

Supplementary information for Discounting in finite-time bargaining experiments

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Supplementary information

An overview of the supplementary information can be seen below. This is divided into four sections, Section A includes additional empirical analysis, Section B includes additional procedural details regarding the lab based treatments using the shrinking-pie procedure and the effective-discounting procedure. Section C contains additional procedural details for online treatments using bargaining-delay procedure. Section D sample of instructions for all treatments.

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A Additional empirical analysis

In this section we provide additional empirical tests, figures and tables. A.1 contains details about non-parametric tests of treatment effects. A.2 contains parametric tests of treatment effects. A.3 contains distributional tests of treatment effects and figures illustrating these. A.4 contains descriptive statistics for all periods, and tables giving average behavior by block. A.5 contains analysis of non-equal split offers. A.6 contains analysis of disadvantageous counteroffers, a finding of Ochs and Roth (1989). A.7 examines potential trends of games throughout the experiment and contains robustness checks. A.8 contains a direct comparison of first-period offers with Ochs and Roth (1989).

A.1 Non-parametric tests of treatment effects

Table A1: Wilcoxon rank sum tests

First-period offers	z	exact p-value
S3A vs. S2A	0.313	0.8413
S2A vs. S2S	-1.358	0.2222
E3A vs. E2A	-1.358	0.2222
E2A vs. E2S	-1.984	0.0556
B3S vs. B2S	0.104	1.0000

The reported values are from the two-way Wilcoxon rank sum tests comparing block means.

Table A2: Wilcoxon rank sum tests

First-period rejections	z	exact p-value
S3A vs. S2A	0.000	1.0000
S2A vs. S2S	0.000	1.0000
E3A vs. E2A	0.940	0.4206
E2A vs. E2S	-1.051	0.3333
B3S vs. B2S	0.000	1.0000

The reported values are from the Wilcoxon rank sum tests comparing block means.

A.2 Parametric tests of treatment effects

Table A3: First-period offers' treatment effects

First offers analysis	Coefficient	SE	P> t
S3A vs. S2A	-1.088	1.538	0.497
S2A vs. S2S	3.16	1.622	0.083
E3A vs. E2A	1.868	1.586	0.269
E2A vs. E2S	3.128	1.372	0.049
B3S vs. B2S	1.173	4.089	0.781

Regression coefficients reported. Standard errors clustered on matching blocks. SE refers to the standard errors clustered at the block level.

Table A4: First-period rejection-rate treatment effects

First-period rejections analysis	Coefficient	SE	P> t
S3A vs. S2A	-0.008	0.030	0.793
S2A vs. S2S	0.108	0.065	0.132
E3A vs. E2A	-0.080	0.080	0.342
E2A vs. E2S	0.072	0.075	0.363
B3S vs. B2S	-0.064	0.109	0.572
EDP vs. SP ^a	0.176	0.041	0.000

^a Comparing the rejection rates across technologies where EDP is the effective-discounting procedure (pooling E3A, E2A and E2S) and where SP is the shrinking-pie procedure (pooling S3A, S2A and S2S). SE refers to the standard errors clustered at the block level.

A.3 Distributional tests of treatment effects

In this section, we conduct additional analysis of the distributions of first offers. Table A5 reports two-sample Kolmogorov–Smirnov tests both on all offers and on individual mean offers. When testing all offers, all main results are significant; however, there is certainly interdependence between individual offers, which is problematic. When using each participant’s mean first offer, only S2A vs. S2S remains significant. Table A6 performs stochastic dominance tests as suggested in Barrett and Donald (2003) using the statistical Python package from Lee and Whang (2023). Let F and G be the CDFs of the initials offers in two treatments. This is done by testing both the null that F weakly stochastically dominates G, and the null that G weakly stochastically dominates F. A rejection of one and not the other is then taken as evidence of stochastic dominance. Again, we perform these tests on all offers and individual mean offers. For all offers, all main results are significant, although S3A vs. S2A goes in the opposite direction of theory. When individual mean offers are tested, only S2A vs. S2S and E2A vs. E2S are significant. This significance can be taken as evidence of a positive treatment effect; however, the main takeaway that the shrinking-pie procedure and the effective-discounting procedure perform equally remains. Figures A1, A2 and A3 show the CDFs of all treatments.

Table A5: Two-sample Kolmogorov–Smirnov tests

Treatment	Individual offers		Mean offer per individual	
	D	Exact p-value	D	Exact p-value
S3A vs. S2A	0.2000	0.000	0.2800	0.285
S2A vs. S2S	0.4360	0.000	0.5200	0.002
E3A vs. E2A	0.1520	0.006	0.2000	0.710
E2A vs. E2S	0.1680	0.002	0.2000	0.710
B3S vs. B2S	0.1143	0.363	0.1817	0.729

The largest difference is reported.

Table A6: Stochastic dominance tests

Treatment	Individual offers		Mean offer per individual	
	L SD R	R SD L	L SD R	R SD L
S3A vs. S2A	0.2670	0.0010	0.5440	0.1320
S2A vs. S2S	0.0000	0.7360	0.0000	0.8040
E3A vs. E2A	0.0130	0.8010	0.1510	0.7190
E2A vs. E2S	0.0000	0.7800	0.0000	0.8010
B3S vs. B2S	0.0260	0.1660	0.3330	0.6640

The second column contains the null hypotheses of the tests. L SD R then implies that the null hypothesis is that Left stochastically dominates Right. Each treatment is tested in both directions. In all tests, the predicted treatment effect is that R statistically dominates L. So a rejection of L > R and a failure to reject R > L can be interpreted as evidence of stochastic dominance. As in Kim et al. (2023), the bootstrapping parameter is set to 1000.

