Appendices

Pre-Play Communication with Forgone Costly Messages: Experimental Evidence on Forward Induction

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Appendix A: Theoretical Background

In this appendix we verify our claim that efficient play in the subgame without communication is the unique pure-strategy equilibrium outcome that passes Gonvindan and Wilson's (2009) FI test in the communication game with reasonable message costs. In addition we show that a variety of solution concepts that capture forward induction reasoning without reference to Nash equilibrium have little or no predictive power in our environment. This is the basis for our assertion that our experiment helps to differentiate empirically between formalizations of the forward-induction idea.

In our analysis, without loss of generality we will lump together strategies of a player that differ only at information sets ruled out by that player's strategy; e.g. if a player's strategy specifies sending a message, we will not explicitly keep track of that player's continuation play in the event that he does not send a messages. All the strategies that we group together are outcome equivalent and indistinguishable by opponents and outside observers. The only effect of carrying the distinction along would be to increase notational burden. In our game with two

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costly messages, the option of not sending a message, and two choices at the action stage, each player has 3×2^9 strategies before and 24 strategies after grouping together outcome-equivalent strategies.

Before applying Govindan and Wilson's forward induction (GW-FI) test to our game, we briefly recall the limited power of Iterative Admissibility (IA), Extensive Form Rationalizability (EFR), and Fully Permissible Sets (FPS) when two players have the option to burn money. To keep this part of the analysis tractable we conduct it for the one-message game where each player has exactly one costly message; later, when we return to applying GW-FI, we do so for the two-message game where each player has two costly messages as in our experiment. In the one-message game, a player who uses strategy *Mij* sends a message, takes action *i* if he receives a message and takes action *j* if he does not receive a message. Similarly *Nij* stands for the strategy of not sending a message, responding to a message with action *i* and taking action *j* if no message is received. For convenience, Table A.1. reports the payoffs from all resulting combinations of these strategies.

Table A.1: Communication Game with One Costly Message

	M22	M21	M12	M11	N22	N21	N12	N11
M22	1000-c, 1000-c	1000-c, 1000-c	-c, 800-c	-c, 800-c	1000-c, 1000	1000-c, 1000	-c, 800	-c, 800
M21	1000-c, 1000-c	1000-c, 1000-c	-c, 800-c	-c, 800-c	800-c, 0	800-c, 0	800-c, 800	800-c, 800
M12	800-c, -c	800-c, -c	800-c, 800-c	800-c, 800-c	1000-c, 1000	1000-c, 1000	-c, 800	-c, 800
M11	800-c, -c	800-c, -c	800-c, 800-c	800-c, 800-c	800-c, 0	800-c, 0	800-c, 800	800-c, 800
N22	1000, 1000-c	0, 800-c	1000, 1000-c	0, 800-c	1000, 1000	0, 800	1000, 1000	0, 800
N21	1000, 1000-c	0, 800-c	1000, 1000-c	0, 800-c	800, 0	800, 800	800, 0	800, 800
N12	800, -c	800, 800-c	800, -c	800, 800-c	1000, 1000	0, 800	1000, 1000	0, 800
N11	800, -c	800, 800-c	800, -c	800, 800-c	800, 0	800, 800	800, 0	800, 800

This is the reduced strategic form of the game in which players have a choice between sending a message, M, and not sending a message, N. A strategy Mij prescribes sending a message, M, taking action i if the opponent sent a message and action j if the opponent did not send a message. A strategy Nij prescribes not sending a message, N, taking action i if the opponent sent a message and action j if the opponent did not send a message. In each cell the entry in the Northwest corner is the row player's payoff and the entry in the Southeast corner is the column player's payoff. The cost of sending a message is indicated by c.

Informally, players in a game use forward induction when they seek to predict another player's future behavior by rationalizing his past actions. There are two strands in the literature that formalize this idea, one that references equilibrium outcomes and one that does not.
The non-equilibrium literature on forward induction starts with Pearce's (1984) introduction of the extensive-form rationalizability condition (EFR). The key idea is that a player will not use a strategy that fails to be a best response to all beliefs at an information set reached by that strategy. Strategies that do not pass this test are eliminated and the test is repeated on the reduced set of strategies until the process converges (to the EFR set).

EFR has forward induction implications because, at a given information set, it restricts the beliefs of the player moving there about strategies of others in accordance with their rationality.[1] The conditions on players' rationality and beliefs that give rise to EFR and related notions of iterated dominance have been clarified by the epistemic game theory literature. In particular, Battigalli and Siniscalchi (2002) show that EFR corresponds to *rationality and common strong belief in rationality* on complete type spaces. A similar characterization is available for iterative admissibility (IA), where in each round all weakly dominated strategies of all players are deleted; m+1 rounds of iterative deletion of weakly dominated strategies corresponds to *rationality and m-th order assumption of rationality* with complete type structures (Brandenburger, Friedenberg and Keisler, 2008). Finally, Asheim & Dufwenberg (2003) propose their notion of fully permissible sets (FPS), which in general neither implies nor is implied by IA or EFR, despite underlying assumptions that rule out weakly dominated strategies.

