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ONLINE APPENDICES FOR

STRUCTURE IN LEGISLATIVE BARGAINING

Adrian de Groot Ruiz
Roald Ramer
Arthur Schram

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APPENDIX A: PROOF FOR PROPOSITION 1 FOR HIGHLY STRUCTURED GAME

In this appendix, we provide the proof of proposition 1, which characterizes the equilibrium outcome of Γ_T^H (when it converges). Since Γ_T^H is (highly) non-convex due to the exterior disagreement point, we cannot use standard results and techniques to derive equilibria; rather it involves a *tour de force* in backward induction. We also ran simulations, which illustrate (and corroborate) the results of the proposition. In particular, they shed some light on what happens if the outcome does not converge. At the end of the appendix, we provide a figure that illustrates the cyclic dependence of the outcome on a and b for $1 < a < 2$ and $a < b < 3$ (as obtained by simulations).

PROOF PROPOSITION 1

Before we can determine the equilbrium, we need to introduce some notation. Due to backward induction and players having a unique best response at each information set, the equilibrium proposal and voting strategies only depend on how many rounds are ahead. Hence, we will count the rounds by the remaining number of rounds $r \equiv T - t + 1$. Hence, the first round has $r = T$ and the last round $r = 1$. Furthermore, this implies that the equilibrium strategy for round r is the same for each game Γ_T^H with $T \geq r$. Hence, it is meaningful to talk in general about the (sub)game Γ_r^H. The equilibrium (behavioral) strategy for player i, σ_i, specifies for each round $r \leq T$ (i) for the proposal stage, a probability distribution over possible proposals $\pi_i^r : Z \to [0,1], p_i^r \mapsto \pi_i^r(p_i^r)$,[1] and (ii) for the voting stage, an acceptance function $\nu_i^r : Z \to \{0,1\}, p^r \mapsto \nu_i^r(p^r)$. The equilibrium outcome of Γ_r^H can be characterized by the probability distribution of the equilibrium outcomes $\mu^r : Z \to [0,1]$.[2] The continuation value $EU_i^r = E_{\mu^r}[u_i(z)] = \sum_{\operatorname{supp}\mu^r} \mu^r(z) u_i(z)$ is the expected utility of

[1] $\left|\operatorname{supp}\pi_i^r\right| \leq 2$

[2] μ^r is a probability mass function and has countable support: $\left|\operatorname{supp}\mu_i^r\right| \leq 3r \max_{r\leq T, i\in N}\left|\operatorname{supp}\pi_i^r\right| = 6r$.

player i of the (sub)game Γ_r^H. We can conveniently express EU_i^r in terms of $f^r \equiv \mu^r(\delta), L^r \equiv E_{\mu^r}[z \mid z \in R]$ and $D^r \equiv E_{\mu^r}[|z| \mid z \in R]$. (Note that $D^r \geq |L^r|$). Define the indicator function $I_R(x) \equiv$ [1 if $x \in R$, 0 if $x \notin R$], the acceptance probability $\xi_i^r(x) \equiv 1-(1-\nu_j^r(p))(1-\nu_k^r(p))$ and the probability of delay $P_{\mu^r}^r[delay] \equiv 1-\frac{1}{3}\sum_N \sum_{\text{supp}\,\mu_i^r} \pi_i^r(x)\xi_i^r(x)$. Then, we get:

$$f^r = \tfrac{1}{3}\sum_N \sum_{\text{supp}\,\pi_i^r} \left(\pi_i^r(x)\xi_i^r(x)I_R(x)\right) + P^r[delay]f^{r-1},\ f^0 \equiv 0$$

If $f^r = 0$, then $L^r \equiv 0, D^r \equiv 0$. Otherwise:

$$L^r \equiv \frac{1}{f^r}\left(\tfrac{1}{3}\sum_N \sum_{\text{supp}\,\pi_i^r \setminus \{\delta\}} \left(\pi_i^r(x)\xi_i^r(x)x\right) + P^r[delay]f^{r-1}L^{r-1}\right) \tag{0.1}$$

$$D^r \equiv \frac{1}{f^r}\left(\tfrac{1}{3}\sum_N \sum_{\text{supp}\,\pi_i^r \setminus \{\delta\}} \left(\pi_i^r(x)\xi_i^r(x)|x|\right) + P^r[delay]f^{r-1}D^{r-1}\right)$$

Since $E_{\mu^r}[u_i(z)] = \Pr_{\mu^r}[z=\delta]\ E_{\mu^r}[u_i(z) \mid z=\delta] + \Pr_{\mu^r}[z \neq \delta]\ E_{\mu^r}[u_i(z) \mid z \neq \delta]$ and $u_i(z)$ are linear in z for $z \in [-a,b] \cup \delta$, from $u_i(z) = 1-|z-z_i|$ we get that (for $\text{supp}\,\mu^r \subseteq [-a,b] \cup \delta$):

$$\begin{aligned} EU_1^r &= f^r(1-a-L^r) \\ EU_2^r &= f^r(1-D^r) \\ EU_3^r &= f^r(1-b+L^r) \end{aligned} \tag{0.2}$$

A player i will accept a proposal p in round r + 1 if and only if $u_i(p) \geq EU_i^r$. This allows us to characterize for round r + 1 (*i*) $\overline{L}_1^{r+1}$, the largest proposal player 1 accepts, (*ii*) $\underline{L}_3^{r+1}$, the smallest proposal player 3 accepts, and (*iii*) $\overline{D}_2^{r+1}$, the largest absolute value a proposal can have for player 2 to accept it:

$$\begin{aligned} \overline{L}_1^{r+1} &= \left(1-f^r\right)\left(1-a\right) + f^r L^r \\ \underline{L}_3^{r+1} &= \left(1-f^r\right)\left(b-1\right) + f^r L^r \\ \overline{D}_2^{r+1} &= \left(1-f^r\right) + f^r D^r \end{aligned} \tag{0.3}$$

Players will only delay if they cannot make a proposal that will be accepted and gives them at least their continuation value. Player 1 or 2 will only delay in round r +

1 if $\overline{L}_1^{r+1} \leq -\overline{D}_2^r$, which is equivalent to (1 – f^r) (2 – a) + f^r (L^r + D^r) < 0. This can only hold if a > 2 and f^r <1. Hence, players 1 and 2 will never delay if $a \leq 2$ and, by the same reasoning, player 3 will never delay if $b \leq 2$.

Note that if $p_i^{r+1} \in R, i \neq 2$ is accepted in equilibrium, it must be accepted by player 2 in round r + 1 and, hence, $u_2(p_i^{r+1}) \geq EU_2^r$. If a < 2, then player 2 will propose 1 – a (or a – 1) in round T. This means that $EU_2^r > 0$ for all r and that she will never accept nor propose δ. Furthermore, if a < 1, player 1 can always propose 0 so that she will never propose δ. Finally, $EU_2^r > 0$ implies L^r <1, and hence $EU_3^r < 0$ if $b \geq 2$. In the following Lemma, we summarise these facts and some conditions that are easily derived.

LEMMA B1. For a < *2,* the equilibrium {σ_1, σ_2, σ_3} is determined by:

1. $v_1^r(p) = 1$ for $p \in [-a, b]$ iff $p \leq \overline{L}_1^r$ and $v_1^r(\delta) = 1$ iff $EU_1^{r-1} \leq 0$.
2. $v_2^r(p) = 1$ for $p \in [-a, b]$ iff $|p| \leq \overline{D}_2^r$ and $v_2^r(\delta) = 1$ iff $EU_2^r \leq 0$.
3. $v_3^r(p) = 1$ for $p \in [-a, b]$ iff $p \geq \underline{L}_3^r(\sigma)$ and $v_3^r(\delta) = 1$ iff $EU_3^{r-1} \leq 0$.
4. $\pi_1^r(\delta) = 1$ iff $-\overline{D}_2^r \geq 1 - a$ and $EU_3^{r-1} \leq 0$; $\pi_1^r(-a) = 1$ iff $-\overline{D}_2^r < -a$; $\pi_1^r(-\overline{D}_2^r) = 1$ iff $-a \leq -\overline{D}_2^r < 1 - a$ or $-\overline{D}_2^r \geq -a$ and $EU_3^{r-1} > 0$;
5. $\pi_2^r(0) = 1$ iff $\overline{L}_1^r > 0$ or $\underline{L}_3^r < 0$; $\pi_2^r(\underline{L}_1^r) = 1$ iff $\overline{L}_1^r \leq 0$, $\underline{L}_3^r > 0$ and $|\overline{L}_1^r| < \underline{L}_3^r$; $\pi_2^r(\underline{L}_3^r) = 1$ iff $\overline{L}_1^r < 0$, $\underline{L}_3^r \geq 0$ and $-\overline{L}_1^r > \underline{L}_3^r$; $\pi_2^r(\overline{L}_1^r) = \pi_2^r(\underline{L}_3^r) = \frac{1}{2}$ iff $\overline{L}_1^r \leq 0$, $\underline{L}_3^r \geq 0$ and $|\overline{L}_1^r| = \underline{L}_3^r$;
6. $\pi_3^r(\text{delay}) = 1$ iff $\underline{L}_3^r > \overline{D}_2^r$ and $EU_1^r > 0$ (only if f^{r-1} <1); $\pi_3^r(\delta) = 1$ iff $\overline{D}_2^r \leq b - 1$ and $EU_1^{r-1} \leq 0$; $\pi_3^r(b) = 1$ iff $\overline{D}_2^r > b - 1$; $\pi_3^r(\overline{D}_2^r) = 1$ iff $b - 1 < \overline{D}_2^r \leq b$ or $EU_1^r > 0$ and $\overline{D}_2^r \leq b$.

Now we are ready to look at whether the equilibrium outcome converges. Let $x^* \equiv \lim_{r \to \infty} x^r$. The probability distribution μ^* is the limit of μ^r if it holds that

$\lim_{r\to\infty} \mu^r(z) = \mu^*(z)$ for all z in the support of μ^*. As defined in section 3, we say that the equilibrium outcome μ^r converges to μ^* if $\mu^* \equiv \lim_{r\to\infty} \mu^r$; if this limit does not exist, we say that μ^r does not converge.

The equilibrium outcome converges to 0 if $\mu^*(0) = 1$, which is equivalent to $f^* = 1$ and $D^* = 1$. The equilibrium outcome converges to δ if $\mu^*(\delta) = 1$, which is equivalent to $f^* = 0$ and $\lim_{r^*\to\infty} \sup_{r \le r^*} D^r \in \mathbb{R}$. Finally, it is straightforward that μ^r does not converge if (*i*) f^* does not exist or (*ii*) $f^* > 0$ and L^* or D^* do not exist.

PROPOSITION 1

(i) *If* $0 \le a < 1$ *or* $a = b = 1$*, then equilibrium outcome converges to 0*

(ii) *If* $a \le b < 2$ *and* $b > 1$*, the equilibrium outcome does not converge, unless* $\frac{13}{7} \le a = b < 2$ or $b = \frac{3}{2}, \frac{5}{4} \le a < \frac{3}{2}$ or $\frac{8}{3} \le b < \frac{13}{14}, a = \frac{5}{7}b - \frac{4}{7}$ or $\frac{3}{2} \le b < \frac{7}{3}$ $, \max\{\frac{7}{5} - \frac{1}{10}b, \frac{7}{5}b - \frac{8}{5}\} < a < \frac{6}{5} + \frac{1}{5}b$. *In these latter cases the outcome may converge, but never to a single outcome in Z.*

(iii) *If* $a \ge 2$, *the equilibrium outcome is* δ.

Proof:

(i.a) We show that if 0 ≤ a < 1, then $f^* = 1$ ***and*** $D^* = 0$.