Figure A1: CDF for S3A, S2A, and S2S

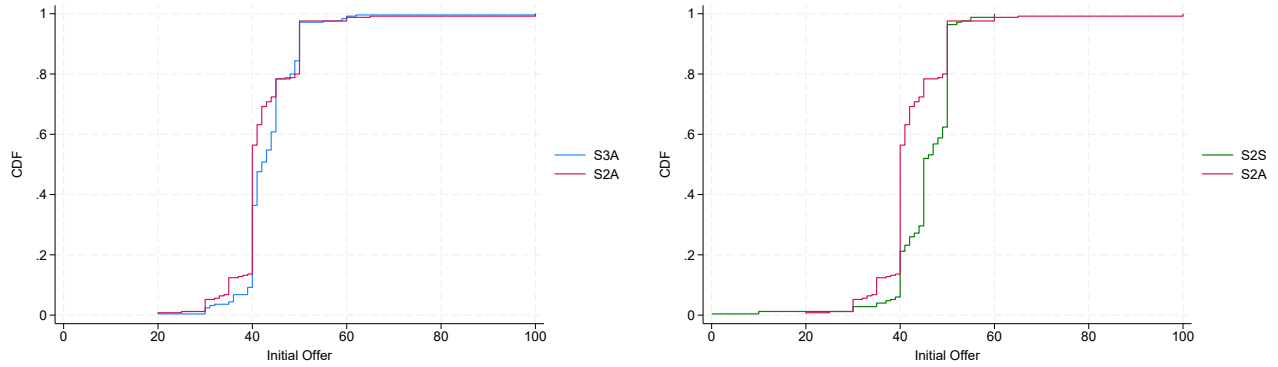


Figure A2: CDF for E3A, E2A, and E2S

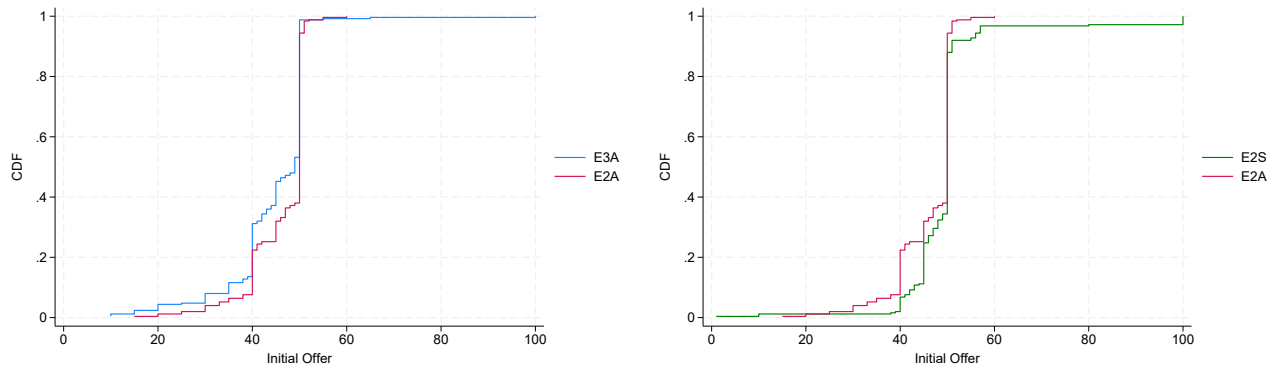
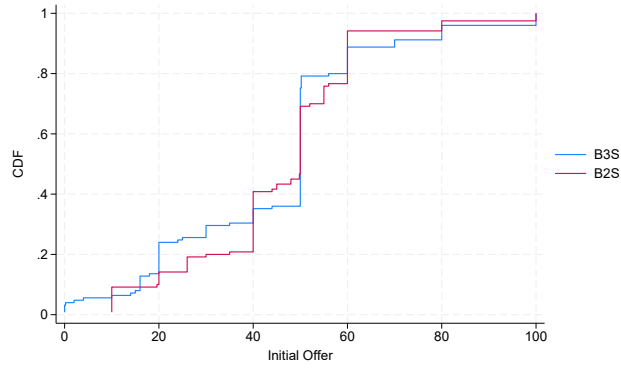


Figure A3: CDF for B2S and B2S



A.4 Descriptive statistics

Table A7: First-period offers across treatments and blocks

Block	Treatment							
	S3A	S2A	S2S	E3A	E2A	E2S	B3S	B2S
1	45.86 (.44)	38.66 (1.03)	45.48 (1.10)	47.36 (.63)	46.46 (1.12)	54.04 (2.93)	46.00 (1.63)	34.40 (3.73)
2	44.08 (.69)	44.16 (.81)	48.38 (.45)	44.92 (1.61)	47.60 (.63)	48.16 (.44)	46.80 (4.90)	42.31 (4.26)
3	42.20 (.87)	42.42 (.76)	43.32 (.87)	45.50 (.69)	43.44 (1.18)	49.54 (.64)	44.53 (4.39)	43.6 (2.79)
4	42.12 (.87)	46.62 (1.71)	46.18 (.70)	46.04 (.68)	47.70 (.66)	46.72 (.59)	47.56 (5.37)	55.42 (3.59)
5	42.60 (.74)	39.56 (.49)	43.86 (1.13)	38.78 (1.89)	46.74 (.58)	49.12 (1.04)	36.88 (4.88)	53.50 (2.21)
Total	43.37 (1.39)	42.28 (.50)	45.44 (.41)	44.52 (.57)	46.39 (.40)	49.52 (.67)	44.35 (1.99)	45.53 (1.69)

Standard error of the mean in parentheses.

Table A8: First-period rejection across treatments and blocks

Block	Treatment							
	S3A	S2A	S2S	E3A	E2A	E2S	B3S	B2S
1	.08 (.038)	.04 (.028)	.42 (.071)	.26 (.063)	.14 (.050)	.32 (.067)	.16 (.075)	.36 (.098)
2	.16 (.052)	.1 (.043)	.14 (.050)	.32 (.067)	.18 (.055)	.32 (.067)	.64 (.098)	.32 (.096)
3	.16 (.052)	.12 (.046)	.16 (.052)	.46 (.071)	.36 (.069)	.46 (.071)	.16 (.075)	.24 (.087)
4	.16 (.052)	.18 (.055)	.08 (.039)	.22 (.059)	.3 (.065)	.18 (.055)	.24 (.087)	.16 (.075)
5	.08 (.039)	.16 (.052)	.34 (.068)	.56 (.071)	.44 (.071)	.5 (.071)	.6 (.100)	.4 (.112)
Total	.128 (.021)	.12 (.021)	.228 (.027)	.364 (.030)	.284 (.029)	.356 (.030)	.36 (.043)	.292 (.042)

Standard error of the mean in parentheses.

Table A9: Descriptive statistics across treatments and periods

	Descriptives								
	First Period			Second Period			Third Period		
	Offer	Reject	n	Offer	Reject	n	Offer	Reject	n
S3A	43.37 (.40)	.128 (.021)	250	36.63 (2.05)	.406 (.088)	32	36.23 (4.28)	.846 (.104)	13
S2A	42.28 (.50)	.12 (.021)	250	34.43 (3.00)	.233 (.079)	30	N/A	N/A	N/A
S2S	45.44 (.41)	.228 (.027)	250	33.21 (1.86)	.456 (.067)	57	N/A	N/A	N/A
E3A	44.52 (.57)	.364 (.030)	250	46.31 (.95)	.637 (.051)	91	40.59 (.928)	.328 (.062)	58
E2A	46.38 (.40)	.284 (.029)	250	41.58 (1.13)	.282 (.054)	71	N/A	N/A	N/A
E2S	49.52 (.67)	.356 (.030)	250	44.83 (.89)	.157 (.039)	89	N/A	N/A	N/A
B3S	44.35 (1.99)	.360 (.043)	125	48.27 (1.76)	.158 (.086)	19	41.6 (3.19)	0 (0.0)	4
B2S	45.53 (1.69)	.292 (.042)	120	43.78 (3.20)	.056 (.056)	18	N/A	N/A	N/A

Means of each variable are reported, standard errors are reported in parentheses. n is the number of games played. Note that each treatment contains the same number of subjects by design, but B3S and B2S have fewer games per player. The number of observations in later periods is determined by the amount of disagreement in earlier periods. Additionally, attrition lowers the number of games in B3S and B2S.

