

Online Appendix “Only You: A Field Experiment of Text Message to Prevent Free-riding in Japan Marrow Donor Program”

Last updated on November 07, 2023

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1 Economic Models for Predictions

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In this section, we present a simple inter-temporal economic model to make predictions of message effects. We assume that the matched donor may have the present bias, which is one of the most important insight from behavioral economics (Laibson 1997, O’Donoghue & Rabin 2001).

Events. Consider three periods ($t = 1, 2, 3$). At $t = 1$, a matched donor receives the compatibility notice, which asks him/her to donate. The matched donor has three options: quick response (responding at $t = 1$); late response (responding at $t = 2$); no response. If the matched donor responds, then the donor pays coordination cost c at that time and obtains net-benefit of transplantation at the next period. The net-benefit of transplantation may be time-variant: b_t if the matched donor responds at period t . We assume $b_1 \geq b_2$. If the matched donor does not respond, the donor does not pay any cost and receive any net-benefit.

Preference. According to Laibson (1997), the utility function is $U_t = u_t + \beta \sum_{\tau=t+1}^3 \delta^{\tau-t} u_\tau$ where $\beta \in (0, 1]$ is the degree of present bias and $\delta \in (0, 1]$ is standard time discount factor. Moreover, at period t , the donor expect that s/he makes decisions after $t + 1$ based on $\hat{\beta} \in [\beta, 1]$. If $\beta < \hat{\beta}$, the donor falsely believes that the present bias of their future self is not as strong.

We will solve an interpersonal game (O’Donoghue & Rabin 2001) to obtain optimal response timing. The first result shows that the matched donor thinks that the late response is never optimal regardless of the present bias before receiving the compatibility notice ($t = 0$).

Result 1. For any β , $\hat{\beta}$ and b_2 , at $t = 0$, the quick response is optimal if $b_1 \geq c/\delta$; otherwise the no response is optimal.

Proof. At $t = 0$, the utility of the quick response is $\beta(-\delta c + \delta^2 b_1)$, which is positive $b_1 > c/\delta$. The utility of the late response is $\beta(-\delta^2 c + \delta^3 b_2)$. Let $b_2 = b_1 - d$ for $d \geq 0$. Then, the utility of the late response is positive if $b_1 > c/\delta + d$. Note that the utility of the no response is zero. Thus, if $b_1 < c/\delta$, then the no response is optimal because the quick response and the late response produce negative utilities. The quick response is preferred to the late response if

$$b_1 \geq \frac{c}{\delta} - \frac{\delta}{1-\delta} d. \quad (1)$$

Thus, the quick response is optimal if $b_1 \geq c/\delta$ since the Equation (1) holds.

This results implies that, before receiving the compatibility notice, the matched donor thinks that the donor quickly respond to the compatibility notice if the transplantation net-benefit is sufficiently large. The next result presents that the donor may delay the response, while receiving the notice, even if the transplantation value is sufficiently large.

Result 2. Suppose that $b_1 = b_2$. At $t = 1$, the quick response is optimal if $b_1 \geq c \frac{1-\beta\delta}{(1-\delta)\beta\delta}$; the late response is optimal if $c \frac{1-\beta\delta}{(1-\delta)\beta\delta} > b_1 \geq c/\beta\delta$; otherwise the no response is optimal.

Proof. We employ the backward-induction to solve the interpersonal game. Consider $t = 2$. If the matched donor does not choose the quick response, the donor can respond to the notice at that period. Then, the utility of the late response at $t = 2$ is $-c + \beta\delta b_2$. Thus, the late response is optimal iff $b_2 \geq c/\beta\delta$. Otherwise, the donor choose the no response. Next, we go back to $t = 1$ and analyze how the donor expects behavior at $t = 2$. The donor believes that future self's present bias is $\hat{\beta}$. Thus, at $t = 1$, the donor expect that s/he will respond at $t = 2$ (the late response) if and only if $b_2 \geq c/\hat{\beta}\delta$. Assuming $b_2 = b_1$, we derive the optimal choice at $t = 1$ in three cases.

- Consider $b_1 < c/\hat{\beta}\delta$. Then, at $t = 1$, the donor expects to give up responding, and actually does so. Thus, the donor at $t = 1$ responds if and only if $U_1 = -c + \beta\delta b_1 \geq 0$ or $b_1 \geq c/\beta\delta$. Otherwise, the donor gives up responding. Thus, the optimal choice is the no response.
- Consider $c/\hat{\beta}\delta \leq b_1 < c/\beta\delta$. Then, at $t = 1$, the donor expects to respond at $t = 2$, but will not actually take that action (no response). Due to this false prediction, the donor at $t = 1$ responds if and only if $U_1 \geq \beta(-\delta c + \delta^2 b_1)$ or

$$c \frac{1 - \beta\delta}{(1 - \delta)\beta\delta} \leq b_1. \quad (2)$$

Otherwise, the donor eventually stops responding. Since $\frac{1}{\beta\delta} < \frac{1-\beta\delta}{\beta\delta}$, the optimal choice is the no response in this case.

- Consider $c/\beta\delta \leq b_1$. Then, at $t = 1$, the donor expects to respond at $t = 2$, and actually does so. Thus, the donor responds at $t = 1$ if and only if equation (2) holds. Otherwise, the donor responds at $t = 2$.

This result is motivated us to create the Early Coordination message. If the net benefit of transplantation is time-invariant, then some matched donors thinks that the quick response is ideal but acutually choose the late response or the no response. Especially, if $c/\delta \leq b_1 < c/\beta\delta$, then the matched donor thinks that the quick response but does not actually respond to the compatibility notice. If $c/\beta\delta \leq b_1 < c \frac{1-\beta\delta}{(1-\delta)\beta\delta}$, then the matched donor thinks that the quick response but does delay response to the compatibility notice.

The next result shows that almost matched donor follows ideal behavior (the optimal choice at $t = 0$; see Result 1) if there is sufficiently large difference between b_1 and b_2

Result 3. Let $b_2 = b_1 - d$. Suppose that $c \left(\frac{1-\beta\delta}{\beta\delta} - \frac{1-\delta}{\beta\delta} \right) < d$. Then, the matched donor actually chooses the quick response if $c/\beta\delta \leq b_1$; otherwise the matched donor actually chooses the no response.

References

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- O'Donoghue, T. & Rabin, M. (2001), 'Choice and Procrastination', *The Quarterly Journal of Economics* **116**(1), 121–160.