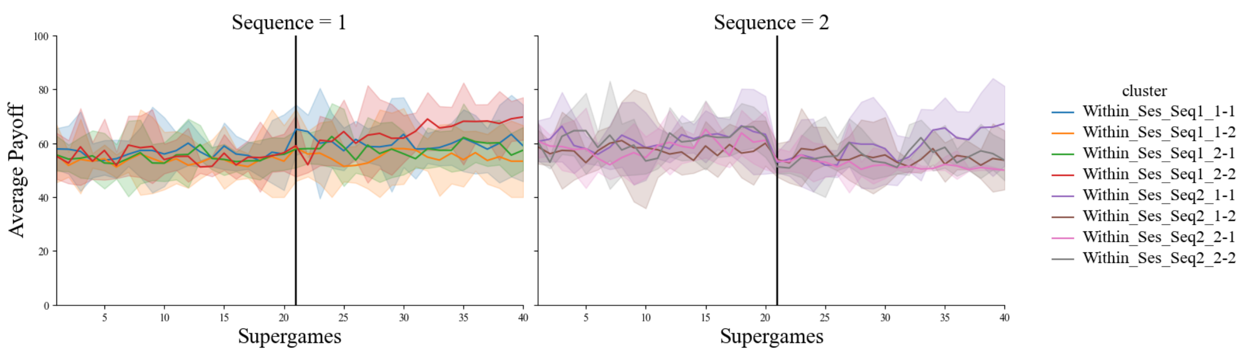


Figure 31: Average Payoff by Section and Supergame (All Periods)

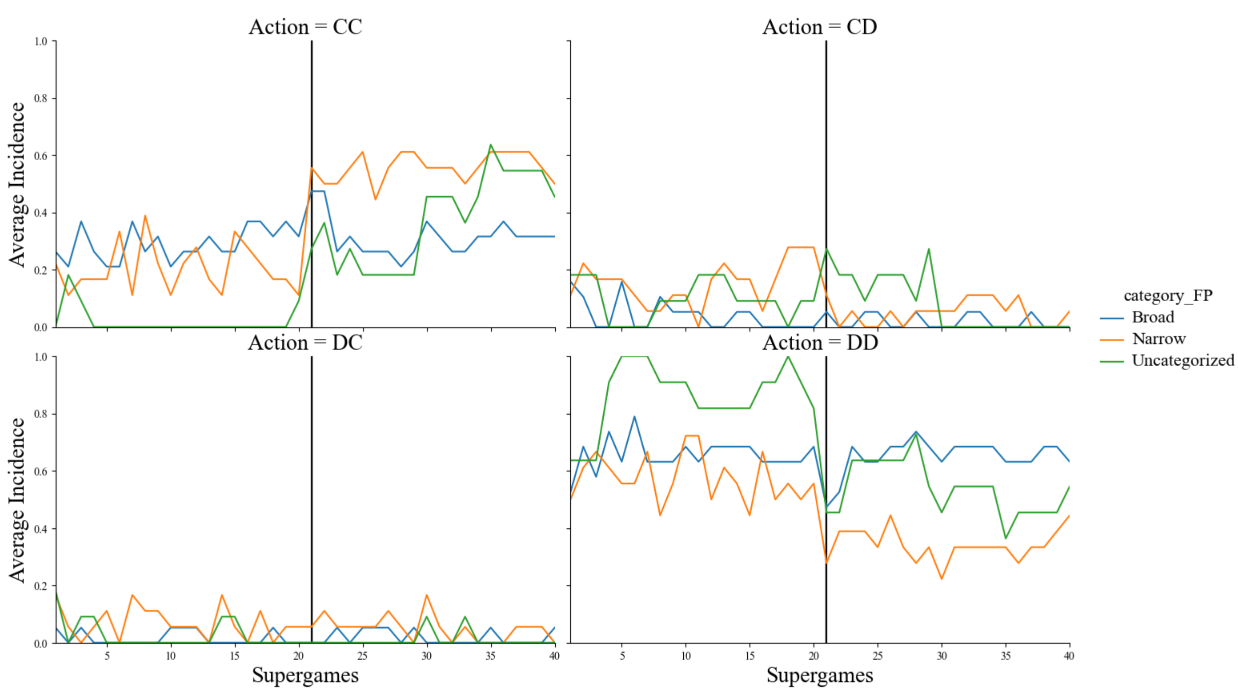


Figure 32: Average Incidence of Actions by Category and Supergame in Sequence 1 (First Period)

