Handwashing and Habit Formation: A Test of Rational Addiction

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Giovanni Reggiani, MIT
Natalia Rigol, Harvard University

2016 Behavioral Economics and Global Health Conference
Handwashing with soap

• High rates of child stunting and mortality worldwide due to bacterial and viral transmission
  • Diarrheal disease, ARI
  • 3.5 million child deaths yearly (UNICEF, WHO 2013)

• Solution: handwashing with soap
  • “the most effective vaccine against childhood infections” (World Bank 2005)
  • potentially most cost-effective method of reducing incidence (Kremer and Zwane 2007)

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Barriers to adoption

- Not information.
- Not resources.

- Repetitive activity.
  - Repeated engagement is costly
  - ...unless it becomes a habit.
- Preventative activity.
  - Returns are not manifested.
  - Returns are in the future.

This applies to many preventative health activities: water treatment, medicine regimens, latrine and cookstove use, etc.
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Conceptual Framework: Rational Addiction


1. Habit formation (addiction): intertemporal complementarities in the utility from consumption
   - Marginal utility from consumption today is higher when more has been consumed in the past

2. Rational habit formation: Agents are aware of complementarities, so changes in future consumption affect current consumption
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Rational addiction empirical literature

\[ c_t = \theta c_{t-1} + \beta \theta c_{t+1} + \delta p_t + \epsilon_t \]

Empirical concerns:

- endogeneity of tax instrument
- serial correlation in prices
- implausibility of future price knowledge
This study

Contributions

1. First experimental test of rational addiction, addressing identification concerns of RA literature
2. First rational habit formation test of a good habit
3. Distinguishes role of rewards (incentives) from feedback (monitoring)
4. Significantly improves measurement technology

Why do we care?

1. Child health impact
2. Designing optimal interventions
   - If agents are not rational habit formers, we have a reason to subsidize initial consumption of habitual activities
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Measurement Technology
Measurement Technology
Handwashing outcome measure

Dispenser use during the family’s self-reported evening mealtime.
Experimental Design

Rollout of dispensers, soap, and/or calendars → After 2 weeks → After 2 months

Full sample

Incentive villages (IV)
- IV0
- IV1
- IV2a
- IV2b
- IV1

Monitoring villages (MV)
- MV0
- MV1
- MV2a
- MV2b
- MV1

IV0 → IV0 → IV0
IV1 → IV1 → IV1
IV2a → IV2a → IV2a
MV0 → MV0 → MV0
MV1 → MV1 → MV1
MV2a → MV2a → MV2a
Incentives

Rollout of dispensers, soap, and/or calendars

Incentive villages (IV)

- IV0: control

- IV1: dispenser, monitoring, and one ticket

- IV2a: anticipate three tickets

- IV2b: receive three tickets

IV0: control
Incentives: rational habit formation

Rollout of dispensers, soap, and/or calendars

After 2 weeks

Incentive villages (IV)

IV0: control

IV1: dispenser, monitoring, and one ticket

IV2a: anticipate three tickets

IV2b: receive three tickets

IV1

IV0: control

IV0

IV0
Incentives: pure effect

Rollout of dispensers, soap, and/or calendars → After 2 weeks → After 2 months

Incentive villages (IV)

IV0: control

IV1: dispenser, monitoring, and one ticket

IV1

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IV2b: receive three tickets

IV0

IV0

IV1
Incentives: persistence of stock accumulation

Rollout of dispensers, soap, and/or calendars → After 2 weeks → After 2 months

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- IV1
- IV1
- IV2b: receive three tickets
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Parallel monitoring experiment

Disentangling:

1. Incentives from feedback alone
2. Rational habit formation drowned out by hidden cost of incentives
Experimental Design

**Rollout of dispensers, soap, and/or calendars** → **After 2 weeks** → **After 2 months**

**Incentive villages (IV)**
- IV0
- IV1
- IV2a → IV2b → IV1 → IV0

**Monitoring villages (MV)**
- MV0
- MV1: dispenser
- MV1
- MV2a
- MV2b
- MV1
- MV0
- MV0
- MV0
- MV0
Monitoring

Rollout of dispensers, soap, and/or calendars

MV0: control

Monitoring villages (MV)

MV1: dispenser

MV2a: anticipate monitoring

MV2b: receive monitoring
Monitoring: rational habit formation

Rollout of dispensers, soap, and/or calendars

MV0: control

MV1: dispenser

MV2a: anticipate monitoring

MV0

MV1

MV2a

After 2 weeks

Monitoring villages (MV)

MV0: control

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MV0

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Rollout of dispensers, soap, and/or calendars → After 2 weeks → After 2 months

Monitoring villages (MV)

MV0: control

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MV1
Monitoring: persistence of stock accumulation

**Rollout of dispensers, soap, and/or calendars**

- After 2 weeks
- After 2 months

- **Monitoring villages (MV)**
  - MV0: control
  - MV1: dispenser
  - MV2a: anticipate monitoring
  - MV2b: receive monitoring

- MV0
- MV0
- MV1
- MV2b: receive monitoring
- MV2a: monitoring
Incentives do not shift daytime use

![Graph showing number of dispenser presses over days with multiple lines for dispenser control and one ticket daily incentive.]