EFR, IA, and FPS come to the same conclusion for the one-message game. All three rule out the strictly dominated strategy M11 of sending a costly signal and then unconditionally playing action 1, and no more. Ben-Porath and Dekel (1992) already noted this coarseness of the IA prediction in money-burning games where more than one player has the option to burn money. For the sake of completeness we include proofs of all three claims for our game.

[1] A classical example of the power of this idea is its application to the battle of the sexes with an outside option: Player 1 has the choice between an outside option with a common payoff of 2 and entering a "battle of the sexes" with payoff pairs (3,1) and (1,3) at the two pure-strategy equilibria and (0,0) otherwise. Player 1's strategy of opting in and then playing for (1,3) is strictly dominated. Hence, if Player 2 is called upon to move he must believe Player 1 aims for (3,1). Given those restricted beliefs the strategy that might have given Player 2 a payoff of 3 is no longer a best reply and it is uniquely optimal for him to play according to the (3,1) equilibrium in the continuation game. As a result, Player 1 opts in and the forward-induction equilibrium payoff pair is (3,1).

Claim. *In the game where both players have a single costly message, with the exception of the strategy of sending a message and then taking action 1 unconditionally (M11), all pure strategies belong to the set of iteratively admissible (IA) strategies.*

Proof: We will check one by one that none of the remaining pure strategies are (weakly) dominated by either a pure or a mixed strategy, both before and after the strictly dominated strategy M11 is eliminated. Since the arguments for both cases are exactly the same, we will not explicitly distinguish them.

For N11 to be dominated, it has to be dominated by N21, the only other best reply against N11. But N21 does strictly worse against M21.

For N12 to be dominated, it has to be dominated by N22, the only other best reply against N22. But N22 does strictly worse against M21.

For N21 to be dominated, it has to be dominated by N22, the only other best reply against M12. But N22 does strictly worse against N21.

For N22 to be dominated, it has to be dominated by N21, the only other best reply against M22. But N21 does strictly worse against N22.

For M12 to be dominated, it has to be dominated by M22, the only other best reply against N21. But M22 does strictly worse against M12.

For M21 to be dominated, it has to be dominated by M22, the only other best reply against M21. But M22 does strictly worse against N12.

For M22 to be dominated, it has to be dominated by M21, the only other best reply against M21. But M21 does strictly worse against N22. **QED**

Claim. *In the game where both players have a single costly message, with the exception of the strategy of sending a message and then taking action 1 unconditionally (M11), all pure strategies belong to the set of extensive-form rationalizable (EFR) strategies.*

Proof: It suffices to construct for each pure strategy *S* that remains after M11 is removed and for every information set that is not ruled out by *S* a conjecture whose support does not include M11 and for which the strategy *S* is a best reply at that information set. Note that at an information set that is reached given the initial conjecture, the conjecture has to remain unchanged. We will use only conjectures that assign probability one to a pure strategy. It then suffices for every strategy *S* to specify an initial conjecture C_S and a conjecture for the information set that is reached when C_S is proved wrong. Denote this alternative conjecture by C_A; if, for example, a player initially conjectures that the other will send a message, he will need an alternative conjecture for the event that he does not receive a message. Accordingly, we will list for each strategy S a triple (S; C_S, C_A). One checks immediately that in the following list of such triples the strategy S is a best reply at the appropriate information sets: (M22; M21, N21), (M21; M21, N12),(M12; N21, M12), (N22; N22, M22), (N21; M12, N11), (N12; N12, M21), (N11; N11, M21). **QED**

Claim. *In the game where both players have a single costly message, with the exception of the strategy of sending a message and then taking action 1 unconditionally (M11), all pure strategies belong to a fully permissible set.*

Proof: We will not reproduce Asheim & Dufwenberg's (2003) definitions here. Suffice it to note that (as easily inferred via their paper) if we can find for each player a non-empty subset of strategies such that each contained strategy is neither weakly dominated nor weakly dominated given that the opponents are restricted to choose from their subsets, then each player's subset is fully permissible. Applied to Table A.1., we infer that for either player {M22, M21, M12, N22, N21, N12, N11} is fully permissible (as seen if we pick that subset for each player). The veracity of the claim is implied. **QED**

Note that, in particular, EFR (IA, FPS) does not rule out the outcome where no messages are sent and both take action 1. This is because sending a costly message and then playing action 1 is rational if it was done in the hope that the other player would also send a message but that message is not forthcoming. Therefore a player who observes the other player sending a message may nevertheless rationally believe that that player will take action 1. When both players have the option of sending a message, messages can be viewed as conditional statements. Sending a message may then be an offer of conditional cooperation: "I will take action 2 provided you send a message as well." In contrast, as we will see, with an approach that emphasizes the role of a equilibrium outcome, a player who sends an off-equilibrium-path message has no expectation of the other player sending a message as well. Since the other player's actions are pinned down by the equilibrium, his messages are unconditional and can be interpreted using equilibrium dominance: The deviating player expects at least as much from his deviation as from the reference equilibrium.

