Using Matched Controls to Evaluate Team Assembly and Effectiveness

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Harvard 2009 Pilot Grant Competition

• Internal competition for $50,000 research pilot grants
  – Funded by NIH Clinical & Translational Award program

• Review process
  – 37,266 people (all Harvard faculty) could apply
  – 458 teams (1,460 faculty) submitted proposals
  – 65 teams (249 faculty) were awarded funding

• NIH required reporting metrics
  – How many teams were funded?
  – How many teams published results?

• Additional goals of the pilot grants
  – Encourage cross institutional/disciplinary collaboration
  – Match junior investigators with mentors

• How do you know what would have happened anyway?
  – Theoretical model of team assembly
  – Matched controls that did not apply for funding (data from EFS)
Multi-theoretical Multilevel (MTML) Model

Integrated explanatory framework to understand collaboration

- **Individual** (actor) level
  - Academic rank, expertise, gender

- **Relational** (dyad) level
  - Common interests, past collaboration

- **Higher order** (ecosystem)
  - Connections between teams
Defining Comparison Groups of Teams

- **Proposal**: 458 Teams Submitted Proposals
- **(Un-)Funded**: 65 Teams Awarded Funding
- **Published**: 5,648 Teams Published in 2010

### Virtual Teams
- **1,469 Applicants in 458*1000 Virtual Teams**
- **35,797 Non-Applicants in 458*1000 Virtual Teams**

### Actual Teams
- **Applied**
- **Did Not Apply**

### Matched Virtual Teams
- Non-Applicants in up to 458*1000 Matched Virtual Teams
Comparing Team Characteristics

**Actual Teams**

0.33 1.00

0.66 Average CoAuthor Density

**Three Random Sets of Virtual Teams**

0.17 0.00

0.00 0.50

1.00 0.33

0.08 Average CoAuthor Density

0.25 Average CoAuthor Density

0.66 Average CoAuthor Density

**Key**

- New Team
- CoAuthors

**Comparison**

Number of Teams

- Actual Teams
- Virtual Teams

CoAuthor Density

**Applicants**

Applicant (A) Attributes

Applicant-Applicant (A-A) Relationships

Proposal Team (T)

Proposal (P)

Applicant-Reviewer (A-R) Relationships

**Reviewers**

Reviewer (R) Attributes

Reviewer-Reviewer (R-R) Relationships

Review Committee (C)
Variables

Attributes (Applicant, Reviewer)
- Biomedical School *
- Has Publications *
- Senior Faculty *
- Trainee *
- MD-PhD Degree *
- Is Female
- C.T. Research
- Proposal Expertise
- Is Also Reviewer
- Is Also Applicant

Relationships (AA, AR, RR)
- Have CoAuthored *
- Have Cited *
- Same Institution *
- Same Field *
- Same Gender

Proposal
- Priority Topic
- MeSH Uniqueness

Team Level Variables
- PI is Female
- Local Ecosystem Density
- C.T. Research Range
- Total Proposal Expertise

Review Committee
- C.T. Research Range
- Total Proposal Expertise

* Variables used to match teams
Profiles Research Networking Software (RNS)

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Narrative
John D. Halamka, MD, MG, is Chief Information Officer of the CareGroup Health System, Chief Information Officer and Dean for Technology at Harvard Medical School, Chairman of the New England Health Electronic Data Interchange Network (NEHEN), CEO of MA-SHARE (the Regional Health Information Organization), Chair of the US Healthcare Information Technology Standards Panel (HITSP), and a practicing Emergency Physician.

Publications

5. Halamka JD. Patients should have to opt out of national electronic care records: AGAINST. EMJ. 2006 Jul 1;33(755):41-2.
Interactive Network Visualizations
Phases of Analysis

• **Team Assembly** Phase
  – How did investigators choose collaborators?
  – Were new collaborations formed?

• **Peer Review** Phase
  – Were there biases in the review process?
  – What were the characteristics of awarded proposals?

• **Post-Award** Phase
  – What was the impact of funding on awarded teams?
  – What impact did applying have on un-funded teams?
# Results: Team Assembly

<table>
<thead>
<tr>
<th>Cohort Characteristics</th>
<th>Virtual Teams</th>
<th>Actual Teams</th>
<th>Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Random</td>
<td>Matched</td>
<td>Regrouped</td>
</tr>
<tr>
<td>Matches Per Proposal</td>
<td>1,000</td>
<td>442.2</td>
<td>1,000</td>
</tr>
<tr>
<td>Distinct People</td>
<td>35,797</td>
<td>31,460</td>
<td>1,469</td>
</tr>
<tr>
<td>People Per Team</td>
<td>3.860</td>
<td>3.860</td>
<td>3.860</td>
</tr>
<tr>
<td>Publications Per Person</td>
<td>23.7</td>
<td>88.4</td>
<td>81.6</td>
</tr>
<tr>
<td>Total Proposal Expertise</td>
<td>0.138</td>
<td>0.277</td>
<td>0.300</td>
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</table>

### Applicant Attributes

<table>
<thead>
<tr>
<th>Applicant Attributes</th>
<th>Virtual Teams</th>
<th>Actual Teams</th>
<th>Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Applicants</td>
<td>Applicants</td>
<td></td>
</tr>
<tr>
<td>Biomedical School</td>
<td>0.651</td>
<td>0.901</td>
<td>0.905</td>
</tr>
<tr>
<td>Has Publications</td>
<td>0.615</td>
<td>0.949</td>
<td>0.952</td>
</tr>
<tr>
<td>Senior Faculty</td>
<td>0.155</td>
<td>0.378</td>
<td>0.405</td>
</tr>
<tr>
<td>Trainee</td>
<td>0.379</td>
<td>0.126</td>
<td>0.104</td>
</tr>
<tr>
<td>MD-PhD Degree</td>
<td>0.050</td>
<td>0.161</td>
<td>0.164</td>
</tr>
<tr>
<td>Is Female</td>
<td>0.410</td>
<td>0.316</td>
<td>0.307</td>
</tr>
<tr>
<td>C.T. Research</td>
<td>0.321</td>
<td>0.610</td>
<td>0.630</td>
</tr>
</tbody>
</table>

