London
Business
School

# **The breakdown and recovery of cooperation in large groups:** Exploring the role of formal structure using a field experiment

Francisco Brahm London Business School
Christoph Loch Cambridge Judge Business School
Cristina Riquelme University of Maryland

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# Motivation (1/2)

## Breakdown of cooperation with scale?

Cooperation: “costly effort that benefits co-workers and the group as whole”

Cooperation is crucial for performance of organizations (Gibbons and Henderson, 2013; Fehr, 2018; Barnard, 1938; Schein, 2010; Organ et al, 2005; Grennan, 2014).

Cooperation and size

- Theory: more difficult (e.g., Graham et al., 2018; Holmström, 1982; Gibbons, 2006)
- Empirics: really? Inconclusive evidence (Pereda et al, 2019; Barcelo and Capraro, 2015; Isaac et al., 1994; Zhang and Zhu, 2011; Yang et al, 2013)

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**RQ1:** *How does cooperation varies with size?*

**This paper:** *Using detailed administrative data, we provide evidence from a specific setting, probing at the mechanism*

# Motivation (2/2)

## Formal structure favours cooperation at scale?

- Formal structure: “grouping the workers of the organization into separate areas/units, and the elements required for these areas/units to be functional (e.g., decision rights, incentive systems, reporting lines, etc.)”
- Main benefit: Grouping promotes learning and specialization (Puranam, 2018)
- Main cost: Separation hinders cooperation (Puranam, 2018; Roberts & Gibbons, 2013)
  - Really? Evolutionary theory suggests otherwise (Nowak, 2006; Boyd and Richerson, 1988; Takezawa and Price, 2010; Rand and Nowak, 2013)

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**RQ2:** *Can formal structure promote cooperation at scale?*

**This paper:** *Using a pre-registered field experiment, we study whether a* <u>*randomly*</u> *placed formal structure promotes cooperation at scale. (By being random, the specialization benefit is muted.)*

# Setting and data (1/3)

## BAPP methodology

We collaborated with DEKRA Insight

We study BAPP, a methodology for workplace safety

BAPP is a great setting to study cooperation as it scales

$$\text{Contact rate} = \frac{\text{observations}}{\text{workers}} = \frac{\text{observations}}{\text{observers}} \times \frac{\text{observers}}{\text{workers}}$$