This equilibrium refinement approach to forward induction dates back to Kohlberg and Mertens (KM) (1986). They coined the term and in their Proposition 6 associated it with the property of stable sets of equilibria containing stable sets of games obtained by removing strategies that are not best replies to any of the equilibria in the set. KM did not formally define forward induction. For this reason and for its ease of applicability we use Govindan and Wilson's (2009) closely related definition (hereafter referred to as GW-FI).

We apply GW-FI to the two-message game that we used in our experiment. Recall that we do not distinguish a player's strategies that differ only in behavior at information sets that are precluded by those strategies. Then, a strategy μijk with $\mu \in \{M_1, M2\ \ , N\}$ and $i, j, k\ \in \{1,2\}$ specifies the choice of message (or none) μ, the response i to message M_1, the response j to message M_2 and the response k to no message, N.

Govindan and Wilson (2009) define forward induction in terms of Reny's (1992) "weak sequential equilibrium." Weak sequential equilibrium coincides with Kreps and Wilson's (1982) sequential equilibrium, except that a player's strategy need not prescribe best replies at information sets that are ruled out by that strategy. GW use a variant of weak sequential equilibrium in which beliefs at an information set are distributions over other players' strategies rather than over nodes in that information set.

Recall that an equilibrium outcome in a game is the distribution over terminal nodes induced by the strategies that support that equilibrium. The key concept in GW's definition of FI is that of a ***relevant strategy***: A pure strategy is relevant for the outcome of a game if there exists a weakly sequential equilibrium with that outcome such that the strategy is a best reply to equilibrium beliefs at every information set not excluded by that strategy. An information set is relevant for an outcome provided that not every combination of strategies relevant for that outcome precludes it. The forward induction requirement then asks that at relevant information sets beliefs be concentrated on relevant strategies.

Definition. (Govindan and Wilson, 2009) *An outcome satisfies* ***forward induction*** *if it results from a weakly sequential equilibrium in which at every information set that is relevant for that* *outcome the support of the belief of the player acting there is confined to profiles of Nature's strategies and other players' strategies that are relevant for that outcome.*

The following result classifies all pure-strategy equilibrium outcomes in the two-message game according whether or not they satisfy forward induction.

Claim. *In the game where each player has the option to either send no message,* $\boldsymbol{N}$*, or one of two costly messages,* $\boldsymbol{M_1}$ *and* $\boldsymbol{M_2}$*, (1) the equilibrium outcome* $\boldsymbol{NN}$**-1** *in which players send no message and take action 1 fails to satisfy forward induction; (2) the equilibrium outcomes* $\boldsymbol{M_r M_s}$***-2*** *with* $r, s = 1{,}2$ *in which players send message* $\boldsymbol{M_r}$ *and* $\boldsymbol{M_s}$ *respectively and take action 2 fail to satisfy forward induction; (3) the equilibrium outcomes* $\boldsymbol{NM_s}$**-2** and $\boldsymbol{M_s N}$**-2**, s=1,2, *in which exactly one player sends a message and both take action 2 fail to satisfy forward induction; and, (4) the equilibrium outcome* $\boldsymbol{NN}$**-2** *in which players send no message and take action 2 satisfies forward induction.*

Proof: (1) The $\boldsymbol{NN}$**-1** outcome is supported by the set of mixtures of strategies *Nij1, i,j=1,2,* that assign probabilities p_{Nij1} to those strategies that satisfy

$$p_{N211} + p_{N221} \leq \frac{800 + c}{1000}\text{ , and} \qquad (1)$$

$$p_{N121} + p_{N221} \leq \frac{800 + c}{1000}\,. \qquad (2)$$

The set of strategies that is relevant for this outcome is $\{Nij1, M_1ij2, M_2ij2\}_{i,j=1,2}$. Hence, at the (relevant) information set of player 1 where player 1 unexpectedly observes player 2 having sent message M_2, GW-FI requires us to restrict player 1's beliefs over player 2's strategies to the set $\{M_2ij2\}_{i,j=1,2}$. Against such beliefs neither *N111* nor *N211* are best replies. Therefore all best replies of player 1 that satisfy the GW-FI belief restriction violate condition (2).

(2) The $\boldsymbol{M_1 M_2}$***-2*** outcome (which we examine representatively for all $\boldsymbol{M_r M_s}$***-2*** equilibrium outcomes) is supported by mixtures over player 1's strategies $M_1 i2k$, with $i, k = 1{,}2$ that satisfy

$$p_{M_1 122} + p_{M_1 222} \leq \frac{1000 - c}{1000} \qquad (3)$$

and by mixtures over player 2's strategies $M_2 2jk$, with $j, k = 1{,}2$ that satisfy

$$p_{M_2 212} + p_{M_2 222} \leq \frac{1000 - c}{1000} . \qquad (4)$$

The set of player 2's strategies that is relevant for this outcome is $\{N2jk, M_1 2jk, M_2 2jk\}_{j,k=1,2}$. Hence, at the (relevant) information set of player 1 where player 1 unexpectedly observes player 2 not having sent a message, GW-FI requires us to restrict player 1's beliefs over player 2's strategies to the set $\{N2jk\}_{j,k=1,2}$. Any mixture over player 1's strategies $M_1 i2k$, with $i, k = 1,2$, that is a best reply to such beliefs must satisfy $p_{M_1 121} = p_{M_1 221} = 0$ and therefore $p_{M_1 122} + p_{M_1 222} = 1$, in violation of condition (3).