- Dispenser control
- One ticket daily incentive
But do shift evening use

Number of uses in evening (5pm and later)

- Dispenser control
- One ticket daily incentive
Incentives hit their target

Likelihood of washing during reported dinner time

- Dispenser control
- One ticket daily incentive
Presentation of results for rational addiction

We first need to identify that:

1. (future) handwashing rates are exogenously shifted
   ⇒ the tripling of tickets and monitoring both change handwashing rates

2. handwashing is a habit-forming activity
   ⇒ after withdrawal of incentives and monitoring, households continue to wash more than control

Then, examine presence of rational habit formation.
   ⇒ households anticipating a tripling of tickets or commencement of monitoring wash more than nonanticipating counterparts
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Contemporaneous effects: interventions increase handwashing

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<td>(1)</td>
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<tr>
<td>Current triple incentive</td>
<td>0.0503**</td>
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<td></td>
<td>(0.0261)</td>
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<td>Current monitoring</td>
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<td>Mean of control group</td>
<td>0.598</td>
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<td>[0.0217]</td>
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<td>Observations</td>
<td>9,912</td>
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Notes: Observations are at the household-day level. All regressions include village and day fixed effects. p-values adjusted for multiple hypothesis testing using Anderson (2008). *** p<0.01, ** p<0.05, * p<0.1.
Contemporaneous effects: tripling tickets increases handwashing

Fraction of households who used at dinner time

Day

Fraction of households

- Standard incentive
- 3x incentive
Contemporaneous effects: monitoring increases handwashing

Fraction of households who used at dinner time

- Dispenser control
- Monitoring
Habit formation: temporary interventions persist

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<td>[0.0385]</td>
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**Notes:**
- Former incentives: 0.225*** [0.0385]
- Former monitoring: 0.0959*** [0.0274]
- Mean of control group: 0.379 [0.0269] 0.267 [0.0234]
Habit formation: temporary incentive effects persist

Dinnertime dispenser use: formerly incentivized

Fraction of households

Day

Dispenser control

Former incentive
Habit formation: temporary monitoring effects persist

Dinnertime dispenser use: formerly monitored

![Graph showing the fraction of households using dispensers over time. The graph includes two lines: one for dispenser control and another for former monitoring.]
## Rational habit formation

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<td>-0.00593</td>
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<td>[0.0305]</td>
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<tr>
<td><strong>Anticipated monitoring</strong></td>
<td>0.052*</td>
<td>0.08**</td>
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</tr>
<tr>
<td>Anticipated triple incentive</td>
<td>-0.00593</td>
</tr>
<tr>
<td></td>
<td>[0.0235]</td>
</tr>
<tr>
<td>Anticipated monitoring</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean of control group</td>
<td>0.454</td>
</tr>
<tr>
<td></td>
<td>[0.0197]</td>
</tr>
<tr>
<td>Observations</td>
<td>23,273</td>
</tr>
</tbody>
</table>

**Notes:** Observations are at the household-day level. All regressions include village and day fixed effects. p-values adjusted for multiple hypothesis testing using Anderson (2008). *** p<0.01, ** p<0.05, * p<0.1.
No evidence of rational habit formation in incentives
Strong evidence of rational habit formation in monitoring

Dinnertime dispenser use: monitoring

- Unanticipated monitoring
- Anticipated monitoring

Day

Fraction of households
Extrinsic v. intrinsic motivation

Why the differences in rational habit formation between incentives and monitoring?

- Loss aversion in monitoring
- Hidden cost of extrinsic rewards in incentives
  - anchoring effects
  - updating of costs (Benabou and Tirole 2003)
### Handwashing results

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness to pay (Rs.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treated household</td>
<td>-4.738**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.935]</td>
<td></td>
</tr>
<tr>
<td>Incentive</td>
<td>-9.060***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[2.303]</td>
<td></td>
</tr>
<tr>
<td>Monitoring</td>
<td>1.415</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[3.705]</td>
<td></td>
</tr>
<tr>
<td>Dispenser control</td>
<td>6.011</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[5.243]</td>
<td></td>
</tr>
<tr>
<td>Mean of pure control</td>
<td>55.74</td>
<td>55.74</td>
</tr>
<tr>
<td></td>
<td>[1.476]</td>
<td>[1.477]</td>
</tr>
<tr>
<td>Observations</td>
<td>2,750</td>
<td>2,750</td>
</tr>
</tbody>
</table>

*Notes:* Observations are at the household level. All regressions include village level fixed effects. *** p<0.01, ** p<0.05, * p<0.1.
Formerly incentivized value soap less