$$= \text{“Effort”} \times \text{“Diffusion”}$$

# Setting and data (2/3)

## Administrative data

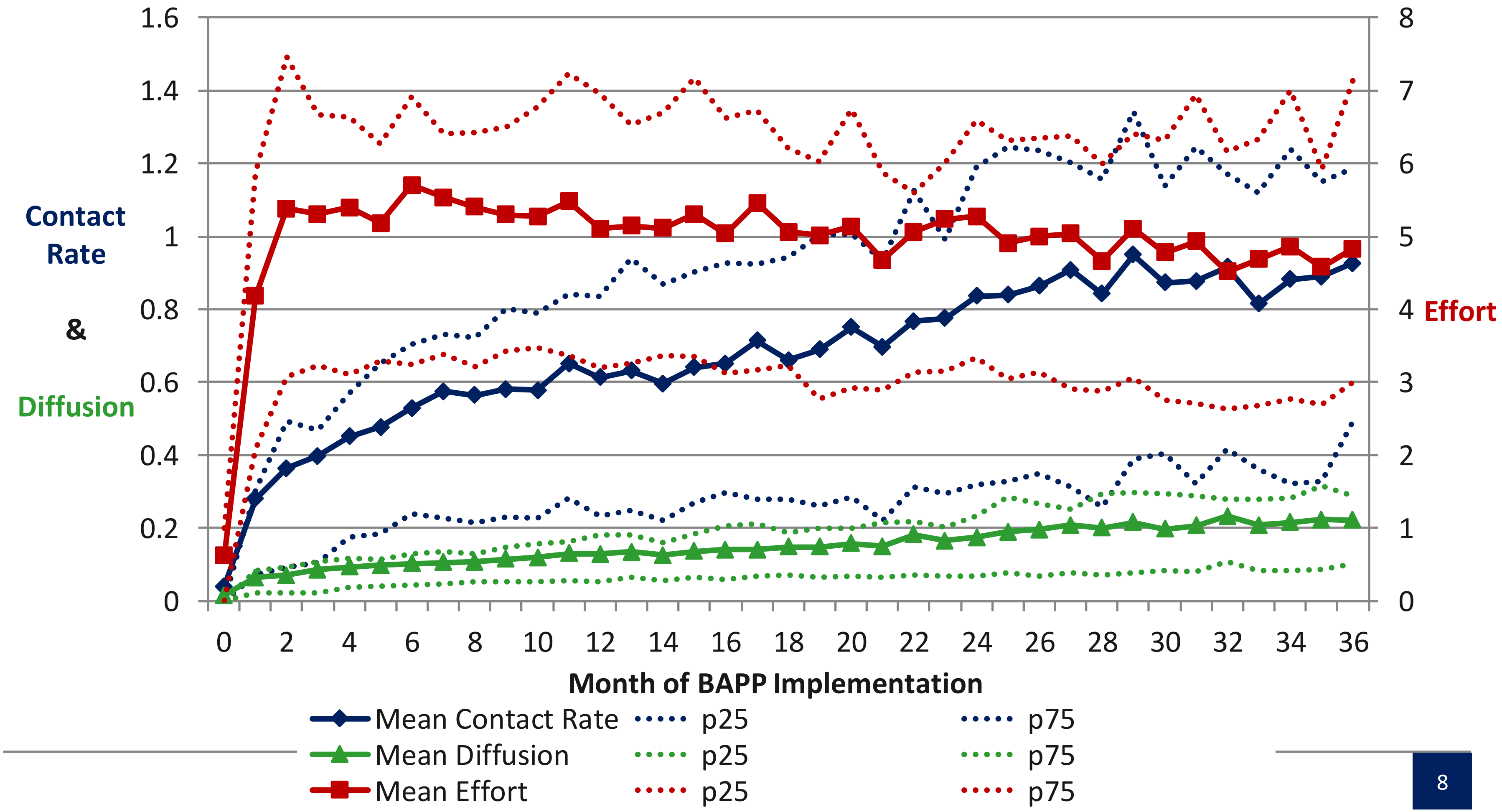
- Access to a dataset of ~1,300 projects between 1990 and 2013
- We use of a sample of 88 implementations
    - Accidents window of -24 and +36 months around BAPP start
    - Sample is representative (using ~ 10 observables)
- Highly detailed data on the ~1,300,000 observations

# Setting and data (3/3)

## Average site

observations / workers = observations / observers x observers / workers

**"contact rate" = "effort" x "diffusion"**



# Cooperation breakdown (1/3)

## Theory and hypothesis

For any worker, defection occurs if this inequality holds:

$$\underbrace{\text{effort x (observers-1)/workers}}_{\text{contact rate w/out me}} > \underbrace{\text{effort x observers/workers}}_{\text{contact rate with me}} - \text{cost}$$

Which simplifies to:

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Thus, in order for diffusion to reduce cooperation,

effort = f(diffusion) such that $\partial\text{eff}/\partial\text{diff} < 0$.

Two mechanisms in BAPP:

1. Decreasing impact of effort on accidents ➔ *Affects all observers*
2. Decreasing reputation/promotion benefits ➔ *Affects newer observers*

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1. Decreasing impact of effort on accidents → *Affects all observers*
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**Hypothesis 1:**

> *“Cooperation in BAPP, and therefore its impact on accidents, will be reduced as the number of observers increase.”*

# Cooperation breakdown (2/3)

**Results for H1 -** “After ~20 observers, adding more is detrimental”

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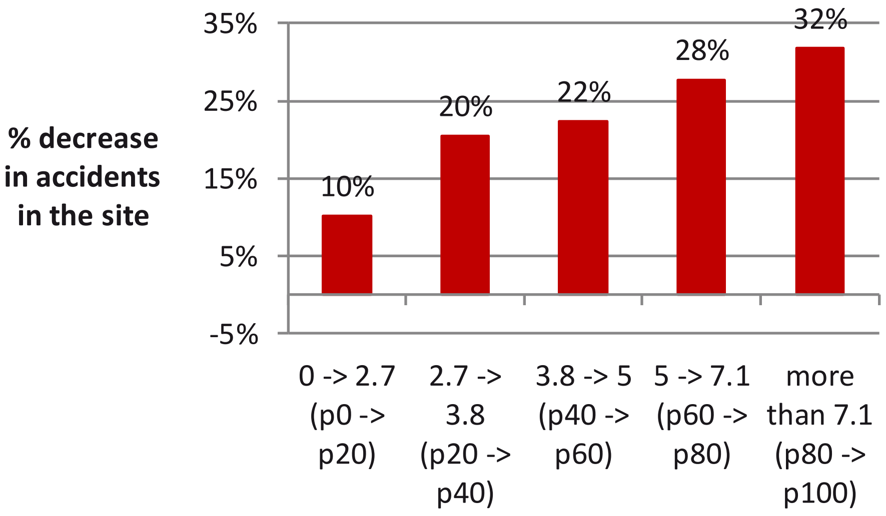
observations / workers = observations / observers x observers / workers