A.5 Analysis of non-equal split offers

Table A10 below indicates that there seems to be less frequent 50-50 offers in shrinking-pie treatments as opposed to effective-discounting procedures, which have about half of the offers being exactly 50 percent, while the bargaining-delay procedure lies in between them. The following analysis looks for potential treatment differences in the non-equal split first-period offers with that difference in frequency as a caveat. E2A v E2S has significant differences in the parametric test and non-parametric test, while S2A vs. S2S is significant only in the parametric test.

Table A10: 50-50 offers

Treatment	Total	Frequency
S3A	32	0.128
S2A	44	0.176
S2S	85	0.34
E3A	114	0.456
E2A	141	0.564
E2S	134	0.536
B3S	49	0.392
B2S	27	0.216

The reported values are from the two-way Wilcoxon rank sum tests comparing block means.

Table A11: Analysis of non-equal split first-period offers

Treatment	Regression analysis			Wilcoxon rank sum tests
	Coefficient	SE	P > t	Exact p-values
S3A vs. S2A	-1.76	1.12	0.123	0.1508
S2A vs. S2S	2.46	1.02	0.020	0.1508
E3A vs. E2A	1.79	2.35	0.452	0.9168
E2A vs. E2S	7.24	3.25	0.032	0.0159
B3S vs. B2S	3.51	7.66	0.649	0.5476

SE refers to the standard errors clustered at the individual level.

A.6 Disadvantageous counteroffers

Table A12: Disadvantageous counteroffers in period 2

Treatment	Frequency		n
	Mean discount factor	Individual discount factor	
S3A	.96875	N/A	32
S2A	.7666667	N/A	30
S2S	.4912281	N/A	57
E3A	.3186813	.1648352	91
E2A	.1408451	.1549296	71
E2S	.4044944	.2247191	89
B3S	.2444444	N/A	45
B2S	.1891892	N/A	37

There were 10 games per player in EDF and SP treatments, meaning there were 250 first-period offers. In BDP treatments, there were 5 games per player, meaning there were 125 first-period offers. Mean discount factors refer to when disadvantageous counteroffers are calculated using the mean within the procedure's elicitation exercise. Individual discount factors refer to when the disadvantageous counteroffer frequency is calculated based on each individual's elicitations.

Table A13: Disadvantageous counteroffers in period 3

Treatment	Frequency		n
	Mean discount factor	Individual discount factor	
S3A	.3076923	N/A	13
E3A	.2758621	.2758621	58
B3S	0	N/A	6

There were 10 games per player in EDF and SP treatments, meaning there were 250 first-period offers. In BDS treatments, there were 5 games per player, meaning there were 125 first-period offers.

A.7 Outcomes across games

First, we observe the first-period offer and rejection rates over games to see if we can observe any clear visual trends. Then we perform some simple regression analyses to check for any trends, and finally we perform some robustness checks on our main results. Because B3S and B2S games occur concurrently, there is no opportunity for behavior to change between games; thus, they are omitted from the following analysis. There is no clear visual evidence of learning effects when examining Figures A4 and A5. See Tables A14 and A15 for an overview of the regression analysis based on the number of games. We see no evidence of trends in first-period offers, which is our main variable of interest. However, for robustness, we perform our main first-period offer analysis after dropping the first five games. A summary can be seen in Tables A16 and A17 below.