Throughout the proof, we will use the following sufficient condition for convergence: For $0 \le a < 1$, $f^* = 1$ and $D^* = 0$ if

$$\text{there exists a round } r^\dagger \text{ such that } f^{r^\dagger} = 1 \text{ and } EU_1^{r^\dagger} > 0 \qquad \text{(SC)}$$

Let (SC) hold for $r^\dagger$. $EU_1^{r^\dagger} > 0$ ($\Leftrightarrow L^{r^\dagger} < 1 - a$) implies that player 1 will not accept nor propose δ in round $r^\dagger + 1$. $f^{r^\dagger} = 1$ implies that player 3 will not delay and that either player 1 or 3 accept 0 in round $r^\dagger + 1$. Consequently, $p_2^{r^\dagger+1} = 0$, $p_1^{r^\dagger+1} = -\overline{D}_2^{r^\dagger+1} = -D^{r^*}$ and $p_3^{r^\dagger+1} = \overline{D}_2^{r^\dagger+1} = D^{r^\dagger}$. Hence, $f^{r^\dagger+1} = 1$, $L^{r^\dagger+1} = \frac{1}{3}(-D^{r^\dagger} + 0 + D^{r^\dagger}) = 0 < 1 - a$ and $D^{r^\dagger+1} = \frac{1}{3}(D^{r^\dagger} + 0 + D^{r^\dagger}) = \frac{2}{3}D^{r^\dagger}$. Thus, (SC) holds for $r^{\dagger}$ + 1 and by induction for all $r \geq r^{\dagger}$. As a result, $f^* = 1$ and $D^* = \lim_{m\to\infty} D^{r^*+m} = \lim_{m\to\infty} \left(\frac{2}{3}\right)^m D^{r^*} = 0$. A sufficient condition for (SC) to hold is that:

$$\text{there is a round } r' \text{ such that} \quad (i)\ \underline{L}_3^{r'} \leq \overline{D}_2^{r'} \leq a \text{ and } \overline{L}_1^{r'} < 1-a \text{ and } (ii)\underline{L}_3^{r'} \geq -\overline{L}_1^{r'} \text{ or } \underline{L}_3^{r'} < 3(1-a) \tag{SC'}$$

$\underline{L}_3^{r'} \leq \overline{D}_2^{r'} \leq a$ and $\overline{L}_1^{r'} < 1-a$ imply that $p_1^{r'} = -\overline{D}_2^{r'}$ and $p_3^{r'} = \overline{D}_2^{r'}$. Hence, $f^{r'} = 1$ and $L^{r'} = \frac{1}{3}E[p_2^{r'}]$. If $\underline{L}_3^{r'} \geq -\overline{L}_1^{r'}$ or $\underline{L}_3^{r'} < 3(1-a)$, then $E[p_2^{r'}] < 3(1-a)$ and $L^{r'} < (1-a)$. Hence (SC) holds for *r'*. In the remainder of the proof we divide the (*a, b*) parameter-set into regions and show that (SC) holds for each region.

We start by looking at the last four rounds. In the final round, $p_1^1 = -a$ and $p_2^1 = 0$. If $b < 2$, then $p_3^1 = \min\{b,1\}$, $f^1 = 1$ and $L^1 < \frac{1}{3}(1-a)$, such that round 1 satisfies (SC). So, let $b \geq 2$. Then $p_3^1 = \delta$ and $f^1 = \frac{2}{3}$, $D^1 = -L^1 = \frac{1}{2}a$. Hence, $\overline{L}_1^2 = \frac{1}{3}(1-2a) < 1-a$, $\overline{D}_2^2 = \frac{1}{3}(1+a)$ and $\underline{L}_3^2 = \frac{1}{3}(b-a-1)$. Since $EU_1^1 > 0$, $p_3^2 = delay$ iff $\overline{D}_2^2 < \underline{L}_3^2$ iff $b > 2(a+1)$. Let us first consider $b \leq 2(a+1)$ and $a \leq ½$. Then $p_1^2 = -a$, $p_2^2 = 0$ and $p_3^2 = \overline{D}_2^2$, so that $f^2 = 1$ and $L^2 = \frac{1}{9}(1-2a) < 1-a$. Hence, round 2 meets (SC). Let us now consider $b \leq 2(a+1)$ and $a > ½$. In this case, $\underline{L}_3^2 \leq \overline{D}_2^2 \leq a$, so that round 2 satisfies (SC') if $-\overline{L}_1^2 \leq \underline{L}_3^2$ or $\underline{L}_3^2 < 3(1-a)$. So let $3(1-a) \leq \underline{L}_3^2 < -\overline{L}_1^2$. This means that $10 - 8a \leq b < 3a$ and $a > \frac{10}{11}$. Furthermore, $p_1^2 = -\overline{D}_2^2$, $p_2^2 = \underline{L}_3^2$ and $p_3^2 = \overline{D}_2^2$, so that $f^2 = 1$, $L^2 = \frac{1}{3}p_2^2 > 1-a$ and $D^2 = \frac{1}{9}(1+a+b) \leq a$. Hence, $p_1^3 = -\overline{D}_2^3 = -D^2$, $p_2^3 = 0$ and $p_3^3 = \delta$, so that $f^3 = \frac{2}{3}$, $D^3 = -L^3 = \frac{1}{2}D^2$. From this, $\overline{L}_1^4 = \frac{1}{27}(8-10a-b)$, $\overline{D}_2^4 = \frac{1}{27}(10+a+b)$ and $\underline{L}_3^4 = \frac{1}{27}(8b-10-a)$). $2 < b \leq 2(a+1)$ and $a > ½$ imply $\overline{D}_2^4 \leq a$ and $\overline{L}_1^4 < (1-a)$. $10 - 8a \leq b < 3a$ implies $-\overline{L}_1^4 < \underline{L}_3^4 < \overline{D}_2^4$. Hence, round 4 satisfies (SC). Thus (SC) holds if

$$b \le 2(a+1) \qquad \text{(A)}$$

Let b > 2 (a + 1) from now on. $EU_3^r < 0$ for all r and player 3 can now delay consecutive rounds and alternatingly delay and not delay. This requires a careful characterization of the dynamic before we proceed. We will call a set of consecutive rounds in which player 3 delays a delaying sequence. We index these sequences by s (again backwards), with s = 1 the final delaying sequence, s = 2 the prefinal delaying sequence etc. Let R(s) be the set of rounds in the s-th delaying sequence and define $\overline{r}(s) \equiv \max R(s)$ and $\underline{r}(s) \equiv \min R(s)$. Finally, let $m(s) = \overline{r}(s) - \underline{r}(s) + 1$ be the number of delaying rounds in *R(s)*.

Let us look at $\underline{r}(s)$-1. $p_3^{\underline{r}(s)} = delay$ implies $EU_1^{\underline{r}(s)-1} > 0$ and $f^{\underline{r}(s)-1} = \frac{2}{3}$. As player 1 accepts δ in $\underline{r}(s)$ - 1, she also accepts 0 and $p_2^{\underline{r}(s)-1} = 0$. Since $p_1^{\underline{r}(s)-1} = -\overline{D}_2^{\underline{r}(s)-1}$, this means that $D^{\underline{r}(s)-1} = -L^{\underline{r}(s)-1} = -\frac{1}{2}\overline{D}_2^{\underline{r}(s)-1}$. We proceed to rounds r ∈ R(s). Since player 3 delays, $\underline{L}_3^{\underline{r}(s)} > \overline{D}_2^{\underline{r}(s)}$ and $p_2^{\underline{r}(s)} = \min\{0, \overline{L}_1^{\underline{r}(s)}\} \le 0$. As $D^{\underline{r}(s)} = -L^{\underline{r}(s)}$ and $f^{\underline{r}(s)-1} = \frac{2}{3}$, by (0.1) and Lemma B1 it must be that f^1 < 1, $L^r = -D^r < 0$ and $EU_1^r > 0$ for all $r \in R(s)$. Furthermore:

$$\begin{aligned}
&\text{If } D^r = -L^r, \text{ then:} \\
&\alpha_+^{r+1} \equiv \overline{D}_2^{r+1} + \overline{L}_1^{r+1} = \left(1-f^r\right)\left(2-a\right) \\
&\alpha_-^{r+1} \equiv \overline{D}_2^{r+1} - \overline{L}_1^{r+1} = \left(1-f^r\right)a + 2f^r D^r \\
&\gamma_+^{r+1} \equiv \overline{D}_2^{r+1} + \underline{L}_3^{r+1} = \left(1-f^r\right)b \\
&\gamma_-^{r+1} \equiv \underline{L}_3^{r+1} - \overline{D}_2^{r+1} = \left(1-f^r\right)\left(b-2\right) - 2f^r D^r
\end{aligned} \qquad (0.4)$$

In particular, (0.4) holds for r = $\underline{r}(s)-1, .., \underline{r}(s)$.

Moreover, as player 3 delays in rounds $r \in R(s)$ and $f^{\underline{r}(s)-1} = \frac{2}{3}$:

$$f^r = \tfrac{2}{3} + \tfrac{1}{3} f^{r-1} \forall r \in R(s) \qquad (0.5)$$

$$f^{\underline{r}(s)+m} = \frac{3^{m+2}-1}{3^{m+2}} \text{ for } m = -1, 0, 1, .., m(s)-1 \qquad (0.6)$$

From (0.4) we get $\alpha_-^{\underline{r}(s)} = \frac{1}{3}a + \frac{4}{3}D^{\underline{r}(s)-1}$ and it turns out that $\alpha_-^r = \alpha_-^{\underline{r}(s)} \equiv \alpha_-(s)$ for $\underline{r}(s) \le r \le \overline{r}(s)+1$. For s = 1 it is simple. Suppose α_-^r= a and D^r = -L^r = $\frac{1}{2}a$. Then immediately $\alpha_-^{r+1} = a$. Furthermore, due to the symmetry $D^{r+1} = -L^{r+1} = \frac{1}{2}a$. Since $D^{\underline{r}(1)-1} = D^1 = -L^1 = \frac{1}{2}a$ and $\alpha_-^{\underline{r}(1)-1} = \alpha_-^1 = a$, by induction it follows that $\alpha_-^r = a$ for $\underline{r}(1) \le r \le \overline{r}(1)+1$. For $s > 1$, we need to assume that $\overline{L}_1^{\underline{r}(s)} \le 0$ and $\overline{D}_2^{\underline{r}(s)} \le a$ and justify it later. Suppose $\overline{L}_1^r \le 0$, $\overline{D}_2^r \le a$ and $p_3^r = delay$. Hence, $p_1^r + p_2^r = -\alpha_-^r$ and, using (0.1) , $D_r = \dfrac{\frac{2}{3}\cdot\frac{1}{2}(-p_1^r - p_2^r) + \frac{1}{3} f^{r-1} D^{r-1}}{f^r} = \dfrac{(1-f^{r-1})a + 3 f^{r-1} D^{r-1}}{3 f^r}$. Substituting this term and using (0.5), we get that $\alpha_-^r - \alpha_-^{r+1} = a\,(f^r - f^{r-1}) + 2\, f^{r-1} D^{r-1} - 2\, f^r D^r = 0$. Hence, $\alpha_-^{r+1} = \alpha_-^r$. Furthermore, using the same substitutions, we get $\overline{D}_2^{r+1} - \overline{D}_2^r = -\frac{1}{3}(2-a)(1-f^{r-1}) < 0$ and $\overline{D}_2^{r+1} < \overline{D}_2^r \le a$. Finally, $\overline{L}_1^{r+1} = \overline{D}_2^{r+1} - \alpha_-^{r+1} = \overline{D}_2^{r+1} - \alpha_-^r < \overline{D}_2^r - \alpha_-^r = \overline{L}_1^r \le 0$. Hence, as $p_3^r = delay \forall r \in R(s)$, $\alpha_-^r = \alpha_-^{\underline{r}(s)}$ for $\underline{r}(s) \le r \le \overline{r}(s)+1$.

Using (0.4) and (0.6), we get the following results for $m = 0,1,.., m(s)$:

$$\begin{aligned}
\overline{L}_1^{\underline{r}(s)+m} &= \tfrac{1}{2}(\alpha_+^{\underline{r}(s)+m} - \alpha_-^{\underline{r}(s)+m}) = \frac{1-\frac{1}{2}a}{3^{m+1}} - \tfrac{1}{2}\alpha_-(s) \\
\overline{D}_2^{\underline{r}(s)+m} &= \tfrac{1}{2}(\alpha_+^{\underline{r}(s)+m} + \alpha_-^{\underline{r}(s)+m}) = \frac{1-\frac{1}{2}a}{3^{m+1}} + \tfrac{1}{2}\alpha_-(s) \\
\underline{L}_3^{\underline{r}(s)+m} &= \gamma_+^{\underline{r}(s)+m} - \overline{D}_2^{\underline{r}(s)+m} = \frac{\frac{1}{2}a+b-1}{3^{m+1}} - \tfrac{1}{2}\alpha_-(s) \\
\gamma_-^{\underline{r}(s)+m} &= \gamma_+^{\underline{r}(s)+m} - 2\overline{D}_2^{\underline{r}(s)+m} = \frac{a+b-2}{3^{m+1}} - \alpha_-(s)
\end{aligned} \tag{0.7}$$

Since, player 3 only delays in round r iff $EU_1^{r-1} > 0$ and $\gamma_-^r > 0$, from (0.7) we get that $m(s) = \min\{m \in R : \gamma_-^{\underline{r}(s)+m} \le 0\} = \text{ceiling}\left[\dfrac{\ln(a+b-2) - \ln(3\alpha_-(s))}{\ln(3)}\right]$.