(3) The $\boldsymbol{NM_2}$**-2** outcome (which we examine representatively for all $\boldsymbol{NM_s}$***-2*** and $\boldsymbol{M_s N}$***-2*** equilibrium outcomes, s=1,2) is supported by arbitrary mixtures of player 2 over strategies in the set $\{M_2 ij2\}_{i,j=1,2}$ and by mixtures of player 1 over strategies in the set $\{Ni2k\}_{i,k=1,2}$ that satisfy the condition

$$p_{N122} + p_{N222} \leq \frac{1000 - c}{1000} . \qquad (5)$$

The set of strategies of player 2 that is relevant for this outcome is $\{Nij2, M_1 ij2, M_2 ij2\}_{i,j=1,2}$. Consider the relevant information set of player 1 who has followed his equilibrium strategy, not sent a message and who has observed a deviation by player 2 to not sending a message. GW-FI requires us to restrict the support of player 1's beliefs at this information set to the set of strategies $\{Nij2\}_{i,j=1,2}$. Against such beliefs, however, no strategy of player 1 that assigns positive probability to any of the strategies in the set $\{Ni21\}_{i,j=1,2}$ is a best reply. Any mixture over player 1's strategies $Ni2k$, with $i, k = 1,2$, that is a best reply to such beliefs must satisfy $p_{N121} = p_{N221} = 0$ and therefore $p_{N122} + p_{N222} = 1$, in violation of condition (5).

(4) The equilibrium outcome $\boldsymbol{NN}$**-2** is supported by arbitrary mixtures over strategies in the set $\{Nij2\}_{i,j=1,2}$. These strategies are also the relevant strategies. Hence the only relevant information sets for this outcome are the ones where neither player has sent a message. Since they are on the equilibrium path, the belief restriction has no bite. **QED**

Appendix B: Instructions (RC-10 Condition)

General Information:

This is an experiment in decision-making. This study has been reviewed by the University of Pittsburgh's Institutional Review Board and been given expedited approval.

Thank you for attending the experiment. The purpose of this session is to study how people make decisions. **If you have any questions during the experiment, please raise your hand and wait for an experimenter to come to you. Please do not talk, exclaim, or try to communicate with other participants during the experiment.** Participants intentionally violating the rules may be asked to leave the experiment and may not be paid.

You will be paid for your participation. You will receive a $2 participation fee in addition to the money you make from the game that we will describe shortly. All payoffs during the experiment are denominated in an artificial currency, experimental currency units (ECU). At the end of the experiment, ECU will be converted to cash at the rate of $1 per 2500 ECU. Upon completion of the experiment, your earnings will be converted to dollars and you will be paid privately, in cash. The exact amount you receive will be determined during the experiment and will depend on your decisions and the decisions of other participants.

Please click "Continue" when you are ready.
If you have a question, please raise your hand and wait for the experimenter.

Continue

Playing the Game:

This experiment consists of 40 periods. In each period, you will be randomly matched with another player. You will never know this player's identity and he or she will never know your identity.

You and this other player will each make a decision based on the table below. The amounts shown in the table will reflect the possible payments you might receive. This payment depends on the choice that you make and the choice that the other player makes.

Each participant will choose strategy 1 or strategy 2. You may change your choices as often as you like, but once you click on "OK" your choice will be final. Note that when you make your decision you will not know the choice of the other player.

After you and the other player have made your decisions, the outcome of the period will be revealed to you and the other player. You will see both your strategy choice and the choice of the other player and your earnings for that period. When you are ready to continue, the computer will randomly match you with another participant and you will play the game again.

Payoff Table

		Other Player's Choice	
		1	2
Your Choice	1	Your Payoff: 800 Other's Payoff: 800	Your Payoff: 800 Other's Payoff: 0
	2	Your Payoff: 0 Other's Payoff: 800	Your Payoff: 1000 Other's Payoff: 1000

Please click "Continue" after you have read the above carefully.
If you have a question, please raise your hand and wait for the experimenter.

Continue

Payoff Quiz

Before we begin the experiment, we would like you to answer a few questions to make sure that everyone understands the task. Everyone will answer the same questions before we proceed. Once you answer the questions below, please click "Continue." If you have answered any questions incorrectly, you will be asked to try those questions again. Please raise your hand if you are having trouble answering any of the questions.

Payoff Table

		Other Player's Choice: 1	Other Player's Choice: 2
Your Choice	1	Your Payoff: 800 Other's Payoff: 800	Your Payoff: 800 Other's Payoff: 0
	2	Your Payoff: 0 Other's Payoff: 800	Your Payoff: 1000 Other's Payoff: 1000

1) Suppose you choose 1 and the other player chooses 1.

Your payoff in ECU:

Other player's payoff in ECU:

2) Suppose you choose 1 and the other player chooses 2.