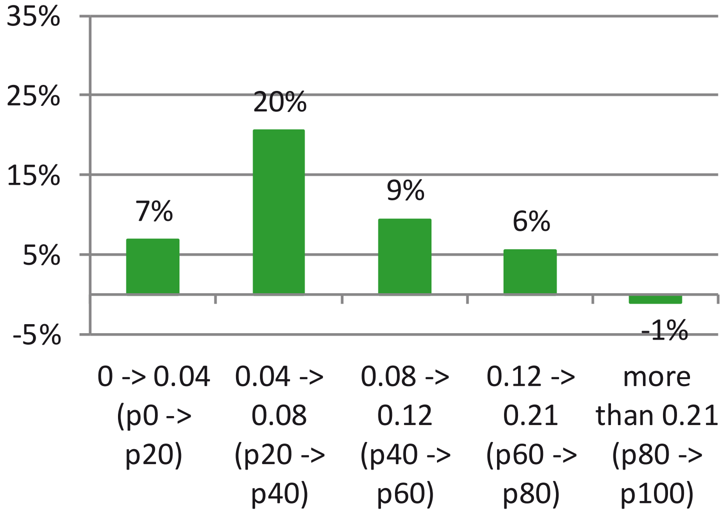
**"contact rate" = "effort" x "diffusion"**

$$ACC_{it} = b_1 + b_2 \text{ x } BAPP_{it} + b_3 \text{ x } TREND_{it} + b_4 \text{ x } BAPP_{it} \text{ x } [Q1eff + \ldots + Q5eff] + b_5 \text{ x } BAPP_{it} \text{ x } [Q1diff + \ldots + Q5dif] + CONTROLS + U_i + ERROR_{it}$$