Equivalently, since $\gamma_-^{\underline{r}(s)+m(s)-1} > 0$ and $\gamma_-^{\underline{r}(s)+m(s)} \le 0$, we get:

$$2 - a + 3^{m(s)}\alpha_-(s) < b \le 2 - a + 3^{m(s)+1}\alpha_-(s) \forall s \tag{0.8}$$

In round $\overline{r}(s)+1 = \underline{r}(s)+m(s)$ player 3 will not delay. Since $EU_1^{\overline{r}(s)} > 0$ and $\underline{L}_3^{\overline{r}(s)+1} \le \overline{D}_2^{\overline{r}(1)+1} < \overline{D}_2^{\overline{r}(s)} \le a$,

$$\overline{r}(s)+1 \text{ satisfies (SC') if } \underline{L}_3^{\overline{r}(s)+1} < 3(1-a) \tag{0.9}$$

$\underline{L}_3^{\overline{r}(1)+1} \le \overline{D}_2^{\overline{r}(1)+1} \le \overline{D}_2^{\underline{r}(1)+1} = \frac{1}{9}(1+4a)$. Hence, by (0.9) $\overline{r}(1)+1$ satisfies (SC') if

$$a < \tfrac{26}{31} \tag{B}$$

Let $a > \frac{26}{31}$. It turns out that if $\overline{r}(s)+1$ does not satisfy (SC), then $\overline{r}(s)+3 = \underline{r}(s+1)$. Let $\overline{r}(s)$ + 1 not satisfy (SC). In this case $EU_1^{\overline{r}(s)+1} \leq 0$ and $p_2^{\overline{r}(s)+1} = \underline{L}_3^{\overline{r}(s)+1}$. Consequently, $p_2^{\overline{r}(s)+2} = 0$, $p_3^{\overline{r}(s)+2} = \delta$ and $p_1^{\overline{r}(s)+2} = -\overline{D}_2^{\overline{r}(s)+2} = -D^{\overline{r}(s)+1} = -\frac{1}{3}(2\overline{D}_2^{\overline{r}(s)+1} + \underline{L}_3^{\overline{r}(s)+1}) = -\frac{1}{6}\left(\frac{2-a+2b}{3^{m(s)+1}} + \alpha^{-}(s)\right)$ (using (0.7)). Thus, $f^{\overline{r}(s)+2} = \frac{2}{3}$, $EU_1^{\overline{r}(s)+2} > 0$ and $D^{\overline{r}(s)+2} = -L^{\overline{r}(s)+2} = -\frac{1}{2}p_1^{\overline{r}(s)+2}$. Using (0.4), we get $\gamma_{-}^{\overline{r}(s)+3} = \frac{1}{9}\left(3b - 6 - \alpha_{-}(s) - \frac{2-a+2b}{3^{m(s)+1}}\right)$. Furthermore, since $D^{\underline{r}(s)-1} = -\frac{1}{2}p_1^{\underline{r}(s)-1} \leq \frac{1}{2}a$, $\alpha_{-}(s) = \frac{1}{3}a + \frac{4}{3}D^{\underline{r}(s)-1} \leq a$ and, by (0.8), $\frac{1}{3^{m(s)+1}} \leq \frac{\alpha_{-}(s)}{a+b-2}$. Hence, $\gamma_{-}^{\overline{r}(s)+3} \geq \frac{1}{9}\left(3b - 6 - a\left(1 + \frac{2-a+2b}{a+b-2}\right)\right)$. Since $b > 2(a + 1)$ and $a \geq \frac{26}{31}$, $\gamma_{-}^{\overline{r}(s)+3} > \frac{2}{9}(2a-1) > 0$. Thus, $p_3^{\overline{r}(s)+3} = delay$ and $\overline{r}(s)+3 = \underline{r}(s+1)$. As a consequence, $\alpha_{-}(s+1) = \frac{1}{3}a + \frac{4}{3}D^{\underline{r}(s+1)-1} = \frac{1}{3}a + \frac{4}{3}D^{\overline{r}(s)+2}$:

$$\alpha_{-}(s+1) = \frac{1}{3}a + \frac{1}{9}\alpha_{-}(s) + \frac{2-a+2b}{3^{m(s)+3}} \tag{0.10}$$

We conclude our characterization of the delaying sequences by showing we can indeed assume $\overline{L}_1^{\underline{r}(s)} \leq 0$ and $\overline{D}_2^{\underline{r}(s)} \leq a$ for $s > 1$. Since $\alpha_{-}(s) \leq a$ and $a \geq \frac{26}{31}$, $\overline{D}_2^{\underline{r}(s)} = \frac{1}{3}(1 - \frac{1}{2}a) + \frac{1}{2}\alpha_{-}(s) < a$. Showing $\overline{L}_1^{\underline{r}(s)} \leq 0$ requires some work. Let $\overline{L}_1^{\underline{r}(s)} \leq 0$ or $s = 1$. Using (0.3), $\overline{L}_1^{\underline{r}(s+1)} = \overline{L}_1^{\overline{r}(s)+3} = -\frac{1}{18}\left(\frac{2-a+2b}{3^{m(s)+1}} + \alpha_{-}(s) + 6(a-1)\right)$. Since $\overline{r}(s)+1$ does not satisfy (SC'), $\underline{L}_3^{\overline{r}(s)+1} \geq 3(1 - a)$ and, using (0.7), this implies $\frac{1}{3^{m(s)+1}} \geq \frac{6-6a+\alpha_{-}(s)}{-2+a+2b}$. Furthermore, (0.10) implies that $\alpha_{-}(s) \geq \frac{1}{3}a$ for $s > 1$. Hence, $\overline{L}_1^{\underline{r}(s+1)} \leq -\frac{2(18+9a^2+a(b-27))}{27(2b+a-2)} < 0$ (as $b > 2(a + 1)$). Since in particular $\overline{L}_1^{\underline{r}(2)} \leq 0$, by induction it follows that $\overline{L}_1^{\underline{r}(s)} \leq 0$ for all $s > 1$.

We proceed by dividing the parameterplane not covered by (A) and (B) according to $m(1) \geq 1$, the number of rounds player 3 delays in the first delaying cycle, and proof that (SC) holds for some $\overline{r}(s)+1$. By $\alpha_{-}(1) = a$ and (0.8)

$$2-a+3^{m(1)}a < b \leq 2-a+3^{m(1)+1}a \tag{0.11}$$

By (0.9), $\overline{r}(1)+1$ satisfies (SC') if $\underline{L}_3^{\overline{r}(1)+1} = \frac{\frac{1}{2}a+b-1}{3^{m(1)+1}} - \frac{1}{2}a < 3\,(1 - a)$ if

$$b < 1+3^{m(1)+2} - \tfrac{1}{2}(1+5\cdot 3^{m(1)+1})a \tag{C}$$

Now, let $\overline{r}(1)+1$ not satisfy (SC) and (A) - (C) not hold. Using $\alpha_{-}(1) = a$ and (0.10), we get $\alpha_{-}(2) = \frac{2-a+2b}{3^{m(1)+3}} + \frac{4}{9}a$. Hence, by (0.7), $\gamma_{-}^{\underline{r}(2)+m(1)} = \frac{10a+7b-20}{3^{m(1)+3}} - \frac{4}{9}a$. This is positive iff:

$$b > \tfrac{2}{7}(10-5a+2\cdot 3^{m(1)+1}a) \tag{D}$$

This means that if (D) holds $m(2) > m(1)$ and $\underline{L}_3^{\overline{r}(2)+1} \leq \underline{L}_3^{\underline{r}(2)+m(1)+1}$. Using (0.7) and the upperbound for b in (0.11), we get $\underline{L}_3^{\underline{r}(2)+m(1)+1} = \frac{2}{9}\left(\frac{a+b-2}{3^{m(1)+1}} - a\right) \leq 0 < 3(1-a)$. Hence, if (D) is met $\overline{r}(2)+1$ satisfies (SC').

Finally, let $\overline{r}(2)+1$ not satisfy (SC) and (A) - (D) not hold. As long as $m(s) = m(1)$, from (0.10) we get

$$\alpha_{-}(s+1) = \frac{1}{3}a + \frac{1}{9}\alpha_{-}(s) + \frac{2-a+2b}{3^{m(1)+3}} \tag{0.12}$$

The unique steady state of this difference equation is $\alpha_{-} = \frac{1}{8}\left(3a + \frac{2-a+2b}{3^{m(1)+1}}\right)$, which is a global attractor with a monotonic dynamic since $0 < \frac{d\alpha_{-}(s+1)}{d\alpha_{-}(s)} < 1$. Using the upperbound for b in (0.11), $m(1) \geq 1$ and $a \geq \frac{26}{31}$, we get that $\alpha_{-} \leq \frac{1}{12}(1+7a) \leq a = \alpha_{-}(0)$. Hence, $\alpha_{-}(s)$ decreases monontonically to α_{-}. Suppose $m(s) = m(1)$ for all delaying sequences. Using the righthandside of (C) as lowerbound for b and $0 \leq a$

< 1, we get $\frac{b}{3^{m(1)+1}} - \alpha_- \geq \frac{1}{4}\left(9(1-a) + \frac{2-a}{3^{m(1)+1}}\right) > 0$. Hence, if $m(s) = m(1)$ for all s, there exists an $\hat{s}$ such that $\underline{L}_3^{\overline{r}(\hat{s})+1} + \overline{L}_1^{\overline{r}(\hat{s})+1} = \frac{b}{3^{m(1)+1}} - \alpha_-(\hat{s}) > 0$ and $\hat{s}$ meets (SC').

$m(s)$ is increasing in s, because $\alpha_-(s)$ is decreasing in s and, by (0.8), $m(s)$ is decreasing in $\alpha_-(s)$. This means that if $m(s)$ is not equal to $m(1)$ for all s, there exists an s' such that $m(s') > m(s' - 1) = m(1)$. Furthermore, $\alpha_-(s) > \frac{1}{3}a + \frac{2-a+2b}{3^{m(1)+3}}$ (for $s >$ 1). Using (0.7), this implies that $\underline{L}_3^{\overline{r}(s')+1} \leq \left(\frac{2(a+b)-4}{3^{m(1)+3}} - \frac{1}{6}a\right)$. As a consequence, $\underline{L}_3^{\overline{r}(s')+1} \leq 0$ and $\overline{r}(s')+1$ satisfies (SC) if

$$b \leq \frac{1}{4}(8 - 4a + 3^{m(1)+2}a) \tag{E}$$

Hence, if (E) holds, either $m(s) = m(1)$ for all s or not, both of which imply that (SC) holds for some $\overline{r}(s)+1$. Furthermore, the righthandside of (E) minus the righthandside of (D) is $\frac{3}{28}\left(\left(4 + 5\cdot 3^{m1}\right)a - 8\right)$ and this is positive if $a \geq \frac{26}{31}$ and $m(1) \geq 1$. Hence, since (A) – (D) do not hold, (E) must hold.

In conclusion, for each $(a,b) \in [0,1) \times [a,\infty)$ there exists some round $r \in N$ that satisfies (SC) and, hence, the outcome converges to 0 as r increases. □

(i.b) We show that if a = b = 1, then $\lim_{r\to\infty} f^r = 1$ ***and*** $\lim_{r\to\infty} D^r = 0$**.**

In round 1, $p_1^1 = -1$, $p_2^1 = 0$ and $p_3^1 = 1$. In round r > 1, $p_1^r = -\overline{D}_2^r$, $p_2^r = 0$ and $p_3^r = \overline{D}_2^r$, with $f^r = 1$ and $D^r = \frac{2}{3}\overline{D}_2^r = \frac{2}{3}D^{r-1}$. Consequently, $\lim_{r\to\infty} f^r = 1$ *and* $\lim_{r\to\infty} D^r = 0$.□

(ii) We show that if 1 ≤ a **< 2 and** $b > 1$***, then*** $f^* \neq 0$ **and** f^*, L^* ***or*** D^* ***does not exist,*** *except if* $\frac{13}{7} \leq a = b < 2$ or $b = \frac{3}{2}, \frac{5}{4} \leq a < \frac{3}{2}$ or $\frac{8}{3} \leq b < \frac{13}{14}, a = \frac{5}{7}b - \frac{4}{7}$ or $\frac{3}{2} \leq b < \frac{7}{3}$

$,\max\{\frac{7}{5}-\frac{1}{10}b,\frac{7}{8}b-\frac{8}{5}\}<a<\frac{6}{5}+\frac{1}{5}b$. *In these latter case, the outcome may converge but never to a single outcome in Z.*

Proof: Let $1 \leq a < 2$ and $b > 1$.