### Applicant Relationships

<table>
<thead>
<tr>
<th>Applicant Relationships</th>
<th>Virtual Teams</th>
<th>Actual Teams</th>
<th>Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have CoAuthored</td>
<td>0.000</td>
<td>0.148</td>
<td>0.005</td>
</tr>
<tr>
<td>Have Cited</td>
<td>0.001</td>
<td>0.251</td>
<td>0.029</td>
</tr>
<tr>
<td>Same Institution</td>
<td>0.112</td>
<td>0.481</td>
<td>0.160</td>
</tr>
<tr>
<td>Same Field</td>
<td>0.013</td>
<td>0.327</td>
<td>0.049</td>
</tr>
<tr>
<td>Same Gender</td>
<td>0.688</td>
<td>0.721</td>
<td>0.715</td>
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</table>

### Team Level Variables

<table>
<thead>
<tr>
<th>Team Level Variables</th>
<th>Virtual Teams</th>
<th>Actual Teams</th>
<th>Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI Is Female</td>
<td>0.377</td>
<td>0.333</td>
<td>0.291</td>
</tr>
<tr>
<td>C.T. Research Range</td>
<td>0.415</td>
<td>0.454</td>
<td>0.468</td>
</tr>
<tr>
<td>Local Ecosystem Density</td>
<td>0.699</td>
<td>0.566</td>
<td>0.530</td>
</tr>
</tbody>
</table>

**P-Values:**

- Positive Coefficient: <0.001, <0.01
- Negative Coefficient: <0.05, <0.05, <0.01, <0.001
Results: Team Assembly

Random Teams

- Biomedical School
  - Has Publications
  - Trainee
  - MD-PhD Degree
  - Female

Proposal Teams

Publication Teams

- Have CoAuthored
- Have Cited
- Same Institution
- Same Field
- Same Gender
- Ecosystem Density

Fraction of Individuals (Attributes) or Dyads (Relationships/Teams)

Significance:
- ▲ not sig.
- △ p<0.01
- □ not sig.
- ◇ p<0.01

Random Teams:
- Not significant
- p<0.01

Proposal Teams:
- Not significant
- p<0.01

Publication Teams:
- Not significant
- p<0.01
Results: Peer Review

There were several small differences between funded teams and unfunded teams, but the p-values are weak.

Note that the quality of the science in the proposals is not measured by any of these variables!
## Results: 5-Year Post-Award Outcomes

<table>
<thead>
<tr>
<th></th>
<th>New Publications</th>
<th></th>
<th>New Collaborations</th>
<th>CoAuthor Density</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>All</td>
<td>Cites Grant</td>
<td>Total</td>
</tr>
<tr>
<td>Proposal Teams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Proposals</td>
<td>143.8</td>
<td>3.11</td>
<td>1.799</td>
<td>0.301</td>
</tr>
<tr>
<td>All Not Funded</td>
<td>143.6</td>
<td>3.19</td>
<td>1.692</td>
<td>0.132</td>
</tr>
<tr>
<td>Proposal Not Submitted</td>
<td>125.3</td>
<td>2.24</td>
<td>1.462</td>
<td>0.051</td>
</tr>
<tr>
<td>Scored Not Interviewed</td>
<td>149.7</td>
<td>3.49</td>
<td>1.771</td>
<td>0.159</td>
</tr>
<tr>
<td>Interviewed Not Funded</td>
<td>154.4</td>
<td>3.88</td>
<td>1.853</td>
<td>0.147</td>
</tr>
<tr>
<td>Funded</td>
<td>145.3</td>
<td>2.63</td>
<td>2.446</td>
<td>1.323</td>
</tr>
<tr>
<td>Virtual Teams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random</td>
<td>35.4</td>
<td>0.27</td>
<td>0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>Matched</td>
<td>111.8</td>
<td>1.08</td>
<td>0.028</td>
<td>0.000</td>
</tr>
<tr>
<td>Regrouped</td>
<td>160.5</td>
<td>3.78</td>
<td>0.028</td>
<td>0.002</td>
</tr>
<tr>
<td>Published Teams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 Applicants</td>
<td>115.9</td>
<td>0.69</td>
<td>3.053</td>
<td>0.013</td>
</tr>
<tr>
<td>1+ Applicants</td>
<td>169.2</td>
<td>2.48</td>
<td>3.189</td>
<td>0.098</td>
</tr>
</tbody>
</table>
Results: 5-Year Post-Award Outcomes

New Publications (All)

- Funded
- Not Funded
- Regrouped
- Matched
- Random
- Publication

New CoAuthors (All)

- Funded
- Not Funded
- Regrouped
- Matched
- Random
- Publication

New Publications (Cites Grant)

- Funded
- Not Funded
- Regrouped
- Matched
- Random
- Publication

New CoAuthors (Cites Grant)

- Funded
- Not Funded
- Regrouped
- Matched
- Random
- Publication

Funded teams published 1.55 more grant-citing articles than Matched teams.

New collaborations resulted from Non-Funded teams, but not through grant-citing articles.
Conclusions

• Proposal teams have more diversity than typical teams that write publications. However, there is still far more familiarity than by random chance.

• New lasting collaborations formed even in teams that were not funded. (Indirect effects of the program.)

• Evaluating the formation and effectiveness of teams requires appropriate matched controls to correct for baseline activity