Figure A4: Mean first-period offers by game number

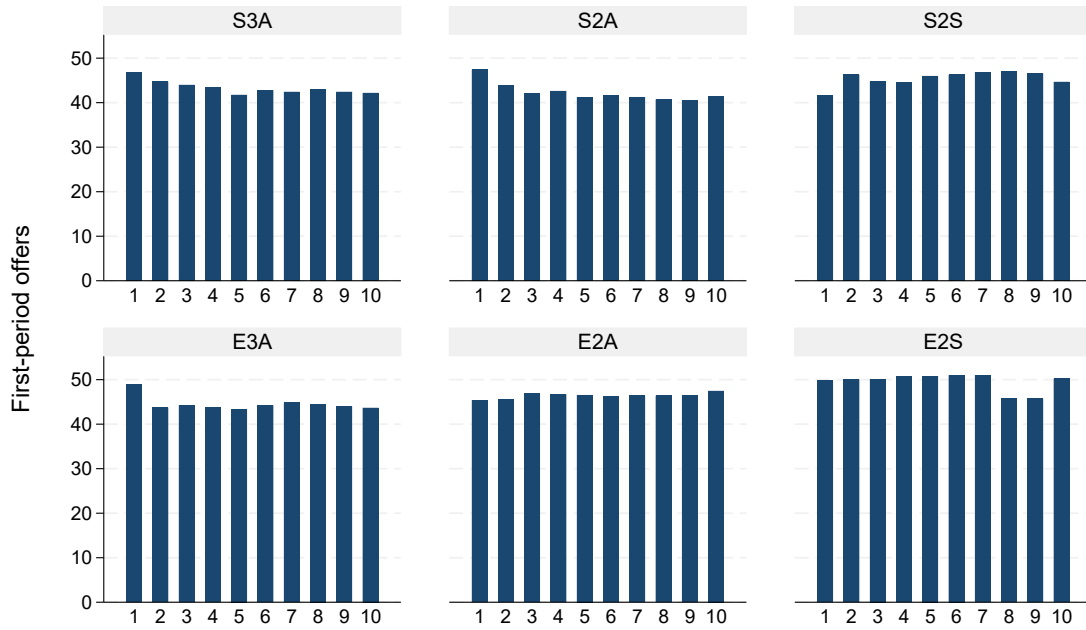


Figure A5: Mean first-period rejection rate by game number

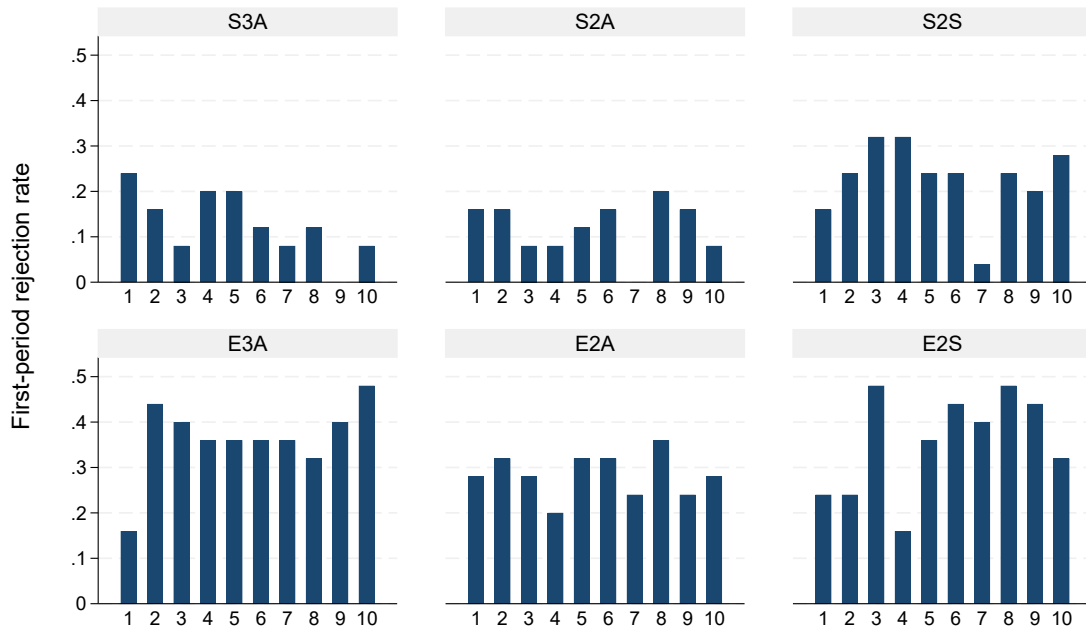


Table A14: Regression analysis of first-period offers over game number

	Coefficient	SE	p-value
S3A	-.397	.203	0.062
S2A	-.533	.271	0.061
S2S	.293	.236	0.227
E3A	.239	.221	0.290
E2A	.132	.111	0.246
E2S	-.283	.371	0.453

SE is the standard errors clustered at the subject level.

Table A15: Regression analysis of first-period rejection over game number

	Coefficient	SE	p-value
S3A	-.017	.007	0.021
S2A	-.002	.005	0.723
S2S	-.003	.007	0.697
E3A	.013	.009	0.170
E2A	.000	.007	0.974
E2S	.018	.009	0.061

SE is the standard errors clustered at the subject level.

Table A16: Main treatment effects with different sample restrictions

First offers analysis	Full sample		Last 5 games	
	Coefficient (SE)	p-value	Coefficient (SE)	p-value
S3A vs. S2A	-1.088 (1.538)	0.497	-1.271(1.560)	0.445
S2A vs. S2S	3.16(1.622)	0.083	4.164(1.577)	0.027
E3A vs. E2A	1.868(1.586)	0.269	2.467 (1.648)	0.169
E2A vs. E2S	3.128 (1.372)	0.049	2.987(1.247)	0.040

Regression coefficients reported with standard errors clustered at the block level in parentheses.

Table A17: Wilcoxon rank sum tests with sample restrictions

First offers analysis	Full sample	Last 5 games
S3A vs. S2A	0.8413	0.6905
S2A vs. S2S	0.2222	0.0714
E3A vs. E2A	0.2222	0.2222
E2A vs. E2S	0.0556	0.0556

The reported values are the exact p-values from the Wilcoxon rank sum tests.

Note that our second comparison moves to significant from non-significant at the 5 percent level in parametric testing. None of the treatment effects meet the stricter level of 1 percent.

A.8 Direct comparison of S3A, S2A, and S2S with Ochs and Roth (1989)

Table A18: Comparison of first-period offers in shrinking-pie treatments with Ochs and Roth (1989)

First-period offers	Ochs and Roth		Our sample	
	Game 1	Game 10	Game 1	Game 10
S3A	46.8	43.9	46.88	42.20
S2A	49.1	47.8	47.44	41.40
S2S	46.25	49.9	41.56	44.68

Ochs and Roth (1989) do not report all game averages; they do report the raw data for the first and last periods, which are shown here.

B Design and procedure details of Lab based treatments

This section includes additional information relating to the lab based treatments, those using the shrinking-pie and effective-discounting procedures. Section B.1 details the exact implementation in the lab. Section B.2 details the elicitation exercise performed at the end of treatments using the effective-discounting procedure. Section B.2 also details the results of that elicitation exercise and the how the discount factors are calculated based on those results.

B.1 Procedural details

Sessions were conducted in the Research Lab at BI Norwegian Business School in Oslo and at the LEE lab at the University of Copenhagen in the period 4/10/19 to 22/11/21.¹ The study was preregistered on 25/2/20 after an initial pilot was run.² Subjects were recruited from the general student populations of BI Norwegian Business School and the University of Copenhagen, respectively. Recruitment and session management were conducted using the ORSEE system (Greiner, 2015). We ran 5 blocks of 10 subjects per treatment, with between 10 and 30 subjects per session. No subject participated in more than one session. A total of 300 subjects participated in a total of 1500 bargaining games played. We implemented randomized matching within blocks. At the conclusion of a session, a random game was selected for each individual and earnings in an experimental currency unit (ECU) were converted to NOK/DKK at a publicly announced exchange rate.³ On average, subjects in the Norwegian sessions earned 31.4 EUR while subjects in the Danish sessions earned 20.0 EUR.⁴ z-Tree was used to program and conduct the experiment (Fischbacher, 2007).

All subjects' decisions were made using a network of anonymous computers. On arrival at the lab, subjects were randomly allocated to cubicles to break up social ties and maintain social distancing. After being seated, instructions were distributed and read aloud to achieve public knowledge of the rules. The instructions were based closely on Ochs and Roth's (1989) original instructions. Instructions can be found in sections D.1 and D.2.

¹Data collection was interrupted due to the Covid19 pandemic.

²AEA RCT Registry, <https://doi.org/10.1257/rct.5497>. Treatments E3A and E2A were preregistered after the pure replication of S3A and S2A. S2S and E2S are additional treatments. B2S and B3S are additional follow-up studies.

³Exchange rates were calibrated based on each lab's targeted hourly payment.

⁴The size of the pie to be shared was 800 NOK or 300 DKK, which corresponded to around 80 EUR and 40 EUR, respectively, at the time of data collection.

Subjects were grouped in blocks of 10. In each block, half of the subjects were randomly assigned type Red, while the other half were assigned type Blue. These types were fixed throughout the 10 bargaining games played. A bargaining game involves the division of 100 points between two subjects. Red types always make the offer in the first period. If the offer is rejected, bargaining moves to the next period and subjects' payoffs are discounted according to the appropriate procedure (see below for details of these procedures). If an offer is rejected in the final period, both players receive a payoff of zero. After each round of bargaining, a summary of the offer, the current period and the opponent's decision were shown before moving to the next period or the next game (depending on whether the offer was accepted and if there were any periods left in a game). Throughout the experiment, a table showing the number of rounds and discount rates for both player types was displayed. Between games, we used randomized matching within blocks. Subjects were informed that due to randomized matching, they could be matched with the same opponent twice in a row, but that it would happen with a low probability.