First, we show that if the outcome converges there exists an $r^{\dagger}$ such that $p_3^r \neq delay$ for all $r > r^{\dagger}$. Since $EU_2^r > 0$ and $\overline{L}_1^r > -\overline{D}_2^r$, $\overline{L}_1^r > -1$ and $p_2^r \in \mathbb{R}$ for all $r \geq r^{\dagger}$. Suppose there exists an r' such that $p_3^r = delay$ for all $r \geq r'$. This implies that $EU_1^r > 0$, $p_2^r = \overline{L}_1^r < 0$ and $p_1^r = -\overline{D}_2^r > -a$ for all $r \geq r'$ and hence by (0.1) that $f^* = 1$. Furthermore, using (0.3), (0.4), and the logic behind (0.7), we get that $\alpha_-^r = \alpha_-^{r'} > 0$ and, hence, $D^r = \frac{2}{3}\frac{1}{2}(-p_1^r - p_2^r) + \frac{1}{3}D^{r-1} \geq \frac{1}{3}(-p_1^r - p_2^r) = \frac{1}{3}\alpha_-^{r'}$ for all $r \geq r'$. Now, $p_3^r = delay$ only if $\overline{D}_2^r < \underline{L}_3^r$, which implies by (0.4) that $(1 - f^r)(b - 2) - 2f^r D^r > 0$ for all $r \geq r'$. However, this is not possible, since $f^* = 1$ and $D^r \geq \frac{1}{3}\alpha_-^{r'} > 0 \forall r \geq r'$. Hence, there does not exist an r' such that $p_3^r = delay$ for all $r \geq r'$. Convergence (of $\underline{L}_3^r - \overline{D}_2^r$) implies the opposite holds:

$$\text{there exists an } r^{\dagger} \text{ such that } p_3^r \neq delay \text{ for all } r \geq r^{\dagger} \tag{0.13}$$

Second, there can be no convergence to δ as $p_2^r \in \mathbb{R}$ for all r.

Third, there can be no convergence to 0. $\lim_{r\to\infty} f^r = 1$ and (0.13) would imply that there exists an r' such that $f^r = 1$ for $r \geq r'$. This means that $p_1^r = -\overline{D}_2^r$, $p_2^r = 0$ and $p_3^r = \overline{D}_2^r$ for all $r \geq r' + 1$. Consequently, $L^r = 0$ and, hence, $EU_1^r \leq 0$ and $EU_3^r < 0$ for $r \geq r' + 1$. However, if this is the case $p_3^{r+1} = \delta$, contradicting $f^r = 1$ for $r \geq r' + 1$.

Finally, we show there can be no convergence to anything else then 0 or δ, save for four exceptions. Suppose that f^*, L^* and D^* exist, but $0 < f^* \leq 1$ and $D^* > 0$. Now, $f^* = \frac{1}{3}$, $\frac{2}{3}$ or 1. We have seen above that $f^* = 1$ is not possible. Let $f^* = \frac{1}{3}$. This means that there exists a round r' such that $f^r = \frac{1}{3}$, $\overline{D}_2^r \leq a - 1$ and, thus, $D^r \leq 3a - 5$ for $r \geq r'$. Suppose $p_2^r = \min\{0, \overline{L}_1^r\}$ for $r \geq r'$. This implies that $L^{r-1} = -D^{r-1}$ and $L^{r-1} < 0$, such that $\overline{L}_1^r < 0$. Furthermore, $D^r = -\overline{L}_1^r = \frac{2}{3}(a-1) + \frac{1}{3}D^{r-1}$. Convergence implies that $\lim_{r\to\infty} D^r - D^{r-1} = 0$ and solving for $D^r = D^{r-1}$ yields $D^* = -L^* = a - 1$. However, since $a < 2$, $D^* = a - 1 > 3a - 5$ and $D^r \leq 3a - 5$ cannot hold for all $r \geq r'$. Hence, $p_2^r \neq \min\{\overline{L}_1^r, 0\}$ and a similar reasoning (with $a - 1 \leq b - 1 < 3a - 5$) shows that $p_2^r \neq \max\{0, \underline{L}_3^r\}$. Thus, let $\pi_2^r(\overline{L}_1^r) = \pi_2^r(\underline{L}_3^r) = \frac{1}{2}$ for $r \geq r'$. This means that $L^r = 0$, $-\overline{L}_1^r = \underline{L}_3^r$ and, hence, $a = b$ for $r \geq r'$. Furthermore, $D^r = \frac{1}{2}(\underline{L}_3^r - \overline{L}_1^r) = \frac{2}{3}(a-1)$. Hence, $L^* = 0$ and $L^* = \frac{2}{3}(a-1)$. $D^r \leq 3a - 5$ requires $\frac{13}{7} \leq a = b < 2$.

Let, ultimately, $f^* = \frac{2}{3}$. This means that there exists a round r' such that $f^r = \frac{2}{3}$, $1 - a \leq \overline{L}_1^r$, $a - 1 < \overline{D}_2^r \leq b - 1$, $p_1^r = -\overline{D}_2^r$, and $p_3^r = \delta$ for $r \geq r'$. In particular, this implies

$$L^r \geq 1 - a \text{ and } \tfrac{3}{2}a - 2 < D^r \leq \tfrac{3}{2}b - 2 \forall r \geq r' \tag{0.14}$$

To begin, suppose $p_2^r = 0$. Now, $L^r = -D^r$ and $D^r = \frac{1}{2}\overline{D}_2^r = \frac{1}{6} + \frac{1}{3}D^{r-1}$ for $r > r'$. Solving for $D^r = D^{r-1}$ yields $D^* = -L^* = \frac{1}{4}$. As $L^* = -\frac{1}{4}$, $\overline{L}_1^{r*} < 0$ and $p_2^r = 0$ requires $\underline{L}_3^{r*} \leq 0$. Together with (0.14), this implies that $b = \frac{3}{2}$ and $\frac{5}{4} \leq a < \frac{3}{2}$. Suppose now that $p_2^r = -\overline{L}_1^r < 0$ for $r \geq r'$. Hence, $L^r = -D^r$ and $D^r = \frac{1}{2}(\overline{D}_2^r - \overline{L}_1^r) = \frac{1}{6}a + \frac{2}{3}D^{r-1}$. Solving for $D^r = D^{r-1}$ gives $D^* = \frac{1}{2}a = -L^*$. However, this is not possible due to (0.14), since $L^r \geq 1 - a > -\frac{1}{2}a$. To continue, suppose $\pi_2^r(\overline{L}_1^r) = \pi_2^r(\underline{L}_3^r) = \frac{1}{2}$ for $r \geq r'$. $\underline{L}_3^{r+1} + \overline{L}_1^{r+1} = \frac{1}{3}(4L^r + b - a) = 0$ implies $L^r = \frac{1}{4}(a-b)$ for $r \geq r'$. Furthermore, $D^r = \frac{1}{2}\overline{D}_2^r + \frac{1}{4}\underline{L}_3^r - \frac{1}{4}\overline{L}_1^r = \frac{1}{12}\left(a + b + 4D^{r-1}\right)$ and $L^r = -\frac{1}{2}\overline{D}_2^r + \frac{1}{4}\underline{L}_3^r + \frac{1}{4}\overline{L}_1^r = \frac{1}{12}\left(b - a - 2 - 4D^{r-1} - 4L^{r-1}\right)$. Solving for $L^r = L^{r-1}$ and $D^r = D^{r-1}$ and using $L^r = \frac{1}{4}(a-b)$, we get that $L^* = \frac{1}{4}(a-b)$ and $D^* = \frac{1}{8}(a+b)$. (0.14) implies that $\frac{8}{3} \leq b < \frac{13}{14}$ and $a = \frac{5}{7}b - \frac{4}{7}$.

The last possibility is $p_2^r = \underline{L}_3^r > 0$. Thus, $\underline{L}_3^r + \overline{L}_1^r < 0$ and $L^r < \frac{1}{4}(a-b)$ for $r \geq r'$. Furthermore, $D_r = \frac{1}{2}\left(\underline{L}_3^r + \overline{D}_2^r\right) = \frac{1}{6}\left(b + 2\left(D^{r-1} + L^{r-1}\right)\right)$, $L^r = \frac{1}{2}\left(\underline{L}_3^r - \overline{D}_2^r\right) = \frac{1}{6}\left(b + 2\left(L^{r-1} - D^{r-1} - 1\right)\right)$. Solving for $L^r = L^{r-1}$ and $D^r = D^{r-1}$, we get $L^* = \frac{1}{10}b - \frac{2}{5}$

and $D^* = \frac{3}{10}b - \frac{1}{5}$. (0.14) and $L^r < \frac{1}{4}(a-b)$ imply that $\frac{3}{2} \le b < \frac{7}{3}$ and $\max\{\frac{7}{5} - \frac{1}{10}b, \frac{7}{5}b - \frac{8}{5}\} < a < \frac{6}{5} + \frac{1}{5}b$.

In conclusion, if $1 \le a < 2$ and $b > 1$, then a necessary (but not necessarily suffcient) condition for convergence is that either of the following holds:

$$\begin{aligned}
&(i)\, \tfrac{13}{7} \le a = b < 2 \text{ with } f^* = \tfrac{1}{3}, L^* = 0, D^* = \tfrac{2}{3}(a-1)\\
&(ii)\, b = \tfrac{3}{2}, \tfrac{5}{4} \le a < \tfrac{3}{2} \text{ with } f^* = \tfrac{2}{3}, D^* = -L^* = \tfrac{1}{4}\\
&(iii)\, \tfrac{8}{3} \le b < \tfrac{13}{14}, a = \tfrac{5}{7}b - \tfrac{4}{7} \text{ with } f^* = \tfrac{2}{3}, L^* = \tfrac{1}{4}(a-b), D^* = \tfrac{1}{8}(a+b);\\
&(iv)\, \tfrac{3}{2} \le b < \tfrac{7}{3}, \max\{\tfrac{7}{5} - \tfrac{1}{10}b, \tfrac{7}{5}b - \tfrac{8}{5}\} < a < \tfrac{6}{5} + \tfrac{1}{5}b \text{ with } f^* = \tfrac{2}{3}, L^* = \tfrac{1}{10}b - \tfrac{2}{5}, D^* = \tfrac{3}{10}b - \tfrac{1}{5}.
\end{aligned} \tag{0.15}$$

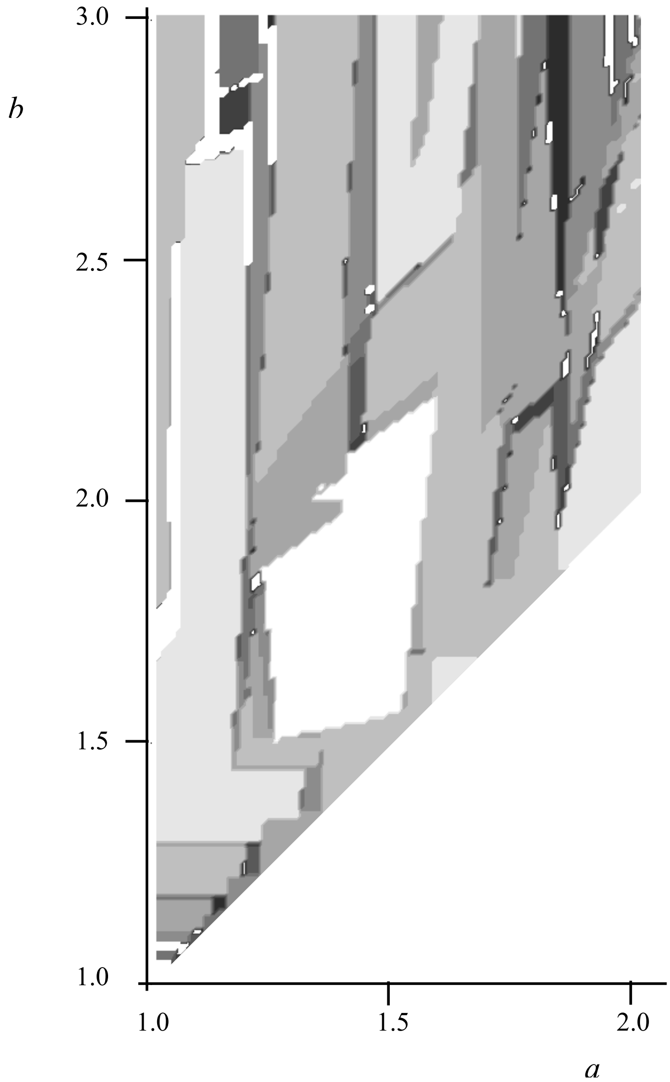
(Note that these four regions covers a very small part of the parameter set.) □

(iii) If a ≥ 2, then $f^* = 0$ **and** $\lim_{r^*\to\infty} \sup_{r \le r^*} D^r \in \mathbb{R}$

Proof: It is immediate that $p_i^r = \delta$ for all r and i. Hence, $f^r = 0$ and $D^r = 0$ for all r. □.

