Self-Signaling and Pro-Social Behavior: a cause marketing mobile field experiment

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Rich literature at intersection of economics and psychology

Standard behaviorist psychology and economic theory predict economic ($$) incentive should increase willingness to behave pro-socially.

- Cognitive Evaluation Theory: extrinsic rewards replace intrinsic motivation and can crowd out an individual's behavior.
- Hidden costs of rewards or corruption effects (Lepper et al. 1978).
Rich literature at intersection of economics and psychology

Standard behaviorist psychology and economic theory predict economic ($\) incentive should increase willingness to behave pro-socially

Long literature in cognitive social psychology disputes prediction

- role of motivation crowding: Cognitive Evaluation Theory
- extrinsic rewards replace intrinsic motivation
- *intrinsically* motivated individual’s behavior *crowded out* by *extrinsic* incentives (Deci 1971, Deci and Ryan 1975)
- *hidden costs of rewards* or corruption effect (Lepper et al 1978)
Many empirical examples where economic incentives crowd out pro-social behavior

Many empirical examples where economic incentives crowd out pro-social behavior


- Evidence mixed (e.g. Mellström and Johannesson 2008, Lacetera, Macis and Slonim 2009, Landry et al 2010)
Moderators of incentive effects on pro-social behavior

- Understanding the mixed evidence

- *Reputational* motivation such as a *social signal*
- In addition to intrinsic and extrinsic motivations

- Actions reveal information to peers
  - Signal extraction problems

  - prosocial behavior higher in public than private
  - monetary incentives work in private, but have neutral effect in public
Self-signaling as a moderator of extrinsic incentives

- **Self-perception as opposed to social image**
- **Individual as an outside observer learns about self through observed actions** (Bem 1972)
  - The dual selves: one chooses, one observes/judges
  - Observed action generates a signal about the “self”
  - Rewards can dampen the signal
Self-signaling and the crowding out effect of $ incentives

- $ incentives dampen the self-signal, reducing pro-social behavior

Large-scale Cause Marketing Mobile Field experiment

- buy movie tickets bundled with charitable donation
- Private signal (no public display of action)
- Observe actual purchase behavior

Conduct follow-up survey about motivation
Model-free evidence

- Positive and monotonic effects from “pure discounts”
- for large donation levels, price discounts crowd out purchase
  - demand can slope upwards!
- non-monotonicity cannot be explained by standard demand theories

Rule out alternative explanations for crowding-out

- mere incidence of payment
- contextual inference
Estimate a structural model of self-signaling (DellaVigna et al 2012)
fits non-montonic moments of choice behavior in sample
Qualitative insights: self-perception as altruistic (warm-glow) versus actual altruism
measure potential non-fungibility of promotion money
**Definition:** “characterized by an offer from the firm to contribute a specified amount to a designated cause when customers engage in revenue-providing exchanges that satisfy organizational and individual objectives” (Varadarajan and Menon 1988)

$1.78$ billion in the US in 2013 and growing


“Cause marketing works because people have an affinity for the cause or the cause’s mission and want to support it.” Paul Jones (Cause Marketing Consultant)

our findings suggest warm-glow, not pure/impure altruism

non-complementarity of discounts and donations vs integrated marketing

**Cause Marketing**
Self-signaling model overview


- Rational economic consumer who maximizes total expected utility
  - Preferences: consumption and diagnostic
  - Beliefs (about self)
  - Purchase decision

- Consumer uses own actions to update beliefs about self via Bayes rule

- *Game Theory* between the two selves
Model set-up and notation

- Cause-marketing promotion scenario:
  - Consumer Action (purchase): $y \in \{0, 1\}$
  - Pro-Social product characteristic (donation): $a \geq 0$
  - Price: $p > 0$
two corresponding components to utility:
two corresponding components to utility:

1 Decision-maker self:
   consumption utility: \((V + \alpha p + \gamma a)\)
two corresponding components to utility:

1. Decision-maker self:
   - **consumption utility**: $(V + \alpha p + \gamma a)$

2. Judge self:
   - **diagnostic utility**: $R (a, p, \lambda, y) = \lambda \gamma E (\gamma | a, p, y)$
two corresponding components to utility:

1. Decision-maker self:
   **consumption utility**: $(V + \alpha p + \gamma a)$

2. Judge self:
   **diagnostic utility**: $R(a, p, \lambda \gamma, y) = \lambda \gamma E(\gamma|a, p, y)$

**taste** parameters: $\Theta = (V, \alpha, \gamma)$ and $\lambda \gamma$
Self-Deception

1. Decision-make self:
   consumption utility: \((V + \alpha p + \gamma a)\)

2. Judge self:
   diagnostic utility: \(R(a, p, \lambda\gamma, y) = \lambda\gamma E(\gamma|a, p, y)\)

- self-deception: adjust actions to manipulate self-signal and raise diagnostic utility \(R(a, p, \lambda\gamma, y)\)

Choice behavior

- Total indirect utility at time of choice:

\[
U = \begin{cases} 
(V + \alpha p + \gamma a) + R(a, p, \lambda_{\gamma}, 1) & , y = 1 \\
R(a, p, \lambda_{\gamma}, 0) & , y = 0
\end{cases}
\]
Total indirect utility at time of choice:

\[
U = \begin{cases} 
(V + \alpha p + \gamma a) + R(a, p, \lambda \gamma, 1), & y = 1 \\
R(a, p, \lambda \gamma, 0), & y = 0 
\end{cases}
\]

Purchase ticket if

\[
V + \alpha p + \gamma a + \Delta(a, p, \lambda \gamma) > 0
\]

where

- \( \Delta(a, p, \lambda \gamma) = R(a, p, \lambda \gamma, 1) - R(a, p, \lambda \gamma, 0) \) is self-diagnostic benefit

i.e. the warm glow feeling
Diagnostic utility depends on consumer’s posterior after making a choice:

\[ V + \alpha p + \gamma a + \Delta (a, p, \lambda \gamma) \geq 0 \]

Consumer’s posterior with rational Bayesian learning:

\[ E (\gamma | y) \]
\[ E (\alpha | y) \]
Beliefs

- to simplify the model, assume Normal prior self beliefs

\[ \Theta \sim N(\tilde{\Theta}, \Sigma_\Theta) \]

where

\[ \tilde{\Theta} = \begin{bmatrix} \tilde{\gamma} \\ \tilde{\alpha} \\ \tilde{V} \end{bmatrix} \]

\[ \Sigma_\Theta = \begin{bmatrix} \sigma^2_\gamma & 0 & 0 \\ 0 & \sigma^2_\alpha & 0 \\ 0 & 0 & \sigma^2_V \end{bmatrix} \]
If we let $V \sim N(\bar{V}, 1)$, we get *random coefficients* probit choice rule

$$
Pr (y = 1 | p, a) = \int \Phi (\bar{V} + \alpha p + \gamma a + \Delta (a, p, \lambda_\gamma) | 0, 1) \phi (\alpha, \gamma | \mu_{\alpha, \gamma}, \Sigma_{\alpha, \gamma}) \, d\alpha \, d\gamma
$$

where $\Delta (a, p, \Lambda)$ depends on choice-specific (posterior) self-image

$$
E(\Theta | y) = F(\bar{\Theta}, \Sigma_\Theta, \lambda_\gamma, a, p)
$$
Under Normal beliefs, the consumer’s posterior for $\gamma$

$$E(\gamma|y = 1) = \frac{\int \gamma \Phi(\tilde{V} + \Delta(a, p, \lambda) + \gamma a + \alpha p) \phi(\alpha, \gamma | \mu_{\alpha, \gamma}, \Sigma_{\alpha, \gamma}) d\alpha d\gamma}{\int \Phi(\tilde{V} + \Delta(a, p, \lambda) + \gamma a + \alpha p) \phi(\alpha, \gamma | \mu_{\alpha, \gamma}, \Sigma_{\alpha, \gamma}) d\alpha d\gamma}$$