The shrinking-pie procedure was used in S3A, S2A and S2S. In each game, subjects bargained over 100 points, which was constant between periods, while the number of ECU per point varied by period (i.e., the discount factor). In the first period, each point was worth 1 ECU. The discount factor was set at .6 for Red types. For Blue types, discounting was set at .4 in S3A and S2A, while it was .6 in S2S.

The effective-discounting procedure was used in E3A, E2A and E2S. Subjects still bargained over 100 points, which was constant (i.e., the pie was 100 ECU in each round), but when payment was received varied by period. Agreement in the first period entailed no payment delay for both players, whereas agreement in the second period delayed payment for the Red types by one week, and one month for the Blue types in E3A and E2A, and one week for the Blue types in E2S.

B.2 Elicitation time preferences and calculation of equilibrium offers in E3A, E2A and E2S

To compute the equilibrium offers in E3A, E2A and E2S, it was necessary to elicit time preferences. To prevent contamination between experiments, this elicitation was conducted at the end of the bargaining games but before the randomized payment was revealed. Subjects completed two MPLs, for now versus one week from now and for now versus one month from now. One of these decisions was then randomly selected and used as an additional payment. This payment replaced the participation fee used for subjects in treatments S3A, S2A and S2S. The first session using the effective-discounting procedure did not include elicitation, because we needed to ensure that the payment method functioned as intended. Subjects were paid using Vipps mobile transfers. This payment method eliminates any potential transaction costs associated with

needing to collect payment at a later date.⁵⁶

We used a multiple price list (MPL) to elicit subjects’ time preferences over the periods’ lengths corresponding to the treatment delay. This method was chosen because it was simple to implement, widely used in the field and not time intensive (because the experimental sessions were already using 60 minutes). A MPL involves subjects making choices between an amount now or a different amount later, which in our setting is either one week or one month later. Finding a good range of values for the later payment was difficult because the literature finds a large dispersion of elicited discounting factors over short time periods (Frederick et al., 2002; Matousek et al., 2022). There is a tradeoff in precision by increasing the space between intervals; larger intervals lower the precision of each switching point. However, smaller intervals also increase the likelihood of finding no switching point because a subject’s switching point is above the maximum value. Initially, we tried values between 100 and 120 NOK with increments of 2. However, a substantial portion (3/10) chose now in every choice, indicating that their switching point was beyond 120. We then used a constant now payment set at a constant 100 NOK and varied the later payment between 100 and 150 NOK in increments of 5. Rational subjects should have at most only a single switching point, thus any subjects with multiple switching points are coded as invalid. This occurred once in our sample. If a subject prefers 100 now rather than the maximum value of 150 later, we assume this subject would switch if they were offered a 155 NOK later option. We then have 40 observations each from E3A and E2A for δ_{week} and δ_{month} and an additional 50 observations for δ_{week} from E2S. Table B1 summarizes the imputed discount factors for E3A, E2A and E2S.

Table B1: Discount factors by treatment

	δ_{week}			δ_{month}		
	Mean	SD	n	Mean	SD	n
E3A	0.877	0.119	40	0.858	0.127	40
E2A	0.865	0.105	39	.813	0.117	39
E2S	0.869	0.124	50	NA	NA	NA
Total	0.870	0.116	129	0.836	.123	79

Of the individuals in E3A and E2A with elicitations, 38/79 had δ_{month} that differed from their δ_{week} . Of those, 34/38 displayed $\delta_{week} > \delta_{month}$. Of those that had $\delta_{week} = \delta_{month}$, 28/41 were at either extreme of our list, indicating that we were unable to detect a difference with our range of values. Overall, subjects seem to move in the direction expected by theory, that is, lower discount rates for longer horizons. Table B2 summarizes the imputed discount factors for initial proposers and responders, indicating that there are no underlying differences between the groups’ discount factors for the different delay lengths. Please see Section D.2 for an example of the MPL shown to the subjects in the instructions section.

⁵Vipps is the only person-to-person payment method offered by Norwegian banks and requires only a registered phone number and a bank account. It is widely used in the Norwegian population, which minimizes potential selection effects. Vipps had a 78 percent market share in 2019 according to a survey: <https://www.statista.com/statistics/1098533/share-of-users-of-mobile-payment-apps-in-norway/>.

⁶Because this is a Norwegian-specific technology, the treatments collected in Copenhagen paid subjects in cash and consisted of only shrinking-pie treatments.

Table B2: Discount factors by type

	δ_{week}			δ_{month}		
	Mean	SD	n	Mean	SD	n
Initial Proposers	0.866	0.120	65	0.843	0.124	39
Initial Responders	0.874	0.112	65	.829	0.124	40
Total	0.870	0.116	129	0.836	.123	79

C Design and procedure details of online based treatments

This section contains additional details of the treatments collected on Prolific. Section C.1 details the practical details of how sessions were scheduled and implemented. Section C.2 explains how we automated opponents in the case of the opponent not attending later sessions. C.3 Contains technical details of how the experiment was programmed and implemented on an online server. As is common practice in online experiments, we included three comprehension questions in the instructions which were answered with a high degree of accuracy, see Section C.4 for details. Attrition was 42.4 percent and 52.8 percent in B3S and B2S, respectively; see Section C.5 for details. We could not collect time elicitation on the day of the treatments without contaminating the incentives of subjects for the remaining rounds. Instead, we performed a follow-up study targeted directly at those who participated in B3S and B2S. This study had a 75 percent response rate and was used to calculate the equilibrium offers for these treatments; see Section C.6 for details.

C.1 Asynchronous Sessions

Unlike the lab setting, subjects did not arrive promptly in the session, so we divided each day into two sessions, a first session that began at 0900 and lasted until 1200 Norwegian time and allowed subjects to log in and participate at any time during that period, and a second session that ran from 1230 to 1530 Norwegian time. Subjects were sent follow-up emails listing the outcome and payment for each session and details about future sessions. We chose the length of each session to be 3 hours because it gives subjects a large window to log in and act, while ensuring the entire experiment occurs during waking hours in European and US time zones.⁷

Subjects were paid a participation fee of \$1 USD on each day of the experiment, irrespective of attendance at later sessions. This means that B3S had a \$2 USD participation fee split over 2 sessions, whereas B2S had a \$3 USD participation fee split over 3 sessions. This payment approach was taken primarily to comply with Prolific’s terms of service, which requires a participation payment for each session. To prevent these warping incentives in session 1, we then paid these participation fees unconditionally to all subjects.