CYCLES

To illustrate the cyclic dependence of the equilibrium outcome on T when the core is empty, we provide below the simulation results for $1 < a < 2$ and $a < b < 3$. The color of the area indicates the period of the cycle. White regions indicate that there is a steady state. The darker the color of the area, the higher the period of the cycle. The darkest color indicates the period is equal or higher than 10.



APPENDIX B: PROOFS FOR PRORPOSITIONS FOR LOWLY STRUCTURED GAME

In this appendix, we provide the proof of propositions 2 and 3 in section 3.

PROOF OF PROPOSITION 2

To prove that Γ^L is well-defined, we need to show how the game proceeds given some profile $\sigma \in \Sigma$ and some history h_τ. We first define the first moment of movement:

DEFINITION. *Given* $\sigma \in \Sigma$ *and* $h_\tau \in H$ *and let* $R_i(\sigma_i \mid h_\tau) \equiv$ {$\tau \leq t \leq T$: $\sigma_i(h_t(h_\tau)) \neq \sigma_i(h_{t-}(h_\tau))$}. (*i*) $r_i(\sigma_i \mid h_\tau)$ is *the first moment of movement of player i. If* $R_i(\sigma_i \mid h_\tau) = \varnothing$, then $r_i(\sigma_i \mid h_\tau) \equiv T + \rho$ *and player i would not move at any* $h_t(h_\tau) \subseteq h_T(h_\tau)$ *. If* $R_i(\sigma_i \mid h_\tau) \neq \varnothing$ *, then* $r_i(\sigma_i \mid h_\tau) = \min R_i(\sigma_i \mid h_\tau)$. (*ii*) *We define the first moment of movement* $r(\sigma \mid h_\tau) \equiv \min_{i \in N}\{r_i(\sigma_i \mid h_\tau)\}$.

If $R_i \neq \varnothing$, $\min R_i$ must exist, because otherwise (S2) would not hold for $h_{\inf R_i}(h_\tau)$.

Now we can define a function γ that returns a history h' as a function of any unresolved history h_s. The function determines whether the (absence of a) first moment of action directly leads to a resolved history. If this is not the case, it returns another unresolved history with $\tau(h') \geq \tau(h) + \rho$

DEFINITION. *Define* $\gamma : H \times \Sigma \to \tilde{H} \cup \overline{H}$, $(h_\tau, \sigma) \to h'$, *as follows:*

- $h_r(h_\tau) \subset h'$, with $r = r(\sigma \mid h_\tau)$.
- If $r > T$, then $h' = h_{T+\rho}(h_\tau) \in \overline{H}$.
- If $r \leq T$, then $p_i^t(h') = \sigma_i(h_r(h_\tau))\ \forall i, j\ \forall t \in [r, \tau(h'))$
- $h' \in \overline{H}$ if $T - \rho < r \leq T$ or $\sigma_i(h_\tau) = a_j$ for some *i,j*
- $h' \in H$ and $\tau(h') = r + \rho$ if $r \leq T - \rho$ and $\sigma_i(h_\tau) \neq a_j \forall i, j$

Now, it is straightforward to show that that Γ_T^L is well-defined.

PROPOSITION 2. *The game* Γ_T^L *is a well-defined mapping* $\Gamma_T^L(G): H \times \Sigma \to \bar{H}_{T+\rho}, (h_\tau, \sigma) \to \bar{h}$

Proof: Consider $\sigma \in \Sigma$ and $h_\tau \in H$. Γ_T^L applies γ iteratively. It starts with $\gamma^0(h_\tau) = h_\tau$. If $\gamma^k(h_\tau) \in H$, then $\gamma^{k+1}(h_\tau) = \gamma(\gamma^k(h_\tau))$. If $\gamma^k(h_\tau) \in \bar{H}$, then the procedure stops and $\bar{h} = \gamma^k(h_\tau)$. Because $\tau(\gamma(h_\tau)) \geq \tau(h_\tau) + \rho$ and T/ρ is finite, this procedure will always return a resolved history. □

PROOF OF PROPOSITION 3

By *p* we denote the vector (p_1, p_2, p_3) and by p_{-i} we denote the vector (p_j, p_k). For convenience, we set $u_i(\varsigma) \equiv -\infty$.

DEFINITION. *By* $\hat{p}/\hat{z}$ *we denote the strategy profile such that the following 1-3 hold.*

1. *For each active history* $\tilde{h}_\tau \in \tilde{H}_T$ with $\tau > T - \rho$

   (i) $\sigma_i(\tilde{h}_\tau) = a_j$ iff (a) $u_i(p_j^{\tau-}(\tilde{h}_\tau)) \geq u_i(\delta)$ and $u_i(p_j^{\tau-}(\tilde{h}_\tau)) > u_i(p_k^{\tau-}(\tilde{h}_\tau))$ or (b) $p_j^{\tau-}(\tilde{h}_\tau) = \hat{z}$, $u_i(\hat{z}) \geq u_i(\delta)$ and $u_i(p_k^{\tau-}(\tilde{h}_\tau)) \leq u_i(\hat{z})$, or (c) $p_j^{\tau-}(\tilde{h}_\tau) \neq \hat{z}$ and $u_i(p_j^{\tau-}(\tilde{h}_\tau)) = u_i(p_k^{\tau-}(\tilde{h}_\tau)) \geq u_i(\delta)$ and either $p_j^{\tau-}(\tilde{h}_\tau) > p_k^{\tau-}(\tilde{h}_\tau)$ or $p_j^{\tau-}(\tilde{h}_\tau) = \delta$.

   (ii) $\sigma_i(\tilde{h}_\tau) = \delta$ iff $\sigma_i(\tilde{h}_\tau) \notin \{a_1, a_2, a_3\}$

2. *For each active history* $\tilde{h}_\tau \in \tilde{H}_T$ with $T - \rho < \tau \leq T - \rho$

   (i) $\sigma_i(\tilde{h}_\tau) = a_j$ iff (a) $u_i(p_j^{\tau-}(\tilde{h}_\tau)) \geq u_i(\hat{z})$ and $u_i(p_j^{\tau-}(\tilde{h}_\tau)) > u_i(p_k^{\tau-}(\tilde{h}_\tau))$ or (b) $p_j^{\tau-}(\tilde{h}_\tau) = \hat{z}$ and $u_i(p_k^{\tau-}(\tilde{h}_\tau)) \leq u_i(\hat{z})$ or (c) $p_j^{\tau-}(\tilde{h}_\tau) \neq \hat{z}$ and $u_i(p_j^{\tau-}(\tilde{h}_\tau)) = u_i(p_k^{\tau-}(\tilde{h}_\tau)) \geq u_i(\hat{z})$ and either $p_j^{\tau-}(\tilde{h}_\tau) > p_k^{\tau-}(\tilde{h}_\tau)$ or $p_j^{\tau-}(\tilde{h}_\tau) = \delta$.

   (ii) $\sigma_i(\tilde{h}_\tau) = \hat{p}_i$ iff $\sigma_i(\tilde{h}_\tau) \notin \{a_1, a_2, a_3\}$

3. $z\left(\Gamma_{\tilde{h}_\tau}^L(\hat{p}/\hat{z})\right) = \hat{z}$ if $p^{\tau-}(h_\tau) = \hat{p}$ and $\tau \leq T - \rho$.

Such profiles have a special property:

LEMMA 3. *If* $\sigma \in \hat{p}/\hat{z}$ *is a SPE of some subgame* $\Gamma^{L}_{T\backslash h^*}$ *with* $h^* \in \tilde{H}_{T-\rho}$, *then it is a SPE for any subgame* $\Gamma^{L}_{T\backslash \hat{h}}$.

Proof: Let $\sigma = \hat{p}/\hat{z}$ be a SPE of $\Gamma^{L}_{T\backslash h^*}$ and let $\Gamma^{L}_{T\backslash \hat{h}_\tau}$ be a subgame of Γ^{L}_{T}. For all $\hat{h}$ with $\tau(\hat{h}) > T-\rho$, it is immediate from the definition of $\hat{p}/\hat{z}$ that σ is a SPE of $\Gamma^{L}_{T\backslash \hat{h}}$.

Hence, consider some $\hat{h}$ with $\tau(\hat{h}) \leq T-\rho$ and let us look at whether there exists some $\hat{\sigma}_i$ such that $U_i(\hat{\sigma}_i;\sigma_{-i} \mid \hat{h}) > U_i(\sigma_i;\sigma_{-i} \mid \hat{h})$. If players *j* and *k* adhere to σ_{-i}, then $p^{\tau'-}_{-i}(\tilde{h}) = \hat{p}_{-i}$ for all $\tilde{h} \supset \hat{h}_\tau$. At $\hat{h}_\tau$ each player *i* accepts according to σ any proposal yielding a higher payoff than $u_i(\hat{z})$. Hence, a necessary condition for a profitable deviation is that one of the following holds:

1. a subhistory $h'_\tau \supseteq \hat{h}$ exists such that player *i* does not accept under σ_i the most attractive proposal yielding her a higher payoff than $u_i(\hat{z})$ (i.e. $\exists j \neq k : \sigma_i(h'_\tau) \neq a_j$, $p^{\tau-}_i(h'_\tau) = \varsigma$, $u_i(p^{\tau-}_j(h'_\tau)) > u_i(\hat{z})$ and $u_i(p^{\tau-}_j(h'_\tau)) \geq u_i(p^{\tau-}_k(h'_\tau))$.)
2. a subhistory $h'_\tau \supseteq \hat{h}$ exists where she can make a deviating proposal with a higher payoff than $\hat{z}$ that will be accepted in the next active history $h_{\tau+\rho} \supset h'_\tau$. (i.e. for some active history h'_τ, $\exists z : \sigma_i(h'_\tau) \neq z$, $u_i(z) > u_i(\hat{z})$ and for some *j*, $\sigma_j(h_{\tau+\rho}) = a_i$ for $h_{\tau+\rho} \supset h'_\tau$, $p^{\tau+\rho-}_i(h'_{\tau+\rho}) = z$ and $p^{\tau+\rho-}_{-i}(h'_{\tau+\rho}) = \hat{p}_{-i}$.)
3. $u_i(\delta) > u_i(\hat{z})$ and a subhistory $h'_\tau \supseteq \hat{h}$ exists where she can deviate by moving to be silent such that at the next active history no proposal is accepted. (i.e. $\sigma_j(h_{\tau+\rho}), \sigma_k(h_{\tau+\rho}) \notin (a_1, a_2, a_3)$ for $h_{\tau+\rho} \supset h'_\tau$ with $p^{\tau+\rho-}_i(h'_{\tau+\rho}) = q$ and $p^{\tau+\rho-}_{-i}(h'_{\tau+\rho}) = \hat{p}_{-i}$.)

From the definition of $\hat{p}/\hat{z}$ it follows that $\sigma_i(\tilde{h}_\tau) = a_j$ iff $\sigma_i(\tilde{h}^*_T) = a_j$ for $\tilde{h}^*_T \supset h^*$ with $p^{T-}(\tilde{h}^*_T) = p^{\tau-}(\tilde{h}_\tau)$. Hence, if either of aforementioned 1-3 would hold, then player *i* could also profitably deviate at either $\tilde{h}_T^*$ or h^* and σ would not be a SPE of $\Gamma^L_{T\backslash h^*}$.

Hence, no player *i* cannot profitably deviate from σ_i, and σ is a SPE of $\Gamma^L_{T\backslash \hat{h}}$.

We are now ready to characterize the equilibrium outcomes of Γ^L_T.