$$E(\gamma|y = 0) = \frac{\int \gamma [1 - \Phi(\tilde{V} + \Delta(a, p, \lambda) + \gamma a + \alpha p)] \phi(\alpha, \gamma | \mu_{\alpha, \gamma}, \Sigma_{\alpha, \gamma}) d\alpha d\gamma}{\int [1 - \Phi(\tilde{V} + \Delta(a, p, \lambda) + \gamma a + \alpha p)] \phi(\alpha, \gamma | \mu_{\alpha, \gamma}, \Sigma_{\alpha, \gamma}) d\alpha d\gamma}$$
Solving the Model

- cases

1. \( a = 0 \): just have standard binary probit (i.e. because \( \Delta = 0 \))

2. \( a > 0 \): optimal choice is an equilibrium outcome
Equilibrium consists of:

set of posterior self beliefs

\[ \{ E(\gamma|y = 1), E(\gamma|y = 0) \} \]

that satisfies the system

\[ E(\Theta|y) = F(\bar{\Theta}, \Sigma_{\Theta}, \lambda_\gamma, a, p) \]

computational challenges

- numerical solution (no analytic solution)
- potential multiplicity of equilibria
Crowding out and self-signaling

- changes in $a$ or $p$ affect:
  - consumption utility: $V + a\gamma + p\alpha$
  - diagnostic utility: $\lambda \gamma E(\gamma|p,a)$

- crowding out arises if decline in $E(\gamma|p,a)$ is larger than increase in consumption utility
Alternative Crowding Predictions

- Contextual Inference (Benabou and Tirole 2003)
  - promotions generate a signal about product quality, not self
  - crowding out due to large promotion budgets, not discounts
  - does firm’s “promotion effort level” moderate crowding?
Empirical Studies

- Two field experiments
  - Study 1: Look at interaction between small discounts and donations
  - Study 2: Look at interaction between large discounts and donations
Study 1

- SMS promotional experiment in large Chinese city
  - population of 15 million subscribers living 2km from a theater and who purchased a ticket via phone in last 6 months
  - 10,500 subjects sampled
  - SMS offer for general admission voucher on any 2D movie between 1-15-2014 and 1-31-2014 (reg price of 75 RMB)
  - offer distributed on 1-15-2014 and expired at midnight 1-16-2014
- focus on small rewards (discounts) to test *mere incidence of payment* effect
Study 1 design

- **control condition:**
  
  “To buy a voucher for general admission to any of the 2D showings in January with your mobile phone, the purchase link below is valid until January 16...”

- **pure discount condition:**
  
  “To buy a voucher for general admission to any of the 2D showings in January with your mobile phone at a [3, 6, 15, 30, and 36] RMB discount, the link below is valid until January 16...”

- **pure donation condition:**
  
  “To buy a voucher for general admission to any of the 2D showings in January with your mobile phone, [wireless provider’s name] will donate [3, 6, 15, 30, and 36] RMB per each sold ticket to poor aged people, the purchase link below is valid until January 16...”

- **Combination condition:**
  
  “To buy a voucher for general admission to any of the 2D showings in January with your mobile phone at a [3, 6, 15, 30, and 36] RMB discount, [wireless provider’s name] will donate [3, 6, 15, 30, and 36] RMB per each sold ticket to poor aged people, the purchase link below is valid until January 16...”
<table>
<thead>
<tr>
<th>Variable</th>
<th>Donation (RMB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
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<tr>
<td>0</td>
<td>500</td>
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<tr>
<td>3</td>
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<tr>
<td>30</td>
<td>500</td>
</tr>
<tr>
<td>36</td>
<td>500</td>
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</table>
Model-free experimental results for Study 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Donation (RMB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>3</td>
<td>0.006</td>
</tr>
<tr>
<td>6</td>
<td>0.008</td>
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<tr>
<td>15</td>
<td>0.034**</td>
</tr>
<tr>
<td>30</td>
<td>0.062**</td>
</tr>
<tr>
<td>36</td>
<td>0.066**</td>
</tr>
</tbody>
</table>