Your payoff in ECU:

Other player's payoff in ECU:

3) Suppose you choose 2 and the other player chooses 1.

Your payoff in ECU:

Other player's payoff in ECU:

4) Suppose you choose 2 and the other player chooses 2.

Your payoff in ECU:

Other player's payoff in ECU:

5) Each period, I will be randomly matched with a different player than in the previous period.

- TRUE
- FALSE

Please click "Continue" when you are ready.

Continue

Sending a Message:

Because the other player's choice partly determines your payoff, you may wish to send a message to the other player. If you send a message, you may choose message "1" or "2" to indicate the choice that you intend to make. If you choose to send a message, you will incur a cost of 10 ECU. Sending a message does not commit you to any particular choice. That is, you are not required to choose the action that corresponds to the message you send.

You may also choose not to send a message. If you do not send a message, you will not pay 10 ECU.

The other player will also have the same option of sending a message to you. If the other player chooses to send a message, he or she will pay 10 ECU.

Receiving a message from the other player is costless. That is, even if you choose not to send a message you will receive the other player's message if he or she sent one.

After you both decide whether to send messages and after you both observe any message sent by the other player, you will make choices in the task.

Please click "Continue" when you are ready.
If you have a question, please raise your hand and wait for the experimenter.

Continue

Appendix C: Additional Analysis

Table C.1A. Comparisons of Messages and Choices Early and Late in Experiment
(Periods 1 vs. 40)

	Costless	RC-10	RC-100	UC-300	No Messages
Message 2 (Period 1)	83%	34%	14%	2%	
Message 2 (Period 40)	90%	31%	17%	3%	
	z = 0.76 *p = 0.45*	*z = 0.36* *p = 0.72*	*z = 0.46* *p = 0.64*	*z = 0.59* *p = 0.56*	
Choice 2 (Period 1)	90%	79%	80%	56%	53%
Choice 2 (Period 40)	83%	84%	83%	6%	33%
	z = 0.76 *p = 0.45*	*z = 0.87* *p = 0.38*	*z = 0.43* *p = 0.66*	*z = 5.41* *p < 0.001*	*z = 1.56* *p = 0.12*

Note: statistical tests of binomial proportions

Table C.1B. Comparisons of Messages and Choices Early and Late in Experiment
(Periods 1-10 vs. 31-40)

	Costless	RC-10	RC-100	UC-300	No Messages
Message 2 (Period 1)	88%	25%	10%	4%	
Message 2 (Period 40)	89%	28%	14%	5%	
	$t_{58} = 0.14$ $p = 0.89$	$t_{138} = 0.60$ $p = 0.55$	$t_{138} = 0.89$ $p = 0.37$	$t_{98} = 0.20$ $p = 0.84$	
Choice 2 (Period 1)	91%	82%	74%	52%	52%
Choice 2 (Period 40)	83%	83%	80%	9%	30%
	$t_{58} = 1.26$ $p = 0.21$	$t_{138} = 0.06$ $p = 0.95$	$t_{58} = 1.18$ $p = 0.24$	$t_{98} = 7.14$ $p < 0.001$	$t_{58} = 1.87$ $p = 0.07$

Note: statistical tests of mean frequency (by subject)

Table C.2: Random-effects Probit Regressions of Message "2" Use

Dependent variable: Subject sent message "2"	All periods		Period 1	Periods 2 - 40
	(1)	(2)	(3)	(4)
Reasonably Costly Messages (RC-10)	-4.384*** (0.404)	-4.410*** (0.441)	-1.372*** (0.313)	-4.669*** (0.417)
Reasonably Costly Messages (RC-100)	-5.165*** (0.400)	-5.218*** (0.438)	-2.035*** (0.329)	-5.442*** (0.409)
Unreasonably Costly Messages (UC-300)	-5.891*** (0.419)	-5.777*** (0.464)	-3.021*** (0.492)	-6.086*** (0.429)
Period		0.006 (0.008)		
Period X Reasonably Costly Messages (RC-10)		0.001 (0.009)		
Period X Reasonably Costly Messages (RC-100)		0.002 (0.009)		
Period X Unreasonably Costly Messages (UC-300)		-0.006 (0.010)		
Opponent in previous period sent message "2"				0.163** (0.069)
Constant	2.771*** (0.323)	2.662*** (0.361)	0.967*** (0.272)	2.882*** (0.332)
Observations	8,800	8,800	220	8,580
Number of subjects	220	220	220	220
Log Likelihood	-1884.94	-1880.18	-92.13	-1783.67

All models include data from all conditions with messages; models 1, 2, 4 and 5 include subject random effects
Standard errors in parentheses; * - $p < 0.1$; ** - $p < 0.05$; *** - $p < 0.01$

Table C.3: Random-effects Probit Regressions of Action Choice 2 in Stag-Hunt Subgame