PROPOSITION 3. *The set of SPE outcomes is equal to* $[c,b]\cup\delta$ *for any* Γ^L_T *with* $T \geq \rho$*, where* $c = \min\{-a, \max\{-b, b-1\}\}$.

Proof: We first show by construction that $[c,b]\cup\delta$ are SPE outcomes of Γ^L_T if $T \geq \rho$. For $z = 0$, we simply need to observe that $(0,\varsigma,0)/0$ is a SPE of any $\Gamma^L_{T\backslash \tilde{h}_{T-\rho}}$ and hence Γ^L_T. For $z \in [-a, 0)$ consider the following profile: σ is equal to $\hat{p}/\hat{z} = (0,\varsigma,0)/0$, except that $\sigma(h_0) = (\varsigma, z, z)$ and $\sigma(\tilde{h}'_\rho) = \sigma(\tilde{h}''_\rho)$ $= (\varsigma, -a, -a)$ with $p^{\rho-}(\tilde{h}'_\rho) = (\varsigma, z, \delta)$ and $p^{\rho-}(\tilde{h}''_\rho) = (\varsigma, \delta, z)$. Now, $(0,\varsigma,0)/0$ is a SPE of any subgame and h_0 is the only active subhistory of h'_ρ and h''_ρ. Hence, it only remains to be shown that no player can profitably change strategies at $h_0, \tilde{h}'_\rho$ and $\tilde{h}''_\rho$. At $\tilde{h}'_\rho$, player 1 will obtain her maximal payoff. Furthermore, at $\tilde{h}'_\rho$ player 2 nor 3 can profitably deviate: neither of them can accept the other's proposal and, whatever they propose at $\tilde{h}'_\rho$, player 1 will accept *–a* at $h_{2\rho}(\tilde{h}'_\rho)$ given that the other proposes *–a*. By the same reasoning, at $\tilde{h}''_\rho$ no player can profitably deviate. Finally, no player can profitably deviate at h_0. If player 1 moves away from ς, the outcome will be 0, which is worse for her than *z*. Players 2 and 3 cannot do better by proposing anything else; in particular, even if *1 - a* < *z* < 1 proposing δ at *t=0* is not attractive for them, because that will trigger the subgame in which *–a* is the outcome (rather than player 1 accepting δ). Hence, $\hat{p}/\hat{z}$ is a SPE of Γ^L_T.

In a similar way, SPE of Γ^L_T can be constructed that support z∈(0, *b*] as outcome. A SPE of Γ^L_T that supports δ is $\hat{p}/\hat{z} = (\delta,\delta,\delta)/\delta$, which is obviously a SPE of any

$\Gamma^{L}_{T\setminus\tilde{h}_{T-\rho}}$. Finally, a SPE that support $z \in [\max\{-b, b-1\}, -a)$ (if $-b < b - 1 < -a$) is the following profile: σ is equal to $\hat{p} / \hat{z} = (\delta, \delta, \delta) / \delta$, except that $\sigma(h_0) = (z, z, \varsigma)$ and $\sigma(\tilde{h}'_{\rho}) = (b, b, \varsigma)$ for all $\tilde{h}'_{\rho}$ with $p_1^{\rho-}(\tilde{h}'_{\rho}) \neq z$ or $p_2^{\rho-}(\tilde{h}'_{\rho}) \neq z$. It is easily verified that no player can profitably deviate from σ at any $\tilde{h}'_{\rho}$ or h_0.

Second, we show that all points in R outside of $[c, b]$ cannot be equilibrium outcomes. Suppose σ' is a SPE with outcome $\hat{z} \in R \setminus [c, b]$. In this case, player 2 can in equilibrium never accept $x \neq 0$ at a history h_τ, because then either player 1 or 3 could profitably deviate by proposing 0 at $\tilde{t}(h_\tau)$. If 0 is proposed, namely, then in equilibrium either player 2 will accept this, or it will trigger a subgame in which 0 is the outcome under σ'.

Player 1 will in equilibrium never accept x with $|x| > a$, because then player 2 could profitably deviate by proposing $-a$ at $t = \tilde{t}(h_\tau)$ by the same reasoning. Similarly, player 3 will never accept an x with $|x| > b$ in equilibrium. This immediately rules out the possibility that $z \in (-\infty, -b) \cup (b, \infty)$. If $\hat{z} \in$[-b, min{$-a$, max{$-b$, $b-1$}), then it must be accepted by player 3. However, player 3 could then profitably deviate by at no history accepting $\hat{z}$. Since players 1 and 2 will never accept a proposal outside [$-a$, a] in equilibrium, the outcome would always be better than $\hat{z}$ for player 3. □

APPENDIX C:

EXPERIMENTAL INSTRUCTIONS

We present the English translation of the original instructions in Dutch for both treatments.

INSTRUCTIONS LOW TREATMENT

Instructions

You will initially have fifteen minutes to go through these instructions. When time is up, we will ask whether there is anyone who would like some more time. In case you need more time, please raise your hand and we will simply give you the extra time you need.

Introduction

In a moment you will participate in a decision making experiment. The instructions are simple. If you follow them carefully, you can earn a considerable amount of money. Your earnings will be paid to you individually at the end of the session and separately from the other participants.

You have already received five euros for showing up. In addition, you can earn more money during the experiment. In the experiment the currency is 'francs.' At the end of the session, francs will be changed into euros. The exchange rate is **1 euro for each 10 francs.**

In this experiment you can also lose money. To prevent that your earnings become negative, you will receive at the beginning of the experiment 75 francs extra. In the unlikely situation that your final earnings will be negative, your earnings will be zero (but you keep the five euros for showing up.)

Your decisions will remain **anonymous**. They will not be linked in any way to your name. Other participants cannot possibly figure out which decisions you have made.

You are not allowed to talk to other participants or communicate with them in any other way. If you have a question, please raise your hand.

Periods and Groups

The experiment consists of **24 periods**, each of which will be carried out in **groups of three players**.

At the beginning of **each period**, participants will again be randomly divided into groups of three. The chances that you will be with any other participant in the same group for two consecutive periods are therefore very small.

Choices and Earnings

In each period, your group of three participants negotiates about **choosing a number**. The chosen number **determines the earnings** of each of the three participants for that period. The group can choose **any integer between 0 and 100**. The group can also choose not to determine any number (the "**no number**" option).

Hence, the number chosen by the group determines the earnings for each member of the group. These earnings are different per member nevertheless. How much a player earns depends, in addition of the chosen number, also on her '**ideal value**.' Each player in a group receives an ideal and unique value **between 0 and 100**. The earnings for a player increase as the outcome lies closer to this ideal value.

If the outcome is exactly equal to the ideal value of a player, then this player receives the **maximum earnings of 20 francs**. The difference between the ideal value and outcome (if any) decreases the earnings by the **same amount in francs**. For instance, suppose your ideal value in a certain round is 54. Then you receive 20 francs if the outcome of the period is 54, 19 if the outcome is 53 or 55, 18 if the outcome is 52 or 56 etc. Your earnings may also be negative. If the group, for instance, chooses the number 20, then with an ideal value of 54, your earnings will be equal to -14.

The outcome of a period can also be that the group reaches **no agreement**. Hence, one chooses "**no number**." In this case each member of the group receives **0 francs**.

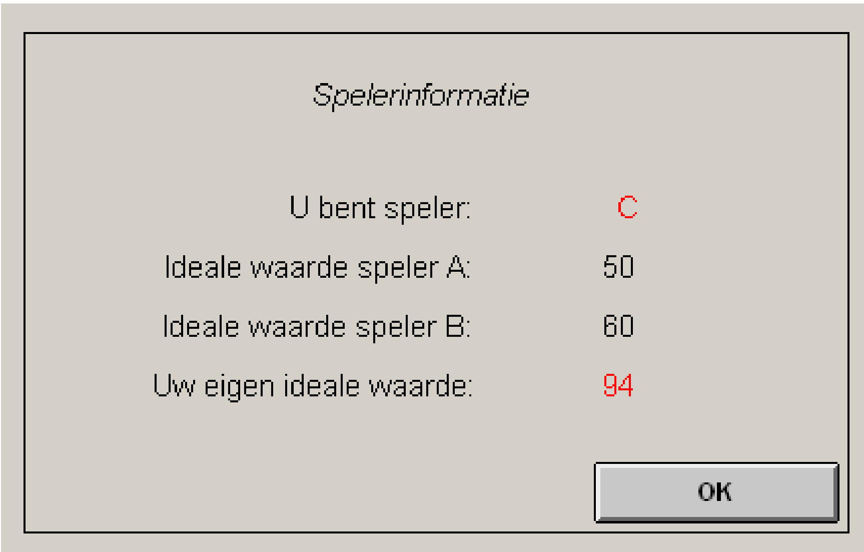
During a round, **players are identified by a letter: A, B and C**. These are based on their ideal value: the player with the lowest ideal value is A and the player with the highest ideal value is C. For instance, suppose the ideal values of the three players are 16, 54 and 86. Then the player with ideal value 16 is player A, the player with ideal value 54 is player B and, finally, the player with ideal value 56 is player C.

The negotiations

The group negotiations on how to choose a number consist of several steps. First, we give an overview. Afterwards, we discuss the separate steps one at a time.

1. **Before** the negotiations start, each player can send a **private message** to **each other member** of the group. A message is a suggestion for the number to choose. Each message from one player to another remains **secret for the third player**.
2. Then, there will be 2.5 minutes during which participants can make and accept proposals. A proposal is a **number between 0 and 100** or a proposal to **end the negotiations**.
3. As soon as a proposal is **accepted** by a player other than the proposer, **the negotiations end**. The accepted proposal is the **group's choice** for that period.
4. **The period also ends** if after **two and half minutes** no proposal has been accepted. The outcome is then "**no number**" and all players earn 0 francs.

Information screen

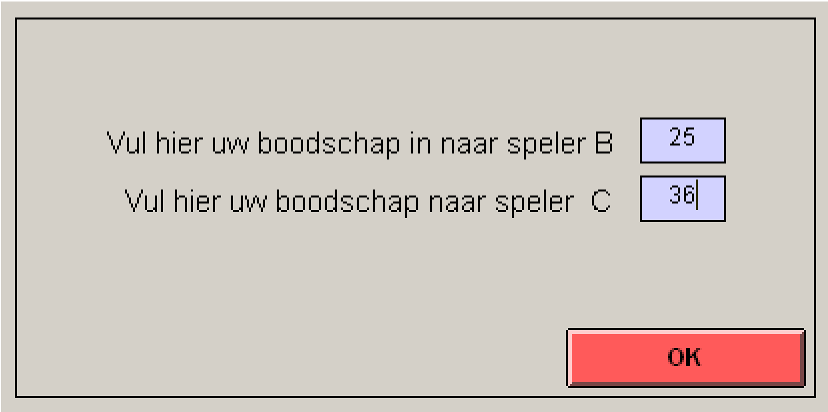


The first screen that you will see in a period, will show which player you are (A, B or C) and the ideal values of you and your group members. Your own letter is marked in red.

If you are ready to proceed, before the time has elapsed, you can press the OK-button.

Sending and receiving messages

Subsequently, you will be able to send a message to each of your two group members and they will be able to send a message to you.



A message is either an integer between 0 and 100 or the word "end." A number is a **suggestion for the group choice**. With "end" you tell the two players that you do not want to negotiate (and therefore have earnings 0). You can also choose to send **no message** by **not filling out anything or typing the space bar**. To send a message, you fill out a number or "end" in one or both cells and you press OK.

