ONLINE APPENDICES
"Emotions and the Micro-Foundations of Commitment Problems"

Contents

A Model of Commitment Problems

To see how power shifts can lead to conflict we provide a brief sketch of a simple two period bargaining model.[1] The basic intuition is that when one player expects to be disadvantaged in the future, they have an incentive to start a conflict in order to forestall the shift in bargaining power. There are two players, A and B. In each period there is a resource with value 10. This resource may be divided between the players. The bargaining protocol is as follows. In the first period player A makes a demand, x_{1A}, to player B. This leaves player B with $10 - x_{1A}$. If the demand is accepted, then in the second period there is another bargaining stage, where player A makes a demand x_{2A}. If the first period demand is rejected then both players play a war lottery, with probability p_1 player A wins. One player wins the resource for period 1, but both players pay costs $c_A = c_B$. The winner of the lottery obtains the entire resource in period 2. If the resource is rejected in the second period, both players pay the cost and play a war lottery, with probability p_2 player A wins.

To analyze the complete information game we use backwards induction. We begin with the second period decision by actor B. In Period 2 player B is indifferent between demand x_{2A} and lottery if $(1 - p_2) \times 10 - c_B = 10 - x_{2A}$. Thus if $x_{2A} = 10p_2 + c_B$ then actor B is indifferent and by assumption accepts the demand. In period 2 player A's expected utility from the lottery is $10p_2 - c_A$. Hence A will prefer to make a demand $x_{2A} = 10p_2 + c_B$ if $p_2 + c_B > p_2 - c_A$. This holds because $c_B = c_A$. They can't make more than this demand because then it will be rejected. So, the optimal demand in the second period is $x^*_{2A} = 10p_2 + c_B$. In the SmallShift condition this amounts to a demand of 7.1 and in the BigShift condition a demand of 9.

Now consider period 1. B's utility from rejecting the lottery in period 1 is $10 \times (1 - p_1) - c_B + \delta 10 \times (1 - p_1)$, where δ represents the discount rate for the second period, or the likelihood that the second period is played. We assume that $\delta = 1$ for any numerical calculations. Player B's utility from accepting a demand x_{1A} is equal to $10 - x_{1A} + \delta(10 \times (1 - p_2) - c_B)$.

Thus player B will reject the demand x_{1A} if

$$\begin{aligned} 10 \times (1 - p_1) - c_B + \delta 10 \times (1 - p_1) &> 10 - x_{1A} + \delta(10 \times (1 - p_2) - c_B) \\ x_{1A} &> 10p_1 + \delta 10p_1 - \delta 10p_2 + c_B - \delta c_B \end{aligned}$$

Hence they will be indifferent if $x_{1A} = 10p_1 + \delta 10p_1 - \delta 10p_2 + c_B - \delta c_B$,

Now consider A's expected utility in period 1. If they have the lottery rejected they get $10p_1 - c_A + \delta 10p_1$. If they have some demand x_{1A} accepted then they get $x_{1A} + \delta(10p_2 + c_B)$. They will want their first period demand accepted if

$$\begin{aligned} x_{1A} + \delta(10p_2 + c_B) &\geq 10p_1 - c_A + \delta 10p_1 \\ x_{1A} &\geq 10p_1 + \delta 10p_1 - \delta 10p_2 - c_A - \delta c_B \end{aligned}$$

Now note that the RHS of this is almost identical to what will make B indifferent, except that it is slightly smaller ($-c_A$ instead of c_B).

[1] This is simply a two period version of the model in Fearon (1995).

Hence A will make demand $x_{1A}^* = 10p_1 + \delta 10p_1 - \delta 10p_2 + c_B - \delta c_B$. In the SmallShift condition this will be a demand of 4.7. Hence offers over 5.3 in the first round will be accepted.