Willingness-to-pay for one month of liquid soap

- Baseline soap expenditure
- Incentive
- Monitoring
- Dispenser control
- Pure control
## Child health: incidence

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any loose stool</td>
<td>-0.0315***</td>
<td>-0.0817***</td>
<td>-0.0393**</td>
<td>-0.204**</td>
</tr>
<tr>
<td>Total days of loose stool</td>
<td>[0.00975]</td>
<td>[0.0236]</td>
<td>[0.0154]</td>
<td>[0.0884]</td>
</tr>
<tr>
<td>Any ARI symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total days of ARI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treated household</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean of pure control</td>
<td>0.100</td>
<td>0.209</td>
<td>0.270</td>
<td>1.247</td>
</tr>
<tr>
<td></td>
<td>[0.00572]</td>
<td>[0.0151]</td>
<td>[0.00886]</td>
<td>[0.0504]</td>
</tr>
<tr>
<td>Observations</td>
<td>3,820</td>
<td>3,830</td>
<td>3,830</td>
<td>3,830</td>
</tr>
</tbody>
</table>

**Notes:** Observations are at the child level. "Treated household" is any household that received a dispenser. p-values adjusted for multiple hypothesis testing using Anderson (2008). *** p<0.01, ** p<0.05, * p<0.1.
## Child health: anthropometry

<table>
<thead>
<tr>
<th>Treated household</th>
<th>Weight for age z-score</th>
<th>Height for age z-score</th>
<th>Mid-arm circ. for age z-score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.135*</td>
<td>0.227*</td>
<td>0.0752*</td>
</tr>
<tr>
<td></td>
<td>[0.0640]</td>
<td>[0.0902]</td>
<td>[0.0518]</td>
</tr>
<tr>
<td>Mean of pure control</td>
<td>-2.167</td>
<td>-1.866</td>
<td>-1.365</td>
</tr>
<tr>
<td></td>
<td>[0.0459]</td>
<td>[0.0666]</td>
<td>[0.0432]</td>
</tr>
<tr>
<td>Observations</td>
<td>863</td>
<td>862</td>
<td>858</td>
</tr>
</tbody>
</table>

**Notes:** Observations are at the child level. "Treated household" is any household that received a dispenser. p-values adjusted for multiple hypothesis testing using Anderson (2008). *** p<0.01, ** p<0.05, * p<0.1.
Child health: treatment on the treated estimates

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any loose stool</td>
<td>-0.0637***</td>
<td>-0.164***</td>
<td>-0.0668**</td>
<td>-0.358**</td>
<td>0.254**</td>
<td>0.417**</td>
<td>0.104</td>
</tr>
<tr>
<td></td>
<td>[0.0200]</td>
<td>[0.0485]</td>
<td>[0.0317]</td>
<td>[0.179]</td>
<td>[0.124]</td>
<td>[0.167]</td>
<td>[0.0981]</td>
</tr>
<tr>
<td>Total days of ARI symptoms</td>
<td>0.100</td>
<td>0.209</td>
<td>0.270</td>
<td>1.247</td>
<td>-2.167</td>
<td>-1.866</td>
<td>-1.365</td>
</tr>
<tr>
<td></td>
<td>[0.00572]</td>
<td>[0.0151]</td>
<td>[0.00886]</td>
<td>[0.0504]</td>
<td>[0.0458]</td>
<td>[0.0665]</td>
<td>[0.0432]</td>
</tr>
<tr>
<td>Weight for age z-score</td>
<td>3,814</td>
<td>3,824</td>
<td>3,824</td>
<td>3,824</td>
<td>861</td>
<td>860</td>
<td>856</td>
</tr>
<tr>
<td>Height for age z-score</td>
<td>3,814</td>
<td>3,824</td>
<td>3,824</td>
<td>3,824</td>
<td>861</td>
<td>860</td>
<td>856</td>
</tr>
<tr>
<td>Mid-arm circ. for age z-score</td>
<td>3,814</td>
<td>3,824</td>
<td>3,824</td>
<td>3,824</td>
<td>861</td>
<td>860</td>
<td>856</td>
</tr>
</tbody>
</table>

Notes: Observations are at the child level for all regressions. Regression shows the treatment on the treated estimates where "treated" is a household who uses the dispenser at dinnertime, which is instrumented for by each of the three treatment groups (incentives, monitoring, and dispenser). p-values adjusted for multiple hypothesis testing using Anderson (2008). *** p<0.01, ** p<0.05, * p<0.1.
To summarize:

1. Financial incentives and monitoring without incentives increases handwashing.
2. Handwashing is habitual: effects persist after incentives or monitoring are removed.
3. Agents are rational regarding habit formation: anticipation of monitoring increases handwashing.
   • ...but not the anticipation of incentives.
4. Handwashing alone has substantial impacts on child health: we now have a sense of the production function.
Thank you!