** Significant at 1 percent level

* Significant at 5 percent level

- ruling out crowding out from small rewards: no crowding out from any discounts (let alone from small discounts)
Study 2

- SMS promotional experiment in large Chinese city
  - population of 15 million subscribers living 2km from a theater and who purchased a ticket via phone in last 6 months
  - 30,300 subjects sampled
  - SMS offer for admission voucher on any 3D showing of *X-Men: Days of Future Past* (5-22-2014 onwards) (reg price of 100 RMB)
  - offer distributed on 5-21-2014 and expired at midnight 5-22-2014

- larger rewards (i.e. discounts) to test for crowding out away from origin

- much larger sample for more power

- cases where same (or more) total promotion budget for combination (discount+donation) versus pure discount to rule out contextual inference
Study 2 design

- **control condition:**

  “To buy a voucher for general admission to any of X-Men: Days of Future Past’s 3D showings, follow this link…”

- **pure discount condition:**

  “To buy a voucher for general admission to any of X-Men: Days of Future Past’s 3D showings at a [20, 35, 50, 60, 75] RMB discount, follow this link…”

- **pure donation condition:**

  “To buy a voucher for general admission to any of X-Men: Days of Future Past’s 3D showings, [wireless provider’s name] will donate [5, 10, 15] RMB per each ticket sold to poor aged people, follow this link…”

- **Combination condition:**

  “To buy a voucher for general admission to any of X-Men: Days of Future Past’s 3D showings at a [20, 35, 50, 60] RMB discount, [wireless provider’s name] will donate [5, 10, 15] RMB per each sold ticket to poor aged people, follow this link…”
## Study 2 design

<table>
<thead>
<tr>
<th>discount (RMB)</th>
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<th>10</th>
<th>15</th>
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</thead>
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<td>20</td>
<td>700</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>35</td>
<td>700</td>
<td>1,000</td>
<td>3,000</td>
<td>3,000</td>
</tr>
<tr>
<td>50</td>
<td>700</td>
<td>1,000</td>
<td>3,000</td>
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<tr>
<td>60</td>
<td>700</td>
<td>1,000</td>
<td>3,000</td>
<td>3,000</td>
</tr>
<tr>
<td>75</td>
<td>700</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Follow-up Survey (5-23-2014)

For 12 of 21 experimental cells, sub-sampled 40 subjects who purchased a ticket and 40 who did not

questions regarding motivation (self-reported on 12-pt scale)

- e.g. whether it was to make buyer feel good, whether it was to support charity, whether it was to see a movie etc.
Model-Free experimental results for Study 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Donation (RMB)</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>0</td>
<td>0.0000</td>
</tr>
<tr>
<td>20</td>
<td>0.0071</td>
</tr>
<tr>
<td>35</td>
<td>0.0329**</td>
</tr>
<tr>
<td>50</td>
<td>0.0557**</td>
</tr>
<tr>
<td>60</td>
<td>0.0600**</td>
</tr>
<tr>
<td>75</td>
<td>0.0629**</td>
</tr>
</tbody>
</table>

** Significant at the 1 percent level

* Significant at the 5 percent level

- Crowding out from larger discounts (only at larger donation sizes)
Small rewards work, but *unintended consequences* of large rewards

![Experimental Results, purchase_mean](image)

Non-montonicity at $a = 10$

\[
Pr(y|p = 80) < Pr(y|p = 65), \ p < 0.01
\]

\[
Pr(y|p = 50) < Pr(y|p = 65), \ p < 0.01
\]
Small rewards work, but *unintended consequences* of large rewards