Where, BAPP = 1 after the implementation and $TREND_{it} = (t - \theta_i)$



**Effort**
**(range of value and corresponding quintile)**



**Diffusion**
**(range of value and corresponding quintile)**

# Cooperation breakdown (3/3)

**Mechanism -** “Newer observers exert less effort, and rotate more”

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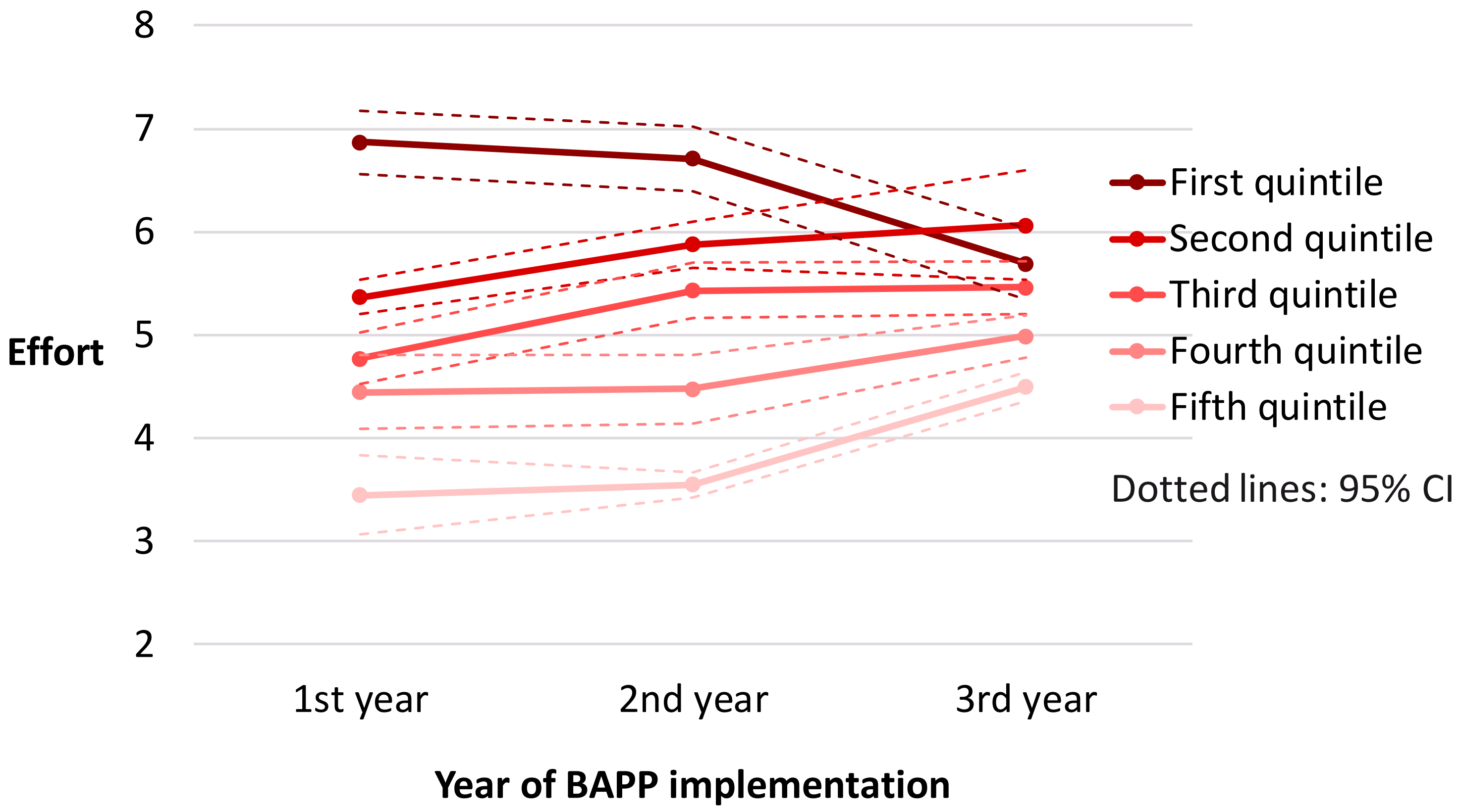

# Structure and coop. recovery (1/4)

## Theory and hypothesis

Imagine random observations in an average site:

P(being observed in t by the same observer of t-1) = P(repeated interactions)
= P(being observed) x P(same observer)
= contact rate x 1/Observers
= effort / workers = 5 / 250 = 2.5%

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Imagine "**g**" groups with observations restricted within them:

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If site has 10 groups ➔ tenfold increase in P(repeated interactions)

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**Hypothesis 2:**

*"Adding structure to BAPP mitigates the reduction in cooperation, and therefore, restore its impact on accidents"*

# Structure and coop. recovery (2/4)

## Experiment

Collaboration with DEKRA Insight and SODIMAC

Implemented the experiment between Jul-17 and May-18

Pre-registration in the AEA registry

# Structure and coop. recovery (2/4)

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Implemented the experiment between Jul-17 and May-18

Pre-registration in the AEA registry

We intervened the BAPP implementation of four stores with three treatments:

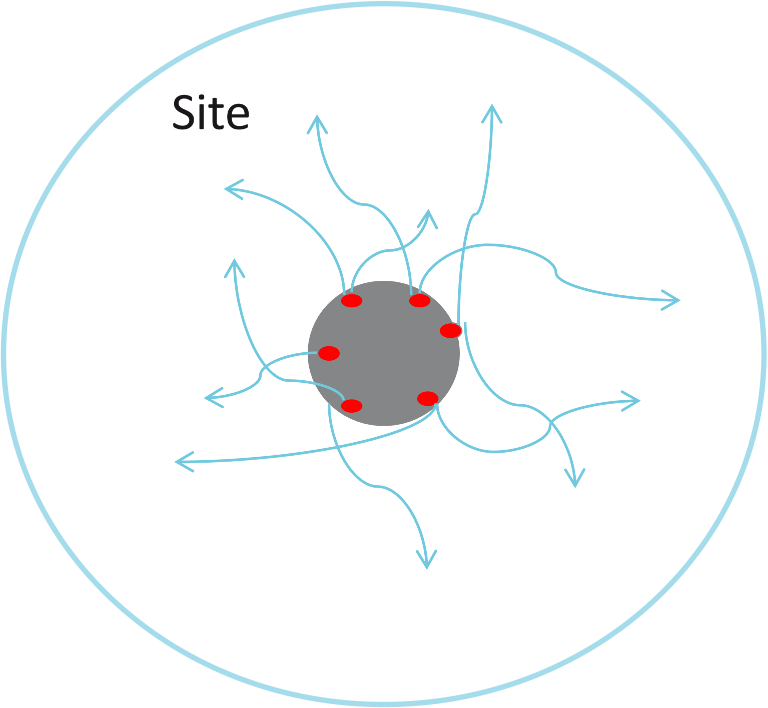
- T1, main treatment; T2 and T3 to probe other mechanisms