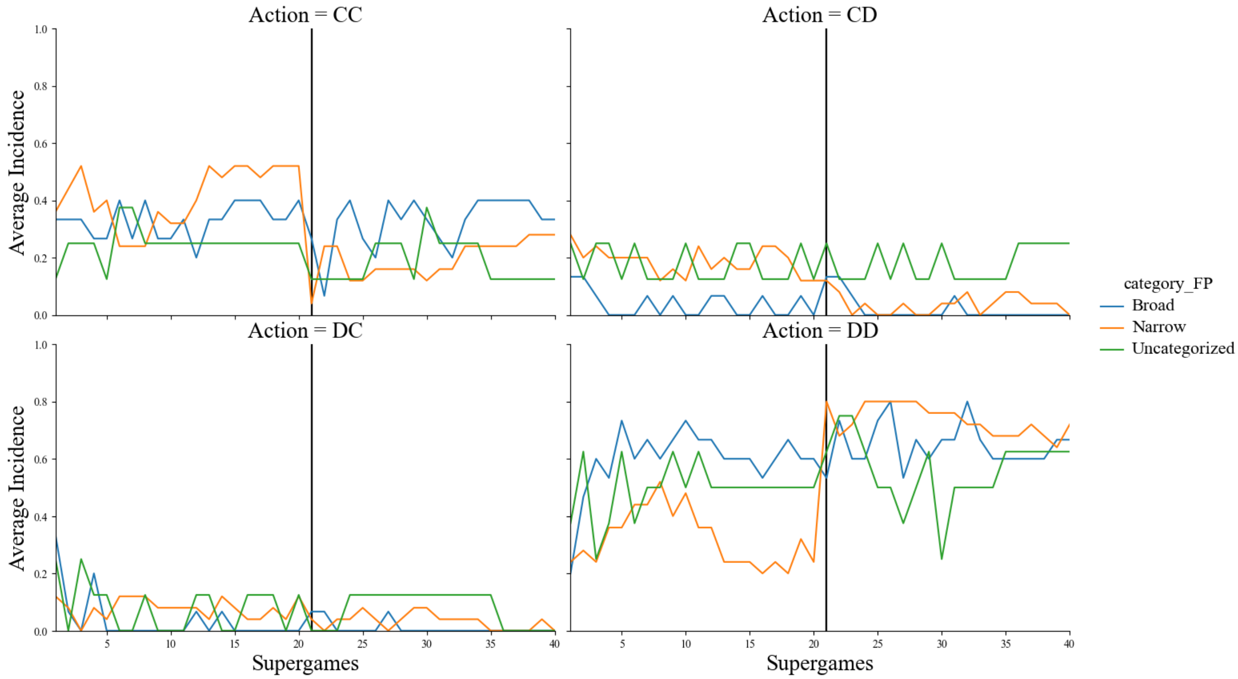


Figure 33: Average Incidence of Actions by Category and Supergame in Sequence 2 (First Period)