⁷Because the protocol is alternating offers, subjects from a day 1 later session must participate in an earlier session on day 8 and vice versa.

C.2 Automation of opponents

Attrition is a concern in longitudinal studies. Because our primary analysis focuses on first-period behavior, our main concern was ensuring that subjects’ first-period behavior was unaffected by attrition concerns. Subjects were informed that in case their opponent did not return for their next session, they would play against the average response from a previous experiment. These automated responses were calculated based on the observed behavior in each round of the most similar effective-discounting procedure treatment, E3A and E2S for B3S and B2S, respectively. Offers were determined by the mean offer in each round of the relevant treatment. Acceptance thresholds were determined by two criteria: first, the likelihood of acceptance above the threshold and the likelihood of rejection below the threshold, and second, that the acceptance threshold must accept the automated offer. First-period automations were included in case of dropouts during the experiment, which happened a single time. The automated responses are summarized in Table C1 below.

Table C1: Automated responses by treatment and period

Automated responses	Treatment			
	B3S		B2S	
Period	Offer	Accept	Offer	Accept
1	45	40	50	40
2	46.2	46	44.8	35
3	40	39.99	NA	NA

Accept refers to the threshold implemented. All offers above the threshold were accepted and all offers equal or lower were rejected.

C.3 Technical details of the Prolific experiment

Treatments B3S and B2S were programmed using the oTree framework in Python (Chen et al., 2016). PyCharm was used as a Python interface due to its ready access to the terminal. oTree does not natively allow for longitudinal studies, so a workaround was found by writing and overwriting the period-specific information (opponents’ offers, last-period offers, accepts, ongoing matches and matching function) into txt files that were saved onto hard-drive space. The experimental program was hosted on a platform called Heroku, which is designed for net-based apps. Heroku allows only temporary storing of local files, so we used an Amazon cloud service called S3 to store the period-specific data. Python files are available on request.

C.4 Comprehension checks in B3S and B2S

Our Prolific experiment included three comprehension checks on the first page to test the subjects’ comprehension. These questions were “How many rounds are there in each game?” “When is round 2(3) of this experiment?” and “Who makes the offer in the first round?” Subjects performed very well on these questions in the first period, indicating that they read the instructions carefully and understood the task. In the second period, subjects performed less well, indicating that perhaps there was some ambiguity in the questions. Regardless, all sessions performed better than would be expected by subjects not reading the instructions at all. See Table C2 below for details.

Table C2: Comprehension checks by question and treatment for the first session

		Q1	Q2	Q3	All Q correct	Overall mean
B3S	Period 1	100%	94%	98%	92%	2.92
	Period 2	84%	68%	84%	24%	2.37
	Period 3	100%	100%	100%	100%	3
B2S	Period 1	100%	98%	98%	96%	2.95
	Period 2	82%	35%	82%	47%	2

C.5 Attrition in B3S and B2S

There was a considerable amount of attrition. However, our main treatment variables are all measured in the first period where attrition was negligible. See Table C3 below for details by round and treatment. There does not appear to be any relationship between the number of games and attrition probability. One could argue that those with very high rejection rates in session 1 are less likely to attend session 2, but the sample sizes are very small.

Table C3: Attrition by session and treatment

	B3S			B2S	
	Period 1	Period 2	Period 3	Period 1	Period 2
Attrition rate among subjects	0%	42.4%	0%	2%	52.8%
Number of subjects in the period	50	33	5	50	36
Attrition rate among games	0%	53.3%	0%	2%	55.6%
Number of unfinished games in the period	250	90	6	250	72

The number of subjects/games is reported below the attrition rate.

C.6 Elicitation time preferences and calculation of equilibrium offers in B3S and B2S

Because B3S and B2S occurred over a series of weeks, we could not collect time elicitation on the day of the treatments without contaminating the incentives of subjects for the remaining rounds. Instead, we performed a follow-up study targeted directly at those who participated in B3S and B2S. The follow-up study was conducted on 7/6/22 and had a response rate of 75 percent. Subjects made a choice between \$5 USD today, and a larger amount in one week, which increased in \$.25 USD increments until the largest amount of \$7.5 USD. As is expected in an online setting, the data we collected were noisier, with a larger proportion of inconsistent responses. Eleven of the 75 responses contained multiple switching points and were thus discarded. Additionally, some subjects chose the later option in the first choice, indicating that they would prefer payment of the same amount in a week over today (or were indifferent between the two). We have treated those as having a discount factor of 1. The summary of the imputed value can be seen below in Table C4. The instructions for this task can be found in section D.4.

Table C4: *Discount factors in Prolific follow-up study*

	δ_{week}		
	Mean	SD	n
Total	0.893	0.109	64

D Sample of instructions

Contents

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D.1 Lab - Shrinking-pie procedure (S3A)

RO.3p

This is an economics experiment, administered by the department of economics at the school.

*In economics experiments deception is **never** used. This means that any information you are provided with in the experiment is **correct**.*

Experiments by other departments at the school may use deception. Whenever they do, you are told so.

Instructions

Welcome! You are participating in an experiment financed by the Department of Economics at BI and the Norwegian Research Council.

You will earn money in the experiment. How much you earn depends on the decisions you make, as well as on the decisions made by other subjects.

All interactions are anonymous and are performed through a network of computers. The administrators of the experiment will not be able to observe your decisions during the experiment. Once the experiment is concluded and you have been paid all identifying information is deleted. Thus, your anonymity is fully preserved in all future analysis of the data collected in the experiment.

All participants in the experiment are present in this room. They have all been recruited in the same way as you and are reading the same instructions as you are for the first time.

It is not allowed to talk to other participants in the room until the experiment is over.

In the experiment your payoffs are denominated in ECUs. Payoffs are explained below.

The experiment

During this experiment you will participate in several bargaining games. At the end of the experiment, one of the bargaining games you participated in will be chosen at random, and you will be paid in cash what you earned in that game.

A bargaining game involves the division of 100 points between two bargainers. Both bargainers must agree on the division, otherwise neither side receives any points that game. A game lasts, at most, three rounds. The value of a point is denominated in experimental currency units (ECUs). The ECU value of the points distributed to an individual depends on the round in which agreement is reached. The value of points will also generally be different for individuals who occupy different bargaining positions.

Types

Each subject in this experiment will be randomly assigned either to be Red or Blue type in all games of this experiment. Reds will only bargain with Blues, and Blues will only bargain with Reds. Reds will always make the offer in the first round.