Dependent variable: Subject chose action 2	All periods			Period 1	Period 1 & no messages
	(1)	(2)	(3)	(4)	(5)
Costless Messages	2.346*** (0.390)	2.115*** (0.450)	0.746* (0.453)	1.198*** (0.387)	
Reasonably Costly Messages (RC-10)	2.132*** (0.328)	1.261*** (0.368)	1.997*** (0.367)	0.708** (0.284)	0.591* (0.345)
Reasonably Costly Messages (RC-100)	1.735*** (0.327)	0.649* (0.366)	1.602*** (0.365)	0.758*** (0.286)	0.664** (0.310)
Unreasonably Costly Messages (UC-300)	-0.353 (0.341)	-0.003 (0.383)	-0.480 (0.381)	0.067 (0.290)	0.136 (0.295)
Period		-0.046*** (0.005)			
Period X Costless Messages		0.020** (0.008)			
Period X RC-10		0.049*** (0.006)			
Period X RC-100		0.059*** (0.006)			
Period X UC-300		-0.023*** (0.007)			
Received Message "2" (Costless Messages)			2.366*** (0.198)		
Received Message "2" X RC-10			-0.848*** (0.233)		
Received Message "2" X RC-100			-0.173 (0.250)		
Received Message "2" X UC-300			-0.745*** (0.249)		
Constant	-0.415 (0.272)	0.456 (0.308)	-0.435 (0.304)	0.084 (0.229)	0.084 (0.229)
Observations	10,000	10,000	10,000	250	148
Number of subjects	250	250	250	250	148
Log Likelihood	-3500.49	-3233.64	-3096.57	-136.18	-91.24

Models 1 through 4 include data from all conditions; model 5 omits Costless Messages condition; models 1 through 3 include subject random effects.
Standard errors in parentheses; * - p < 0.1; ** - p < 0.05; *** - p < 0.01

Figure C.1a: Frequency of Message 2 and Action 2 by Session (No Messages)

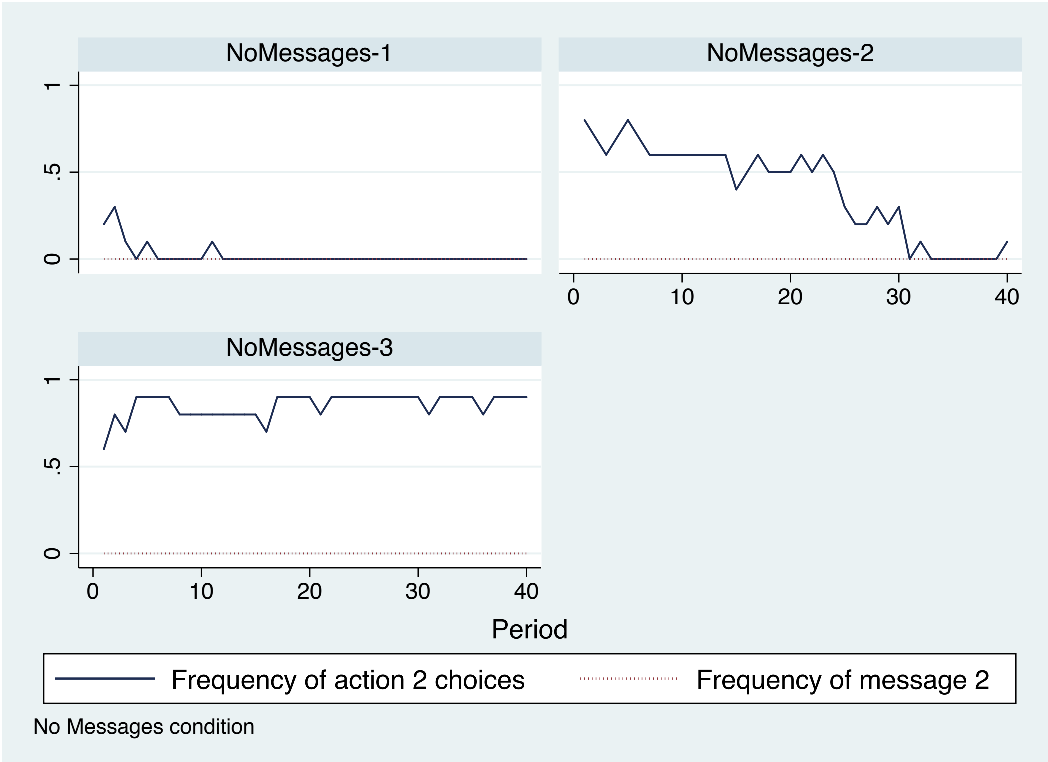


Figure C.1b: Frequency of Message 2 and Action 2 by Session (Costless Messages)