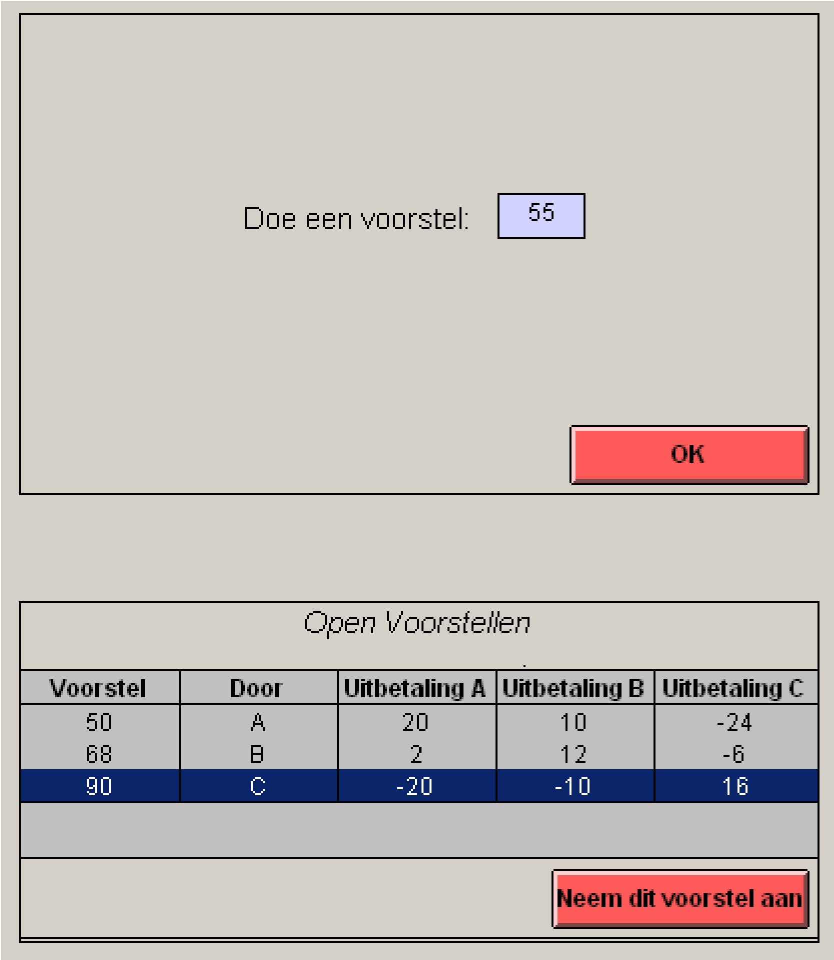
Attention: suggestions you send as a message are not put to a vote and will only be seen by the player who receives the message.

You receive **30 seconds** to send messages. If you do not fill out anything and **press OK** within this time, then no message will be sent. The other players will only see a space at their cell in this case.

After the 30 seconds have elapsed, you will see the messages that the other players sent to you. **You will NOT see what the other players sent to each other**.

Making and accepting proposals

You are then ready to make and accept proposals. In this phase you will see in the top-left corner of your screen all the necessary information (your identity, the messages, the ideal values). At the end of these instructions, we will show you the entire screen lay out.



As a group you will have **two and a half minutes** (150 seconds) to accept a proposal (or not accept one). A proposal can once again be **any integer between 0 and 100 or the word "end."**

During this phase, **you can do three things**: make your own proposal, revise your own proposal or accept a proposal by another player.

To make a proposal, you fill out the number or word you want to propose and press on the "OK" button. This proposal will become immediately visible to the other players in the list "outstanding proposals." Each of the other two players can accept a proposal you make.

To revise your proposal, you simply make another proposal. This must be different from the previous proposal. The old proposal disappears from the list "Outstanding Proposals" (but, as we shall see later, it will remain in the list "Made proposals" on the left of your screen). The new proposal replaces the old one in the list "Outstanding Proposals"

If one of the other layers has made a proposal, then you can **accept a proposal**. You do this by clicking on the proposal you want to accept in the list "Open Proposals" and press the button "Accept this Proposal."

As soon as a **proposal has been accepted** by a player, the **period ends**. The choice of the group for this period is then the accepted proposal. If no proposal is accepted within the two and a half minutes, then the group chooses "no number" and all players receive 0 points.

Results

At the **end of each period**, you will get to see the outcome and the corresponding earnings.

Screens

There is a lot of information you can use while you are making your choices, You can find:

- the player you are
- the ideal values of each player
- the messages you sent and received
- the proposals that have been rejected
- the outcomes of previous periods

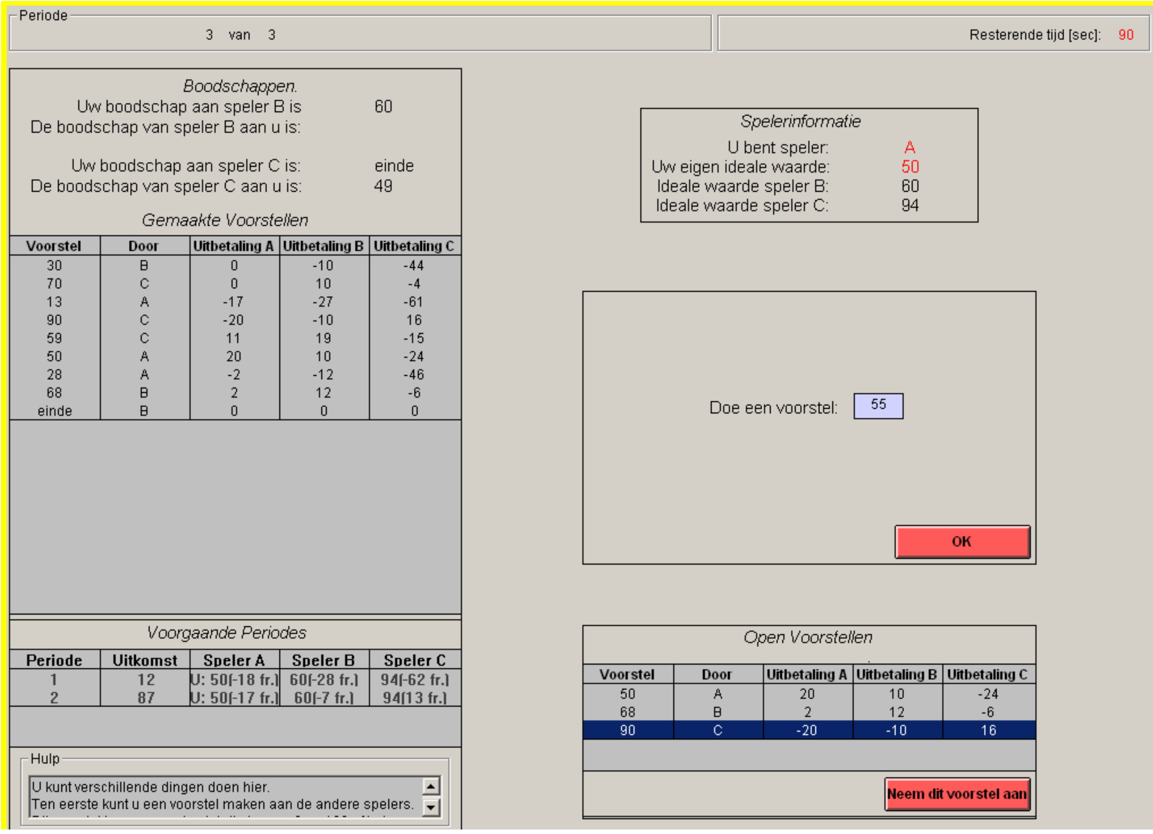
At "Previous Periods," you can find the outcomes of previous periods, together with the ideal values of the player and, between brackets their earnings. The word "You" before the value and payment indicates which player you were.

Vorige Periodes				
Periode	Uitkomst	Speler A	Speler B	Speler C
1	24	50(-6 fr.)	60(-16 fr.)	U: 94(-50 fr.)

At the far-left corner below you see in red the total amount of points (Earnings) that you have made across rounds. Because you received 75 francs at beginning, the counter starts at 75. Divide the final score by 10 to determine your earnings in euros.

All information about previous periods is shown together on the left side of the screen. On the right side of the screen you will find new information and/or what action you have to take. On top, the ideal values of all players are displayed.

Finally, you can find in the far-left corner below a help box with short description of what you have to do.


Periode
3 van 3
Resterende tijd [sec]: 90
Boodschappen.
Uw boodschap aan speler B is 60
De boodschap van speler B aan u is:
Uw boodschap aan speler C is: einde
De boodschap van speler C aan u is: 49
Gemaakte Voorstellen
Voorstel Door Uitbetaling A Uitbetaling B Uitbetaling C
30 B 0 -10 -44
70 C 0 10 -4
13 A -17 -27 -61
90 C -20 -10 16
59 C 11 19 -15
50 A 20 10 -24
28 A -2 -12 -46
68 B 2 12 -6
einde B 0 0 0
Voorgaande Periodes
Periode Uitkomst Speler A Speler B Speler C
1 12 U: 50[-18 fr.] 60[-28 fr.] 94[-62 fr.]
2 87 U: 50[-17 fr.] 60[-7 fr.] 94[13 fr.]
Hulp
U kunt verschillende dingen doen hier.
Ten eerste kunt u een voorstel maken aan de andere spelers.
Spelerinformatie
U bent speler: A
Uw eigen ideale waarde: 50
Ideale waarde speler B: 60
Ideale waarde speler C: 94
Doe een voorstel: 55
OK
Open Voorstellen
Voorstel Door Uitbetaling A Uitbetaling B Uitbetaling C
50 A 20 10 -24
68 B 2 12 -6
90 C -20 -10 16
Neem dit voorstel aan

.

INSTRUCTIONS HIGHTREATMENT

Instructions

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The negotiations

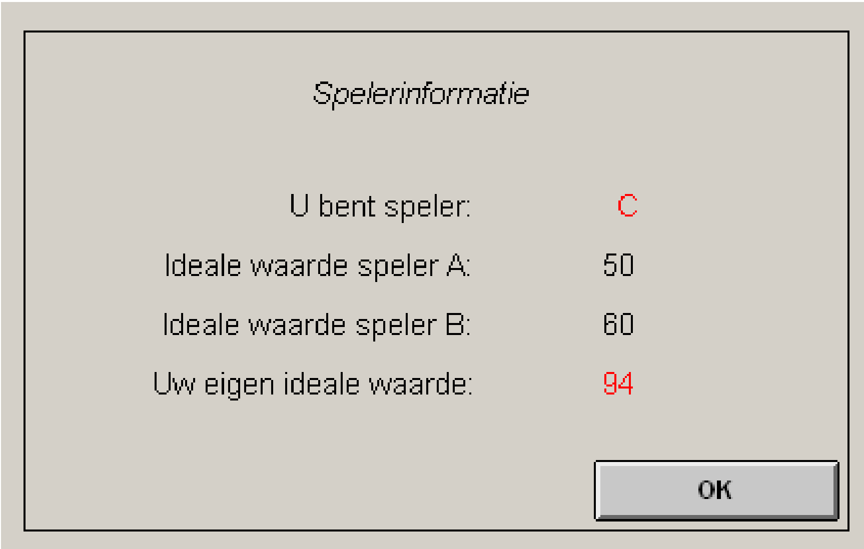
The group negotiations to choose a number consist of several steps. First, we give an overview. Afterwards, we will discuss the separate steps one at a time.

1. **Before** the negotiations start, each player can send a **separate message** to **each other member** of the group. A message is a

suggestion for the number the group can choose. Each message from one player to another remains **secret for the third player**.

2. Next, **at most 10 rounds** follow with making proposals and voting.
3. During each round, **each of the three participants makes a proposals**. This proposal can be any number between 0 and 100 or a proposal to end the negotiations. Subsequently, **one of the three proposals is randomly chosen to be put to a vote**. The other two participants can then vote "**For**" or "**Against**" the chosen proposal (the player who made the chosen proposal automatically votes in favor).
4. If one of these two participants votes "For," then the **proposal is accepted** and the period ends. If both participants vote "Against," then the proposal is rejected and there will be a next round of making proposals and voting. This can continue until nine proposals have been rejected; if also the **tenth proposal is rejected**, then the period **ends** and the outcome is 'no number.'
5. If a proposal to **end the negotiations** is accepted, then the outcome is "**no number**" and, consequently, all players receive 0 francs. If a proposed number is accepted, then this number is the choice of the group for that period.

Information screen



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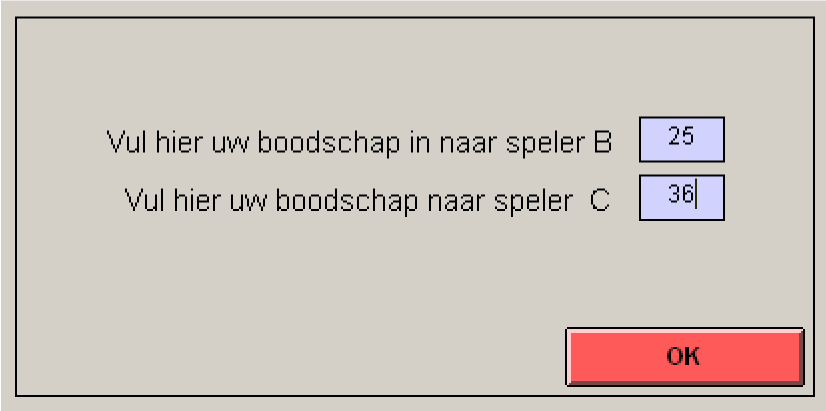

A message is either an integer between 0 and 100 or the word "end." A number is a **suggestion for the group choice**. With "end" you tell the two players that you do not want to negotiate (and therefore have earnings 0). You can also choose to send **no message** by **not filling out anything or typing the space bar**. To send a message, you fill out a number or "end" in one or both cells and you press OK.