Experimental Results, purchase_mean

<table>
<thead>
<tr>
<th>Donor Level</th>
<th>Purchase Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>0.02</td>
</tr>
<tr>
<td>10</td>
<td>0.04</td>
</tr>
<tr>
<td>15</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Mere Incidence of Payment?

\[ Pr(y|a=5, p=100) > Pr(y|a=5, p=80), \ p < 0.01 \]

\[ Pr(y|a=10, p=100) > Pr(y|a=10, p=80), \ p < 0.01 \]

\[ Pr(y|a=15, p=100) > Pr(y|a=15, p=80), \ p < 0.01 \]
Small rewards work, but unintended consequences of large rewards

\[ Pr(a = 0, p = 25) > Pr(a = 15, p = 50) \]

\[ \uparrow \text{budget from 35 to 60 RMB pp} \]

\[ Pr(a = 0, p = 40) - Pr(a = 0, p = 65) > 0 \]

\[ Pr(a = 10, p = 50) - Pr(a = 0, p = 65) < 0 \]
Please indicate the extent to which you agree with the following statement regarding why these consumers made the purchase in order to improve our business and customer service (12-point scale):

**Those consumers wanted to feel good about themselves by donating to the charity.**

- crowding out of this self-reported motivation
Survey evidence

Those consumers value the charity and wanted to support it.

- Flat relationship between perception of charity and promotional conditions (but high!)
Survey evidence

The consumer wanted to watch the movie and would have seen it regardless of the special offer.

Flat relationship between movie preference and price conditions
suggestive of no contextual inference, but confounded with $E(V)$ for inframarginal consumers
assume rational expectations (everyone has same prior about self)

need to address multiplicity of equilibria during estimation to solve coherency problem

use constrained optimization (MPEC) as in Su and Judd (2012), Dube, Fox and Su (2012) and Su (2014)
An MPEC estimator

\[ \mathcal{L}(\Theta, \Lambda, \delta) = \sum_i y_t \log(Pr(y_t = 1|p_t, a_t; \Theta, \Lambda, \delta_t)) \]

subject to constraints

\[ \delta_t = F(\Theta, \Lambda, a_t, p_t), \ t = 1, \ldots, T \]

- \((\Theta, \Lambda)^{MPEC}\) selects equilibrium with highest likelihood
- \((\Theta, \Lambda)^{MPEC}\) is an MLE when observationally equivalent consumers play same self-signaling equilibrium (Su 2014)
- Lagrangean smooth in equilibrium beliefs (vs nested fixed point approach)
Identification

- field experiment generates cross-sectional data

- normalizations
  - $\sigma_V = 1$ is pretty standard in choice literature
  - $\sigma_{\alpha,\gamma} = 0$ is practical due to limited experimental variation

- heterogeneity: $\sigma^2_\gamma$ and $\sigma^2_\alpha$
  - cross-sectional semi-parametric identification of random coefficients (Bajari, Fox and Ryan 2010)

- diagnostic weight: $\lambda_\gamma$
  - non-montonicity in observed choice behavior
### Structural Model Comparisons

<table>
<thead>
<tr>
<th></th>
<th>Probit</th>
<th>R.C. Probit</th>
<th>Self-Signaling on $\gamma$</th>
<th>Self-Signaling on $\gamma$ and $\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L$</td>
<td>-3254.0865</td>
<td>-3251.9625</td>
<td><strong>-3220.8172</strong></td>
<td>-3219.9328</td>
</tr>
<tr>
<td>$BIC$</td>
<td>6539.1297</td>
<td>6555.5195</td>
<td><strong>6503.5478</strong></td>
<td>6512.098</td>
</tr>
</tbody>
</table>

- Self-signaling model fits the data better than simple homogeneous probit or random coefficients probit.
- Allowing for self-signaling on both price and donation dimensions has worse fit.
### Structural Model Comparisons: self-signaling on movies