| | Store 1 | Store 2 | Store 3 | Store 4 |
|---|---|---|---|---|
| T1: Structure | X | X | X | X |
| T2: Structure + Identity | | X | | X |
| T3: Structure + Reputation | | | X | X |

# Structure and coop. recovery (3/4)

## Treatment 1: “Structure”

*Typical BAPP implementation*



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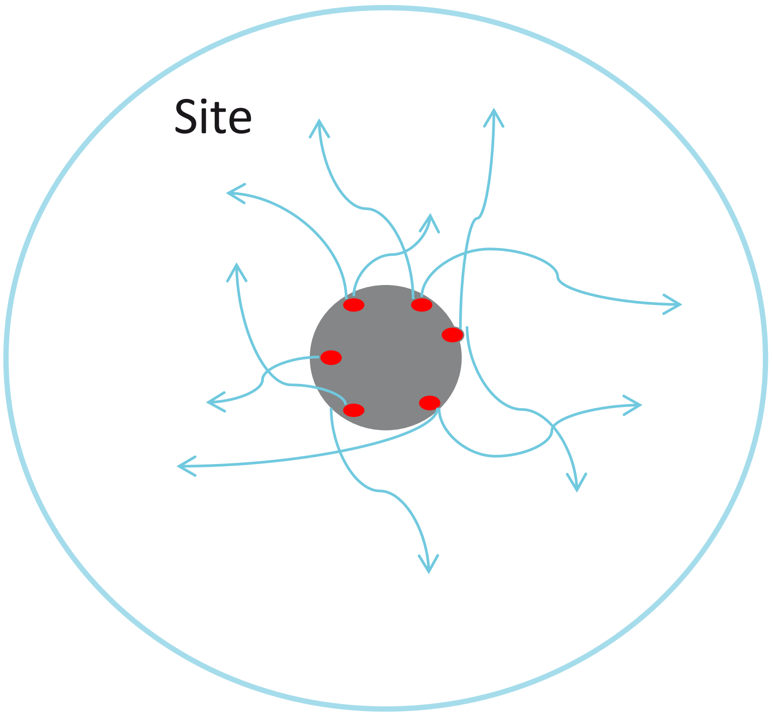
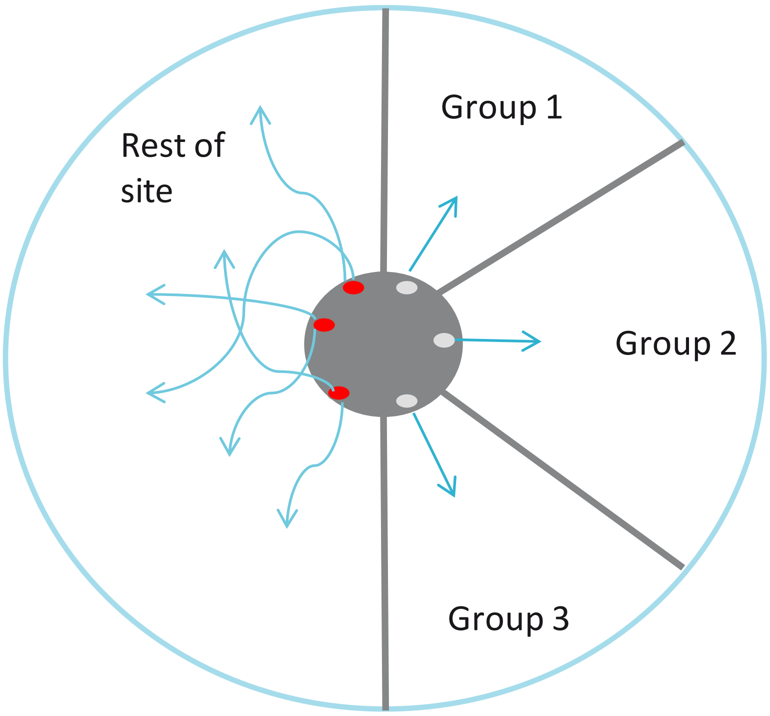