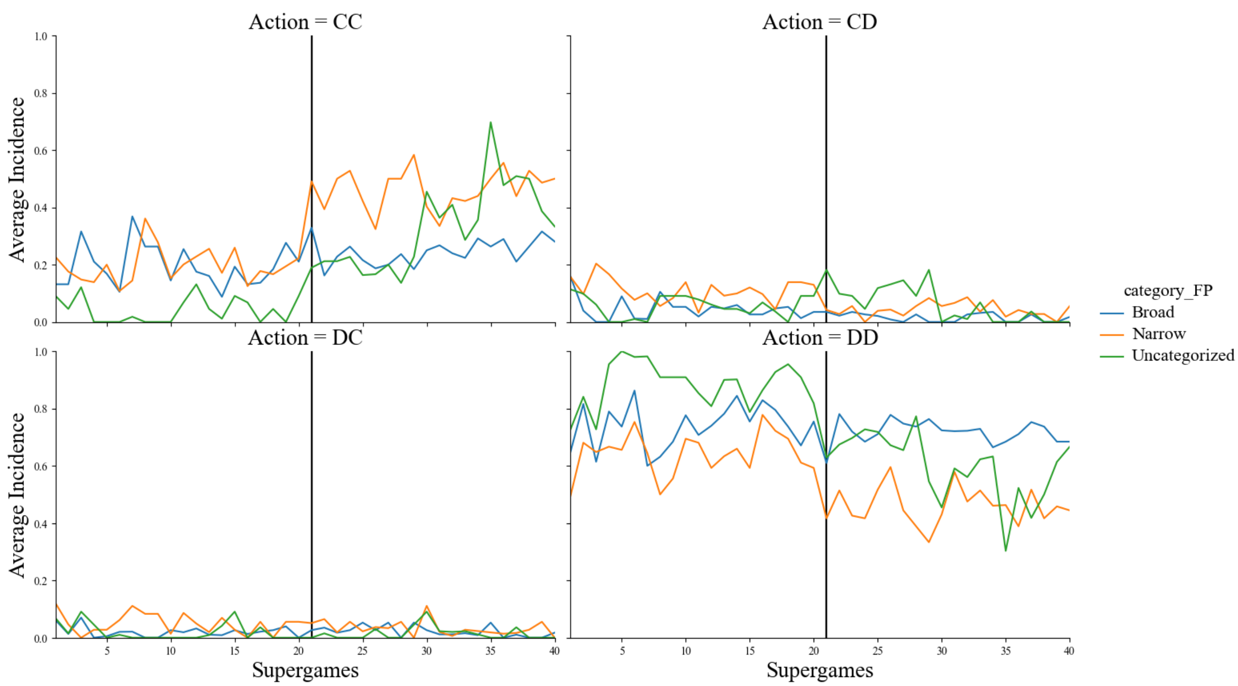


Figure 34: Average Incidence of Actions by Category and Supergame in Sequence 1 (All Periods)

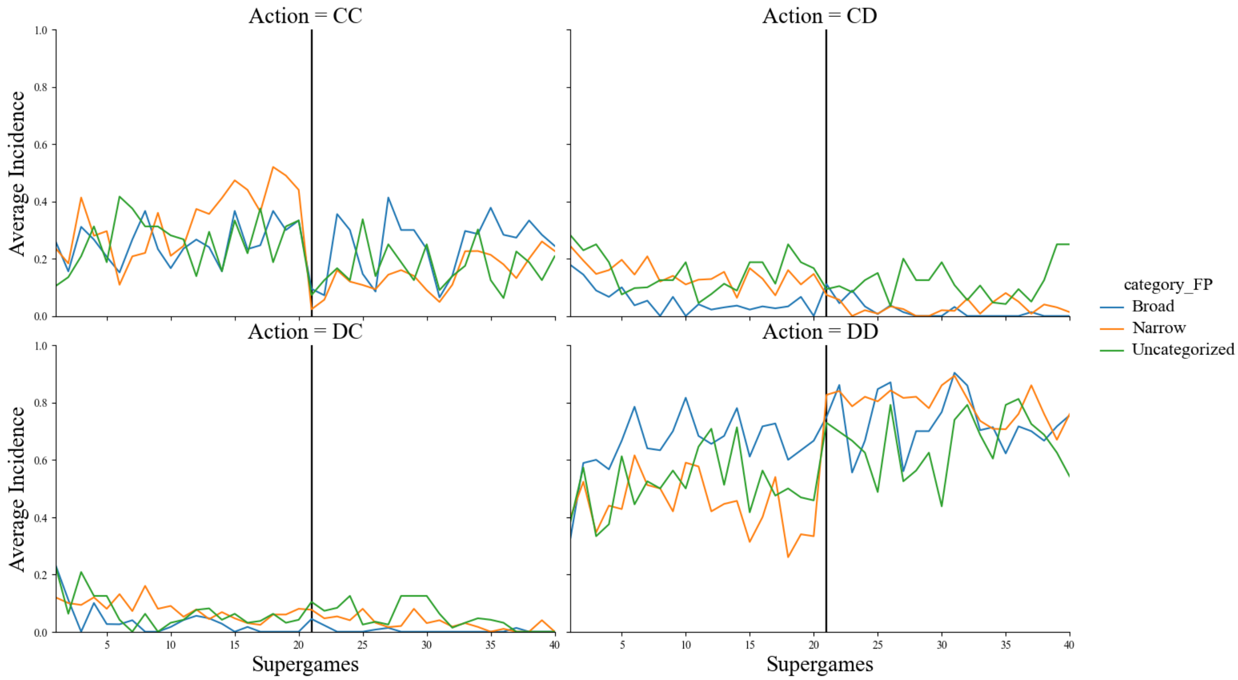


Figure 35: Average Incidence of Actions by Category and Supergame in Sequence 2 (All Periods)