<table>
<thead>
<tr>
<th></th>
<th>Self-Signaling on $\gamma$</th>
<th>Self-Signaling on $\gamma (\sigma_\alpha = 1)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mathcal{L}$</td>
<td>-3220.8172</td>
<td>-3252.559</td>
</tr>
<tr>
<td>$BIC$</td>
<td>6503.5478</td>
<td>6577.3503</td>
</tr>
</tbody>
</table>

- self-signaling on movies leads to significantly inferior fit
- note need to set $\sigma_\alpha = 1$ and allow $\sigma_V$ to vary freely
In-sample fit of self-signaling model

- self-signaling model captures non-monotonicity of price discounts in data
### Structural Estimates

<table>
<thead>
<tr>
<th></th>
<th>Self-Signaling</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>coefficient</td>
<td>st. error</td>
</tr>
<tr>
<td>Donation ($\bar{\gamma}$)</td>
<td>-3.3742</td>
<td>1.5967</td>
</tr>
<tr>
<td>Price, ($\alpha$)</td>
<td>-2.497</td>
<td>1.1378</td>
</tr>
<tr>
<td>Intercept, ($\bar{V}$)</td>
<td>5.3693</td>
<td>1.7324</td>
</tr>
<tr>
<td>$\sigma_{\gamma}$</td>
<td>1.5743</td>
<td>0.674</td>
</tr>
<tr>
<td>$\sigma_{\alpha}$</td>
<td>1.374</td>
<td>0.6454</td>
</tr>
<tr>
<td>$\lambda_{\gamma}$</td>
<td>15.1046</td>
<td>2.2182</td>
</tr>
</tbody>
</table>

- positive and precise self-diagnostic weight on donations, $\lambda_{\gamma}$ (warm glow)
- considerably larger than main effect of donations, $\gamma$
when $a > 0$, equilibrium path bends back on itself
this creates multiplicity in equilibrium shares for given campaign
regions with negative slope create “crowding out”

Dubé, Luo and Fang
Pro-social
The fungibility of promotional dollars

At what point is $1 spent on a donation more “valuable” to the prospective consumer than $1 spent on a discount?

We will now see that the relative effectiveness of a dollar discount versus a dollar donation is not constant.
- select equilibrium with highest likelihood (use predicted choices)
- small donations can raise profits
- recall: jumps due to back-bending equilibrium path
- select equilibrium with highest likelihood (use predicted choices)
- large donations and discounts effective for charitable campaign
Optimal Campaigns

- create campaign grid: \((a, p) = [0, 16] \times [20, 100]\) and select highest-likelihood equilibrium share

- Profit objective (no donation): \(p^* = 44.4\) RMB, \(E(\Pi(p^*)) = 3\) RMB pp

- Profit objective: \(p^* = 100\) RMB, \(a^* = 1\), \(E(\Pi(p^*)) = 5.55\) RMB pp
  - i.e. small donation is effective!

- Charity objective: \(p^* = 22.5\) RMB \(a^* = 16\), \(E(\Pi(p^*)) = 0.27\) RMB pp
Conclusions

- Image motivation can emerge in a private setting
- Extrinsic rewards (discounts) are less effective when self-image matters
- Rewards can crowd-out pro-social behavior through dampening of self-signal

Crowding-out arises at larger, not smaller, discounts
- this is not a mere incidence of payment effect

No crowding out from pure discounts
- this is not contextual inference effect (e.g. corporate motivation to promote low-quality movie)

Structural analysis of preferences:
- consumers not intrinsically motivated by donations, but motivated extrinsically by self-perception of valuing donation
- non-fungibility of promotional money
state-dependence in pro-social behavior

- consumers accumulate a prosocial self-image capital stock (Benabou and Tirole 2011)
- consumers impute (i.e. construct) their preferences from past actions (Ariely and Norton 2011)

raising the cost of the signal today raises diagnostic value, increasing likelihood of future prosocial behavior (Gneezy et al 2012)