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You receive **30 seconds** to send messages. If you do not fill out anything and **press OK** within this time, then no message will be sent. The other players will only see a space at their cell in this case.

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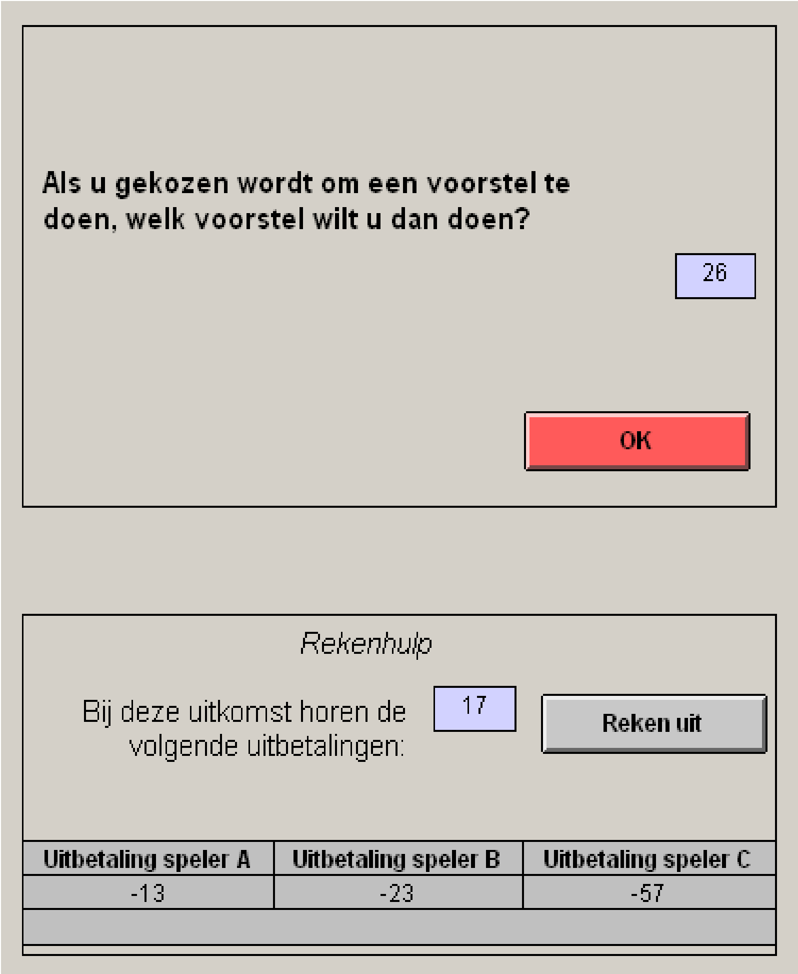


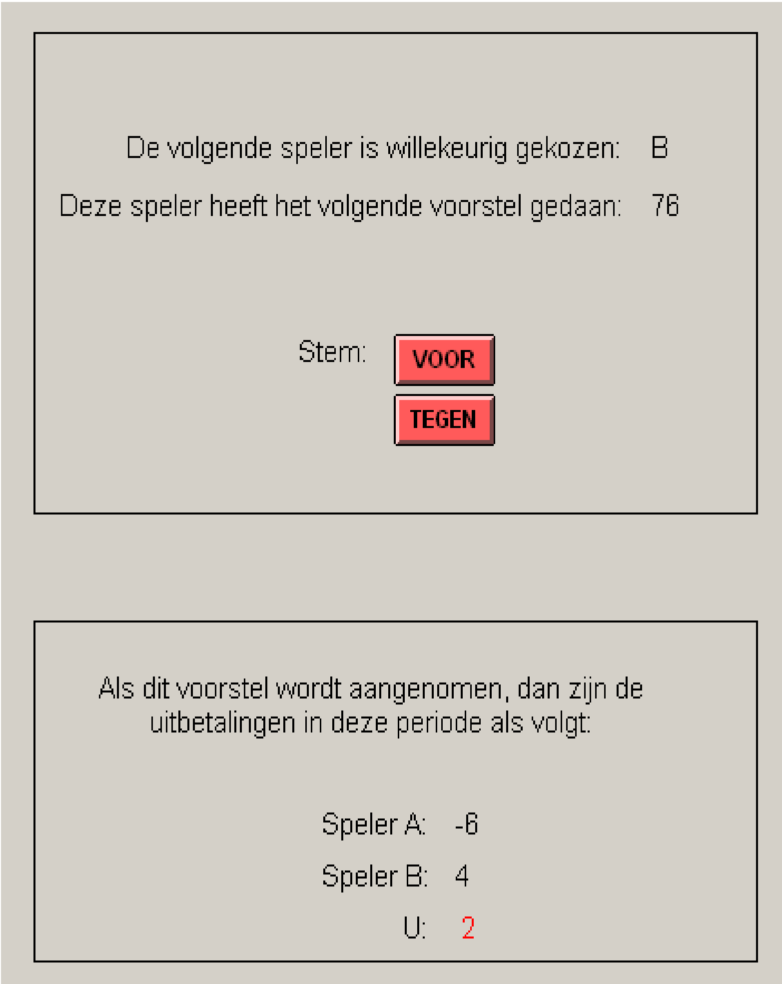
A proposal can once again be **any integer between 0 or 100 or the word "end."**
To make a proposal, you fill out this number or word and press "OK."

To help you calculate quickly which payments belong to which proposal, you also have a **earnings-calculator** at your disposal. If you fill out any number and press "Calculate" then the earnings will appear that all members would receive should that proposal be accepted. This device is only meant to help you. Nothing that you type there, will be seen by the other players.

ATTENTION: In each rounds, everybody fills out a proposal. However, only one of these proposals is (randomly) chosen. This proposal will be revealed to the others and be put to a vote.

You will receive 40 seconds to make your proposal. If you do not type in anything within this time, then **'0'** will be your proposal.

Voting



After everybody has made a proposal, it will be revealed whose proposal has been chosen. Moreover, the payments everyone would receive if this proposal would be accepted are also shown.

Next, the proposal will be put to a vote. The player who made the proposal, automatically votes "For" and **does not press any button**.

The other members can vote by simply pressing "For" or "Against."

If at least **one of the two votes is "For"**, then the proposal is accepted and it will be the outcome of that period. The group has then made a decision and the **period ends**.

If **both vote "Against,"** then the proposal is **rejected** and you will proceed to a next round of proposing and voting. This can continue until nine proposals have been rejected. If the **tenth proposal is also rejected**, then the group was not able to reach a decision and the period **ends**. In this case, the outcome is **"no number."**

Results

At the end of each round, you will see how each player voted, whether the proposal has been accepted and whether or not you will go to a next round.

At the **end of each period**, you will see the outcome and your corresponding earnings.

Screens

There is a lot of information you can use while you are making your choices, You can find:

- the player you are
- the ideal values of each player
- the messages you sent and received
- the proposals that have been rejected
- the outcomes of previous periods

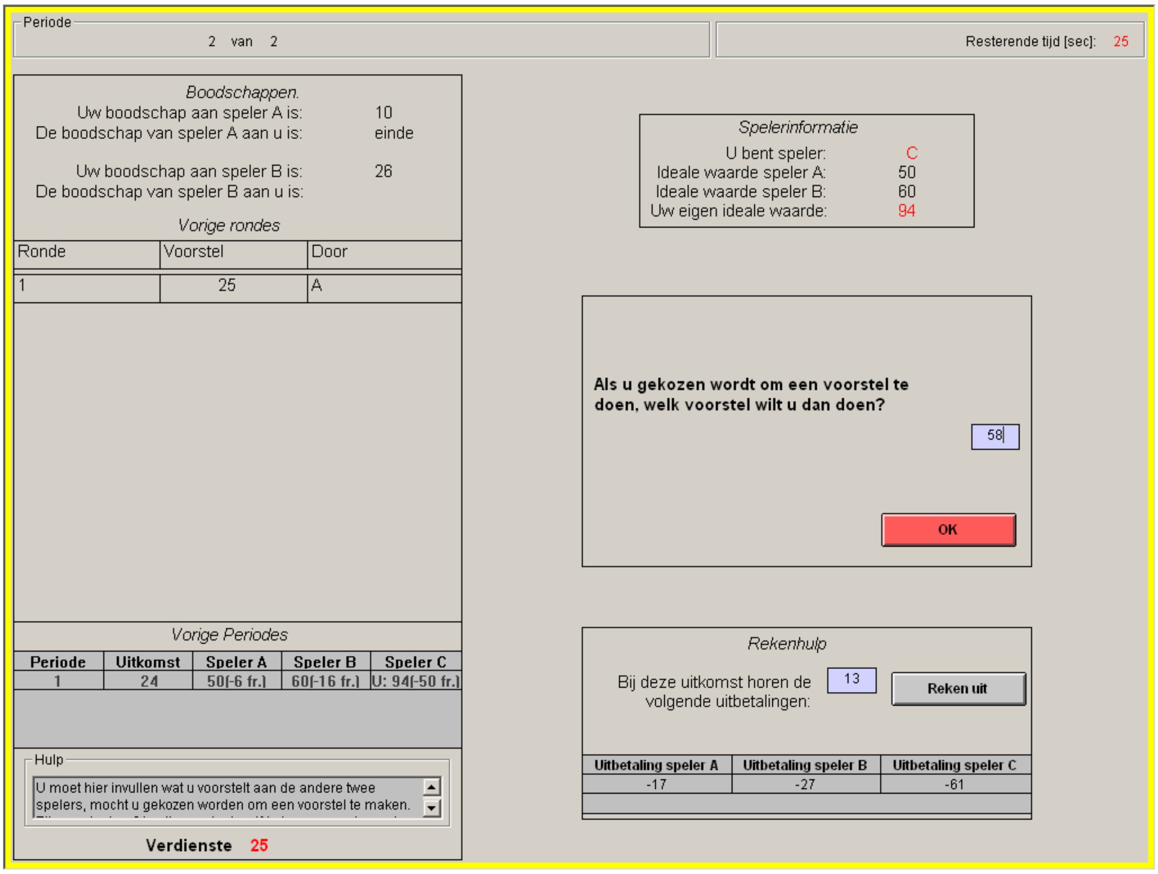
At "Previous Periods," you can find the outcomes of previous periods, together with the ideal values of the player and, between brackets their earnings. The word "You" before the value and payment indicates which player you were.

Vorige Periodes				
Periode	Uitkomst	Speler A	Speler B	Speler C
1	24	50(-6 fr.)	60(-16 fr.)	U: 94(-50 fr.)

At the far-left corner below you see in red the total amount of points (Earnings) that you have made across rounds. Because you received 75 francs at beginning, the counter starts at 75. Divide the final score by 10 to determine your earnings in euros.

All information about previous periods is shown together on the left side of the screen. On the right side of the screen you will find new information and/or what action you have to take. On top, the ideal values of all players are displayed.

Finally, you can find in the far-left corner below a help box with short description of what you have to do.


Periode
2 van 2
Resterende tijd [sec]: 25
Boodschappen.
Uw boodschap aan speler A is: 10
De boodschap van speler A aan u is: einde
Uw boodschap aan speler B is: 26
De boodschap van speler B aan u is:
Vorige rondes
Ronde Voorstel Door
1 25 A
Vorige Periodes
Periode Uitkomst Speler A Speler B Speler C
1 24 50(-6 fr.) 60(-16 fr.) U: 94(-50 fr.)
Hulp
U moet hier invullen wat u voorstelt aan de andere twee
spelers, mocht u gekozen worden om een voorstel te maken.
Verdienste 25
Spelerinformatie
U bent speler: C
Ideale waarde speler A: 50
Ideale waarde speler B: 60
Uw eigen ideale waarde: 94
Als u gekozen wordt om een voorstel te doen, welk voorstel wilt u dan doen?
58
OK
Rekenhulp
Bij deze uitkomst horen de volgende uitbetalingen:
13
Reken uit
Uitbetaling speler A Uitbetaling speler B Uitbetaling speler C
-17 -27 -61