The key question is when the first period demand will be rejected. This will occur when x_{1A}^* is less than 0. That is, when player A can not offer (demand little) enough to make player B accept the demand in light of what they expect to get in period 2. This holds when we have $0 > 10p_1 + \delta 10p_1 - \delta 10p_2 + c_B - \delta c_B$. Assuming $\delta = 1$ this reduces to $p_2 - 2p_1 > 0$. Thus as p_2 gets larger and/or p_1 gets smaller, this condition is more likely to hold.

In the experiment that follows, our BigShift condition has $p_1 = .3$ and $p_2 = .7$ and our SmallShift condition has $p_1 = .49$ and $p_2 = .51$. In the BigShift condition $p_2 - 2p_1 > 0$ holds and so we expect preventive war, but in the SmallShift condition this condition does not hold. Demands less than 4.7 should be accepted.

B Physiological Data Acquisition

Skin conductance data for all participants was collected through the use of two disposable Biopac (Santa Barbara, CA) electrodes (Model: EL507), which are filled with Biopac Skin Conductance Electrode Isotonic Paste (specially formulated with 0.5% saline in a neutral base). These electrodes were placed on the palms of the participant's nondominant hand (the thenar and hypothenar eminences). A constant voltage of 0.5 V was applied between the electrodes. SCL was then checked by research assistants to ensure proper recordings, and following that, participants watched a short video (2m49s) featuring images of beaches and palm tress with calm music. SCL measurements of this time period were used as "baseline" physiological arousal.

We followed the standard procedure for scoring the skin conductance data: raw measures were sampled at 1000 Hz, and amplified using a gain of $25\mu\Omega$ and a low-pass filter of 5Hz, using a BioNex mainframe and amplifier system, and BioLab 2.4 software (Mindware Technologies, Gahanna, OH). Using Mindware's software (EDA module 3.0), research assistants who were blind to both the study hypotheses and conditions calculated SCL (in microsiemens). We then output the scored data into a time series. Finally, in order to address potential individual differences in variability in skin conductance, our data were transformed to deviations from each participant's baseline SCL (the average SCL while the video was played prior to the study) and standardized within each participant.[2]

Our experimental design required a measure of physiological *reactivity*, which in turn means we needed something meaningful to compare to our baseline levels of skin conductance for each participant. In this study, that comparison was made to the physiological arousal of participants *while they made their decision*; i.e., *after* a proposers made an offer and *before* responders made the decision to accept or reject the offer in Period 1. The average deviation from baseline during this particular phase of the experiment is our key physiological variable.[3] Practically, this was made feasible through our development

[2]See Ben-Shakhar 1985; Bush et al. 1993.

[3]Our physiological results are robust to using medians instead of means. Any deviations above 3 are capped at 3 and below -3 is capped at -3, though our results hold when we do not make this common restriction, which was rare in the data.

of computer protocols which placed “tags” in the physiological data at signals (transmitted via parallel port communication) from the bargaining game operating on another computer.

C Mediation Analysis

The mediation effect is the change in the outcome while holding the treatment condition constant but varying the values of the mediating variable. Formally, the mediation effect under treatment condition t, $\delta_i(t)$, can be defined at the individual level as:

$$\delta_i(t) \equiv Y_i(t, M_i(t)) - Y_i(t, M_i(t')), \tag{1}$$

where $Y_i(t, M_i(t))$ represents the value of the outcome variable under the treatment t. As discussed elsewhere inference about this requires the assumption of sequential ignorability, where 1) there is no omitted variable that affects the treatment and outcome and 2) there is no omitted variable that causes both the mediating variable and outcome variable.[4] In the current design, the offer (our treatment) is not randomized. With respect to the first assumption, however, it is worth recalling that our treatment is the offer size of Player **A** and our outcome is the decision by Player **B**. It is implausible that rejection decisions by a different person (Player **B**) could be influenced by the same confounding variable that influences offer decisions (by Player **A**).[5] The second assumption is more difficult to deal with and can be approached either through inclusion of pre-treatment controls, sensitivity analysis, or alternative designs.[6] We discuss these approaches below.

[4]Imai et al. 2011.

[5]All interactions were completely anonymous in our study.

[6]Imai et al. 2013.

References

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