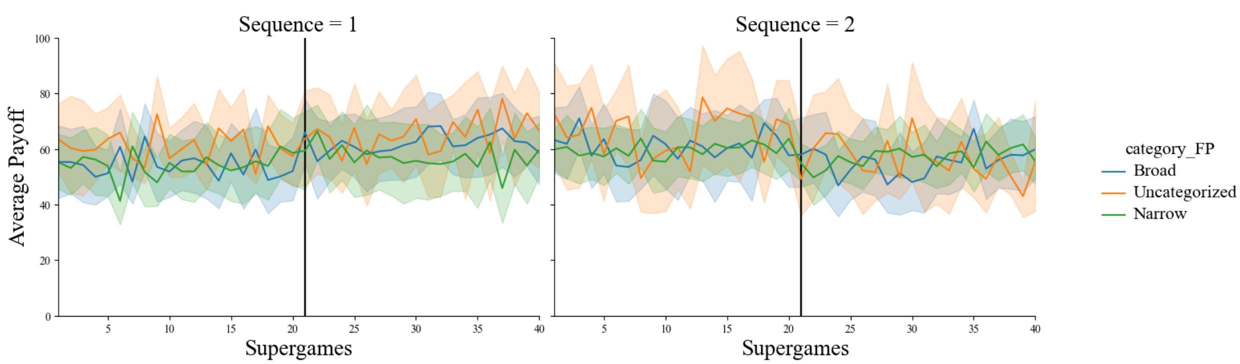


Figure 36: Average Payoff by Category and Supergame (First Period)

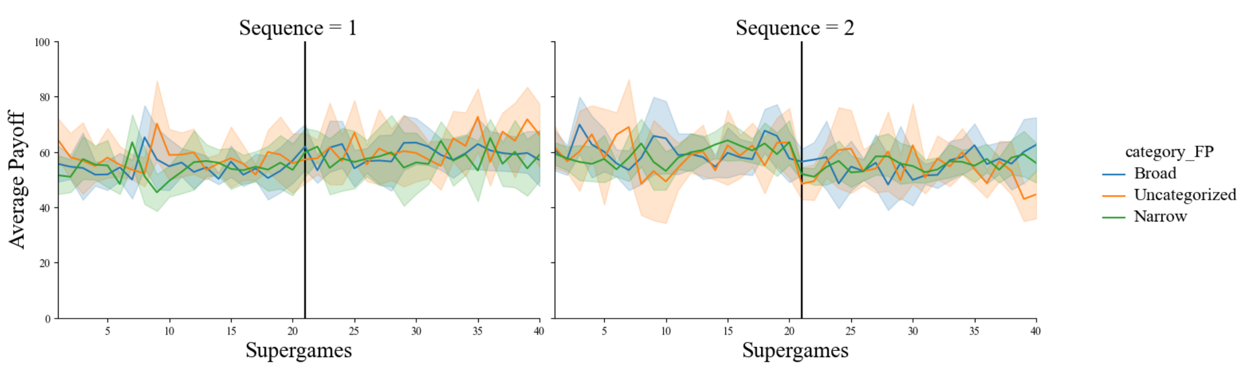


Figure 37: Average Payoff by Category and Supergame (All Periods)