The Conduct of a game

A bargaining game proceeds as follows:

1. **Red decision** Proposes a division of the 100 points.
2. **Blue decision** Accepts or rejects the division. If the offer is accepted, then the game ends and both players receive their agreed amounts. If the offer is rejected, then game proceeds to round 2.
3. **Round 2 exchange rates are applied.**
4. **Blue decision** Proposes a division of the 100 points.
5. **Red decision** Accepts or rejects the division. If the offer is accepted, then the game ends and both players receive their agreed amounts. If the offer is rejected, then the game proceeds to round 3.
6. **Round 3 exchange rates are applied.**
7. **Red decision** Proposes a division of the 100 points.
8. **Blue decision** Accepts or rejects the division. If the offer is accepted, then the game ends and both players receive their agreed amounts. If the offer is rejected, then the game ends and both players receive nothing.

Payoffs

Your payoff for each bargaining game depends on how many points you receive and when you receive them. Points received in earlier rounds are worth more than points received in later rounds. To aid your decision making, a table of all exchange rates per round for both players will be shown on your monitor. An example is shown below.

Exchange rates of ECU per point for each round		
	Player Red	Player Blue
First Round	1	1
Second Round	.6	.4
Third Round	.36	.16

In round 1 an agreement is worth at most 100 ECU to either Red or Blue types. If agreement is not reached in round 1 we go on to round 2. In round 2 an agreement is worth at most 60 ECU to Red and at most 40 ECU to Blue. If round 3 is reached then an agreement is worth at most 36 ECU to Red and at most 16 ECU to Blue.

Feedback

After each offer you will be shown the offer that was made and whether it was accepted or rejected. At the end of each game your entire history of agreements and payoffs in the current and all previous games will be displayed.

Matching

You will be bargaining with a randomly chosen opponent each game. This means that it is very unlikely that you will be matched with the same opponent two games in a row. After a game is completed each Red is paired with a new Blue, and a new game begins. After ten games are completed the experiment is over.

Practice game

We will conduct a practice game at the conclusion of these instructions. The practice game will be played against a random opponent in order to familiarize you with the screenshots and decisions.

You will not earn money from the practice round.

Timely decisions

Note that the experiment can only progress after participants have made their decisions. We ask that you please make a decision within the allocated time limit. This time limit is indicated in the top right corner of you screen.

Earnings

At the end of the experiment we will randomly select one of games played for each subject, then pay each subject the cash value of the ECU earned that game. It is in your interest to earn as much in each game as you can. In this experiment ECU has the following value:

$$1 \text{ ECU} = 5 \text{ NOK}$$

In addition to this, all subjects will receive 50 NOK for attending the experiment.

Are there any questions?

D.2 Lab - Effective-discounting procedure (E3A)

VOR.3p

This is an economics experiment, administered by the department of economics at the school.

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Instructions

Welcome! You are participating in an experiment financed by the Department of Economics at BI and the Norwegian Research Council.

You will earn money in the experiment. How much you earn depends on the decisions you make, as well as on the decisions made by other subjects.

All interactions are anonymous and are performed through a network of computers. The administrators of the experiment will not be able to observe your decisions during the experiment. Once the experiment is concluded and you have been paid all identifying information is deleted. Thus, your anonymity is fully preserved in all future analysis of the data collected in the experiment.

All participants in the experiment are present in this room. They have all been recruited in the same way as you and are reading the same instructions as you are for the first time.

It is not allowed to talk to other participants in the room until the experiment is over.

In today's session you will participate in two experiments. The two experiments are unrelated. The instructions for the second experiment will be given to you after the conclusion of the first experiment. The instructions for the first experiment are given below.

In the experiment your payoffs are denominated in Experimental Currency Units (ECUs). Payoffs are explained below.

The experiment

During this experiment you will participate in several bargaining games. At the end of the experiment, one of the bargaining games you participated in will be chosen at random, and you will be paid via a Vipps transfer what you earned in that game.

A bargaining game involves the division of 100 points between two bargainers. Both bargainers must agree on the division, otherwise neither side receives any points that game. A game lasts, at most, three rounds. The value of a point is denominated in experimental currency units (ECUs). When payment is given to an individual depends on the round in which agreement is reached. The timing of payments will also generally be different for individuals who occupy different bargaining positions.

Types

Each subject in this experiment will be randomly assigned either to be Red or Blue type in all games of this experiment. Reds will only bargain with Blues, and Blues will only bargain with Reds. Reds will always make the offer in the first round.

The Conduct of a game

A bargaining game proceeds as follows:

1. **Red decision** Proposes a division of the 100 ECU.
2. **Blue decision** Accepts or rejects the division. If the offer is accepted, then the game ends and both players receive their agreed amounts. If the offer is rejected, then game proceeds to round 2.
3. **Round 2 payment delays are applied.**
4. **Blue decision** Proposes a division of the 100 ECU.
5. **Red decision** Accepts or rejects the division. If the offer is accepted, then the game ends and both players receive their agreed amounts. If the offer is rejected, then the game proceeds to round 3.
6. **Round 3 payment delays are applied.**
7. **Red decision** Proposes a division of the 100 ECU.
8. **Blue decision** Accepts or rejects the division. If the offer is accepted, then the game ends and both players receive their agreed amounts. If the offer is rejected, then the game ends and both players receive nothing.

Payoffs

Your payoff for each bargaining game depends on how many ECU you receive and when you receive them. ECU received in earlier rounds result in earlier payments than ECU received in later rounds. To aid your decision making, a table of all delay times per round for both players will be shown on your monitor. An example is shown below.

Length of delay for each round		
	Player Red	Player Blue
First Round	No Delay	No Delay
Second Round	1 Week	1 Month
Third Round	2 Weeks	2 Months

An agreement is worth at most 100 ECU to either Red or Blue types in all rounds. If agreement in round 1 is reached, payment is received today. If agreement is not reached in round 1 we go on to round 2. In round 2 an agreement results in payment a week from today to Red and a month from today to Blue. If round 3 is reached then an agreement results in payment 2 weeks from today to Red and 2 months from today to Blue.

Feedback

After each offer you will be shown the offer that was made and whether it was accepted or rejected. At the end of each game your entire history of agreements and payoffs in the current and all previous games will be displayed.

Matching

You will be bargaining with a randomly chosen opponent each game. This means that it is very unlikely that you will be matched with the same opponent two games in a row. After a game is completed each Red is paired with a new Blue, and a new game begins. After ten games are completed the experiment is over.

Practice game

We will conduct a practice game at the conclusion of these instructions. The practice game will be played against a random opponent in order to familiarize you with the screenshots and decisions. You will not earn money from the practice round.

Timely decisions

Note that the experiment can only progress after participants have made their decisions. We ask that you please make a decision within the allocated time limit. This time limit is indicated in the top right corner of your screen.

Earnings

At the end of the experiment we will randomly select one of games played for each subject, then pay each subject the cash value of the ECU earned that game with the accompanying delay. It is in your interest to earn as much in each game as you can. In this experiment ECU has the following value:

$$1 \text{ ECU} = 8 \text{ NOK}$$

In addition to this, all subjects will receive a payment connected with the second experiment in today's session. All payments from today's session will be made using Vipps transfers.