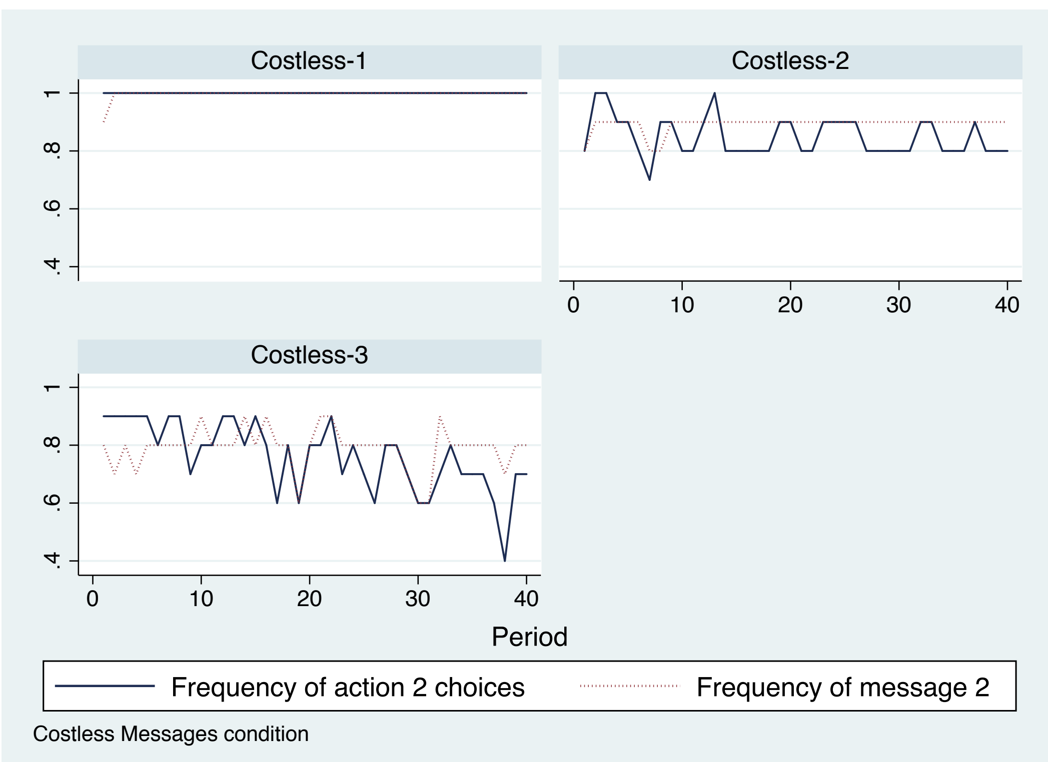


Figure C.1c: Frequency of Message 2 and Action 2 by Session (RC-10)

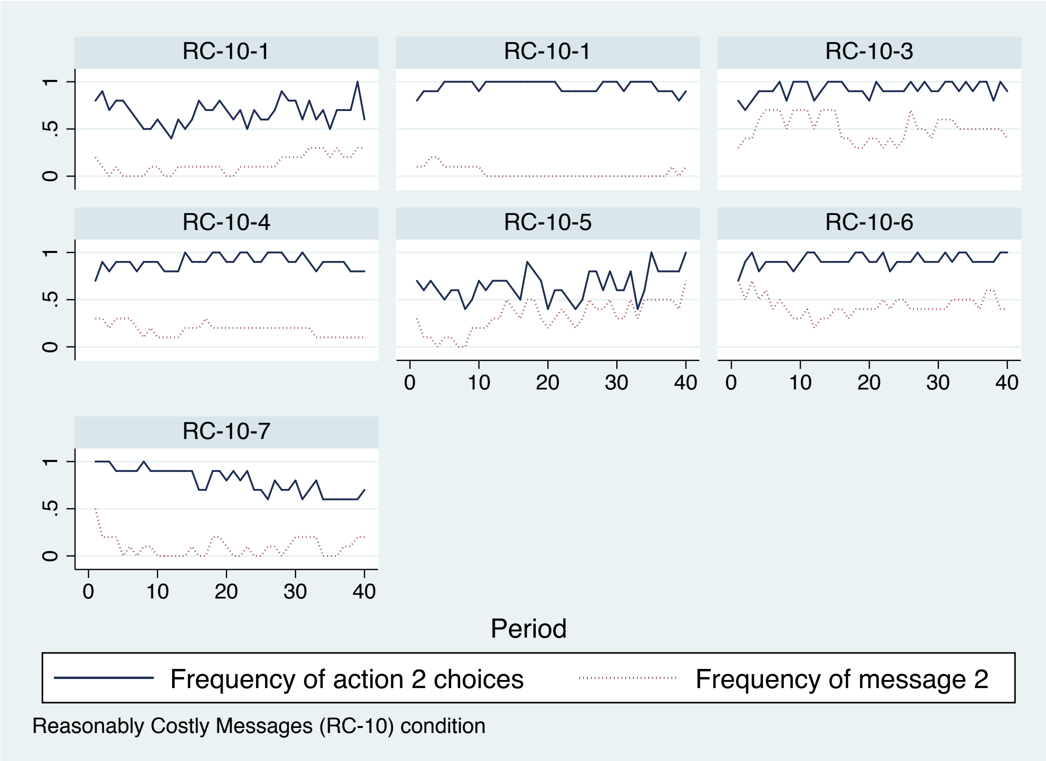


Figure C.1d: Frequency of Message 2 and Action 2 by Session (RC-100)