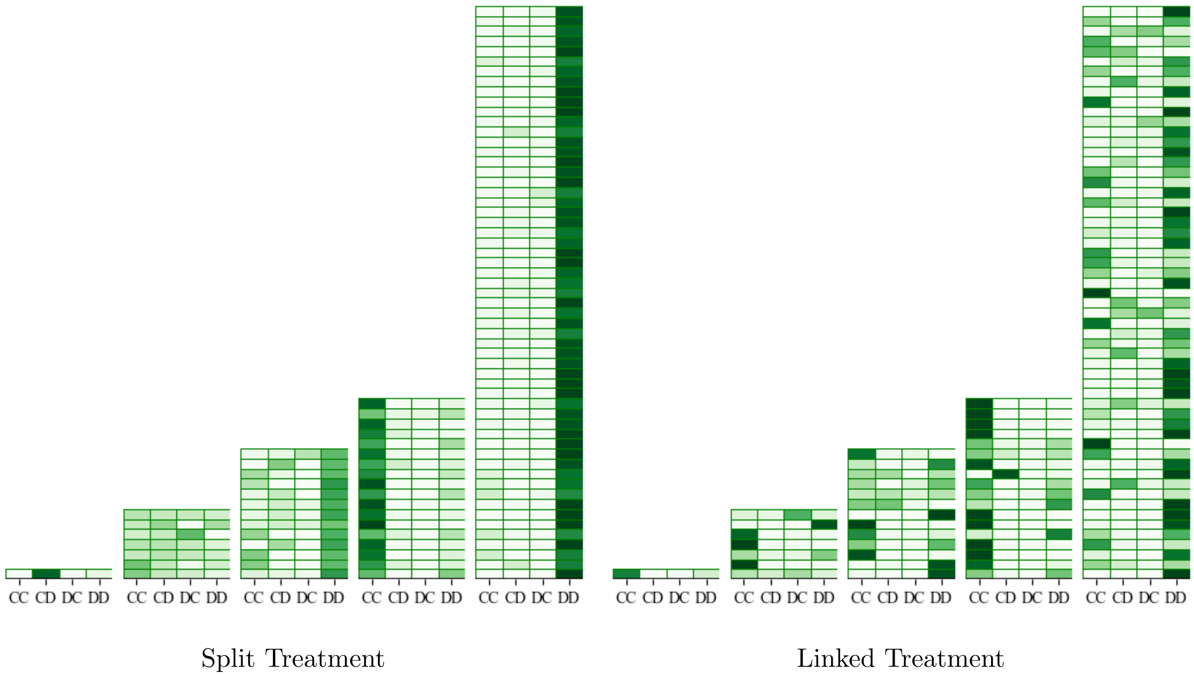


Figure 38: Clusters from Fitting Affinity Propagation Algorithm on First-Period Choices in Split Treatment

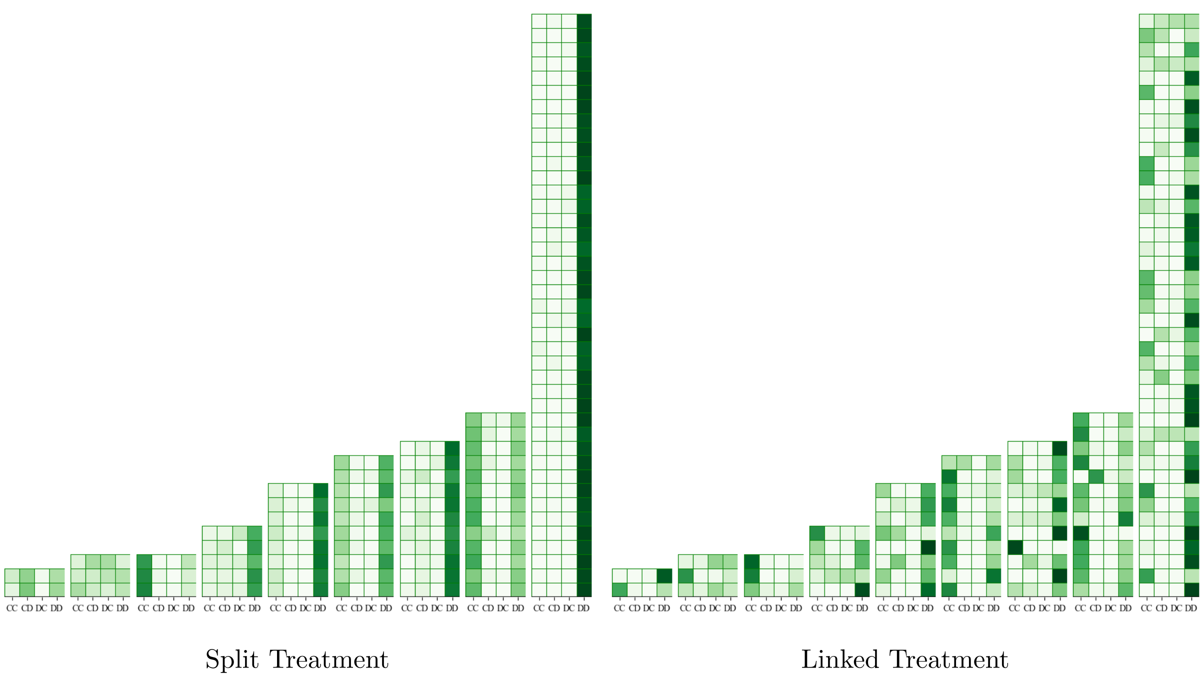


Figure 39: Clusters from Fitting Affinity Propagation Algorithm on Choices from All Periods in Split Treatment