Are there any questions?

This is an economics experiment, administered by the department of economics at the school.

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Instructions

Welcome! You are participating in an experiment financed by the Department of Economics at BI and the Norwegian Research Council.

You will earn money in the experiment. How much you earn depends on the decisions you make, as well as on the decisions made by other subjects.

All interactions are anonymous and are performed through a network of computers. The administrators of the experiment will not be able to observe your decisions during the experiment. Once the experiment is concluded and you have been paid all identifying information is deleted. Thus, your anonymity is fully preserved in all future analysis of the data collected in the experiment.

All participants in the experiment are present in this room. They have all been recruited in the same way as you and are reading the same instructions as you are for the first time.

It is not allowed to talk to other participants in the room until the experiment is over.

The experiment

This is the second experiment in this session. The previous experiment is completely unrelated to the current experiment. In this experiment you will make a series of choices, at the conclusion of the experiment, one of these choices will be randomly selected and be your payment.

First, you will choose between receiving 100NOK today, and a larger amount one week from today. Afterwards you will then choose receiving 100NOK today, and a larger amount one month from today. If you choose "Now", then you will be paid via a Vipps transfer later today. If you choose "later" then you will be paid via a Vipps transfer in 1 week or in 1 month from today.

An example of the decision screen you will be shown is given below

1.	Receive 100.00 today or receive 100.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later
2.	Receive 100.00 today or receive 105.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later
3.	Receive 100.00 today or receive 110.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later
4.	Receive 100.00 today or receive 115.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later
5.	Receive 100.00 today or receive 120.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later
6.	Receive 100.00 today or receive 125.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later
7.	Receive 100.00 today or receive 130.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later
8.	Receive 100.00 today or receive 135.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later
9.	Receive 100.00 today or receive 140.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later
10.	Receive 100.00 today or receive 145.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later
11.	Receive 100.00 today or receive 150.00 in 1 week	Please choose	Now	<input type="radio"/>	<input type="radio"/>	Later

Earnings

At the end of the experiment we will randomly select one of your decisions and that will be used as your payment for this experiment. All decisions have an equal chance of being randomly selected.

In addition to this, all subjects will receive a payment connected with the previous experiment in today's session. All payments from today's session will be made using Vipps transfers.

Are there any questions?

D.3 Online - Bargaining-delay procedure (B3S)

Instructions

Time left to complete this page: **176:10**

Note: Please note that the timer counts down until the end of today's prolific session, the experiment will only take you a few minutes.

Welcome! You are participating in an experiment financed by the Department of Economics at BI and the Norwegian Research Council. This experiment is denominated in US dollars.

In this experiment you will participate in five bargaining games against different opponents. A bargaining game involves the division of \$5.00 between two bargainers. Both bargainers must agree on the division, otherwise neither side receives any payment for that game.

Each participant will be randomly assigned to be Red or Blue for all of their games. In Round 1, Red will make an offer of a division to the Blue who will accept or reject this offer. If the offer is accepted, Blue receives the amount offered, and Red receives \$5.00 minus the amount offered. If the offer is rejected, then the game enters Round 2.

Round 2 will be played one week after Round 1. In Round 2, Blue will make an offer of a division to Red who will accept or reject this offer. If the offer is accepted, Red receives the amount offered, and Blue receives \$5.00 minus the amount offered. If the offer is rejected, then the game enters Round 3.

Round 3 will be played one week after Round 2. In Round 3, Red will make an offer of a division to Blue who will accept or reject this offer. If the offer is accepted, Blue receives the amount offered, and Red receives \$5.00 minus the amount offered. If the offer is rejected, then both players receive nothing.

If you do not attend later rounds, you will not be paid for your Round 2 and 3 matches. If your opponent does not attend later rounds you will play against an automated average response from previous experiments.

If you do not attend later rounds, you will not be paid for your Round 2 and 3 matches. If your opponent does not attend later rounds you will play against an automated average response from previous experiments.

For today's experiment you will receive a participation fee of \$3 for completing the experiment, \$1 of this will be paid after Round 1, and \$1 will be paid after Round 2, and \$1 will be paid after Round 3, regardless of the outcome of today's experiment. In addition, you will be paid the result of any agreements reached in the experiment.

You will receive a follow up email with instructions and an invitation to the later rounds of this experiment. The second round will be played 1 week from the first round and the third round 2 weeks after the first.

Please answer the following questions:

How many rounds are there in each game

When is round 3 of this experiment

Who makes the offer in the first round

Please enter your Prolific ID number

The only information we are collecting are the decisions you make during the games, we do not collect any other information in this experiment. All data gathered is fully anonymized after collection. If you consent please click the button below. If you wish to withdraw consent at a later date you can contact us via our prolific account or at thomas.mckay@bi.no

Next

Instructions

Time left to complete this page: **174:05**

You have been selected as player type **Red**

Today you will make a series of offers in 5 bargaining games and the opponents will respond in a different session later today. You will receive a follow up email with the results of each match and instructions for round 2. Once you have completed your role, you will be informed that you may leave the experiment.

All agreements reached today will be paid **today**

[Next](#)

D.4 Online - Follow-up elicitation exercise (B3S)

Instructions

Welcome! You are participating in an experiment financed by the Department of Economics at BI and the Norwegian Research Council. This experiment is denominated in US dollars.

In this experiment you will make a series of choices. You will choose between an amount of money now, and a larger amount of money in one weeks time. At the end of the experiment we will randomly select one of your decisions and that will be used as your bonus payment for this experiment. All decisions have an equal chance of being randomly selected.

All submissions will be approved on the day of submission. If you chose **now** in the decision that was randomly selected you will receive your bonus payment **today**. If you chose **in one weeks time** in the decision that was randomly selected you will receive your bonus payment **one week from today**.

The only information we are collecting are the decisions you make during the experiment, we do not collect any other information in this experiment. All data gathered is fully anonymized after collection. If you consent please click the button below. If you wish to withdraw consent at a later date you can contact us via our prolific account or at thomas.mckay@bi.no

Please enter your Prolific ID number

Next

Choices

Today you will make a series of choices between a payment today and a payment one week from today. After you have made all of your decisions, one will be randomly selected as your bonus payment for today's session.

Choose between \$5 USD **today** and \$5 USD **in one weeks time**

- I choose payment today
- I choose in payment one weeks time

Choose between \$5 USD **today** and \$5.25 USD **in one weeks time**

- I choose payment today
- I choose in payment one weeks time

Choose between \$5 USD **today** and \$5.5 USD **in one weeks time**

- I choose payment today
- I choose in payment one weeks time

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