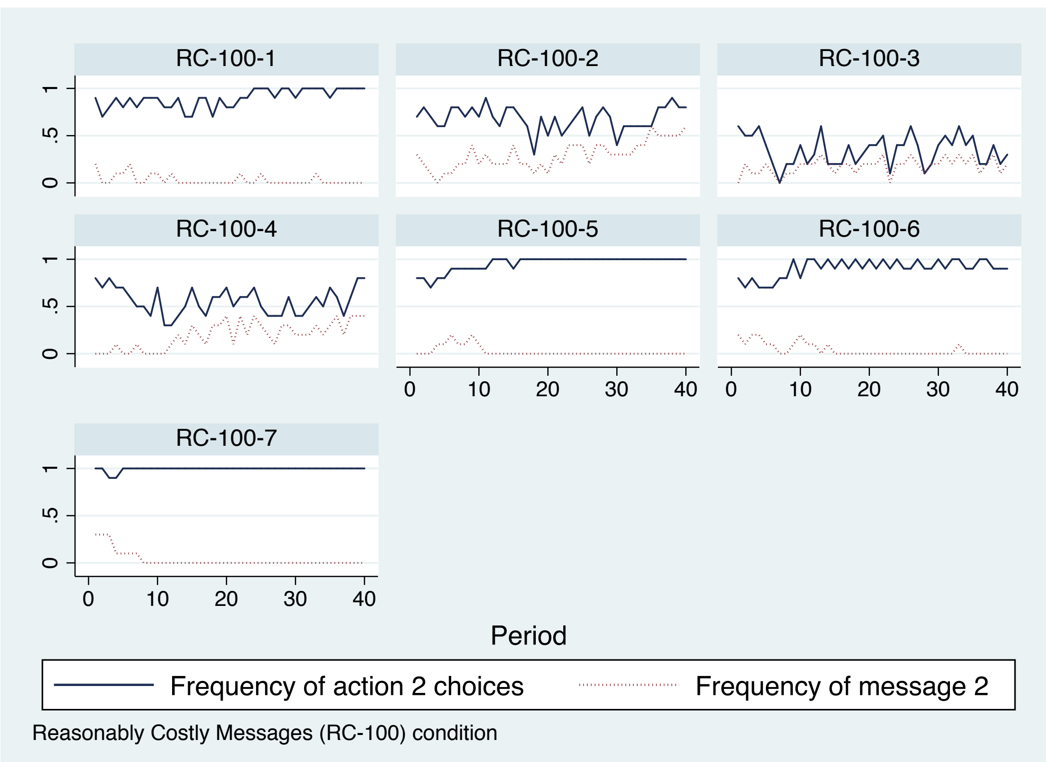
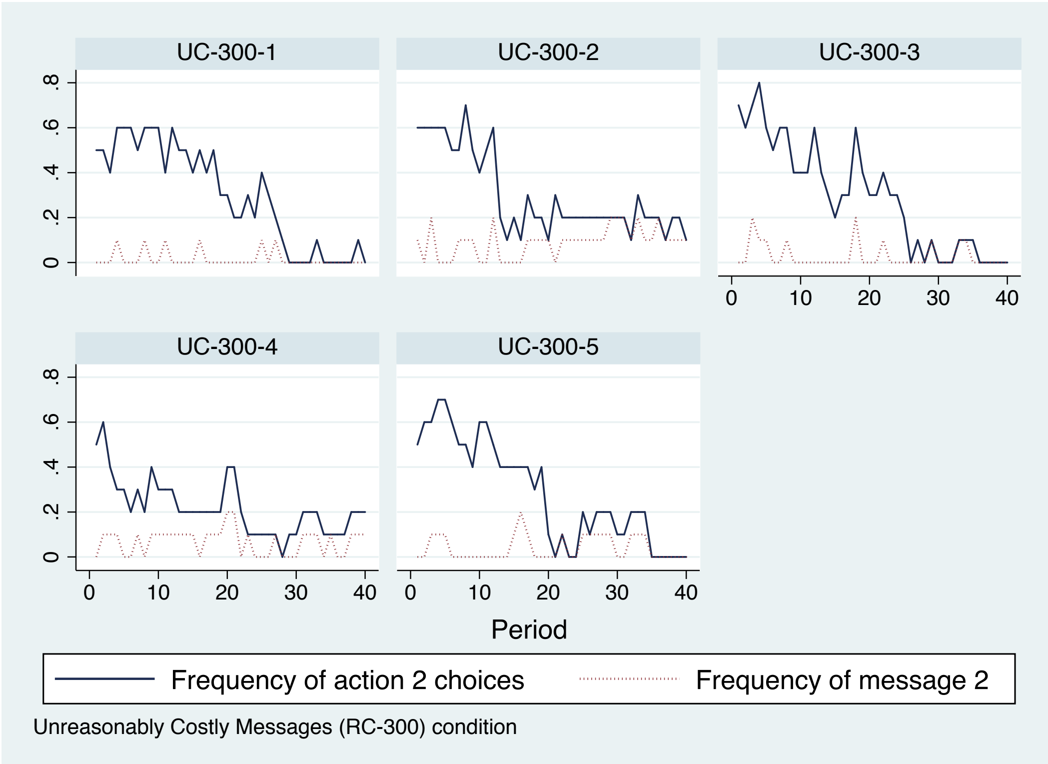


Figure C.1e: Frequency of Message 2 and Action 2 by Session (UC-300)



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