*In our experiment*



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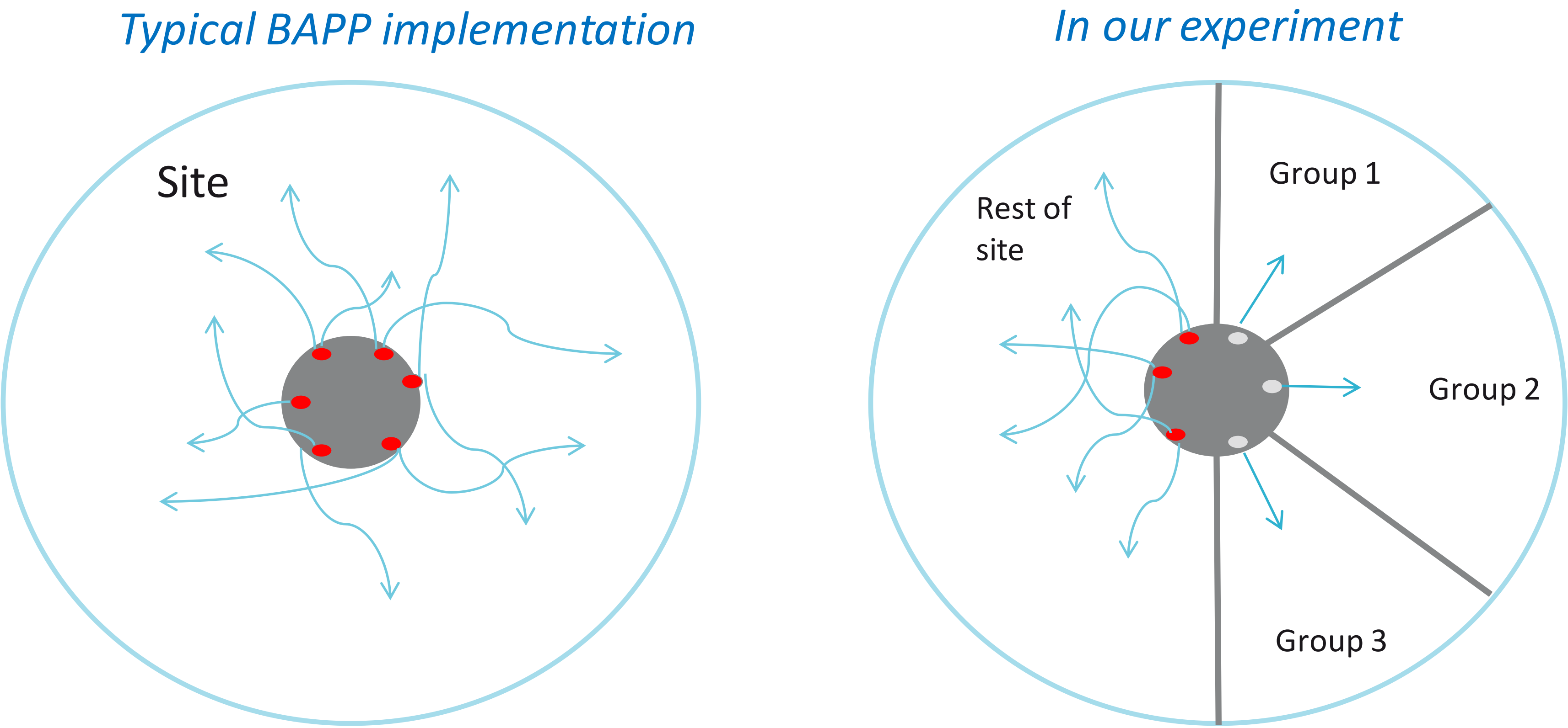

Three mechanisms for T1:

1) Small groups increase <u>repeated interactions</u> between observers and workers
2) Small groups facilitate <u>identity</u> (Treatment 2: Identity)
3) Small groups facilitate <u>social pressure</u> (Treatment 3: Reputation)

# Structure and coop. recovery (4/4)

**Results -** "Structure favours cooperation via repeated interactions"

T1 increased the likelihood of becoming an observer
increased the number of observations (effort)
increased the safe behaviour of workers
decreased the incidence of accidents

T2 reduced the impact of T1

T3 did not affect T1

Three additional tests point at "repeated interactions" as the mechanism

# Takeaways

1. **Cooperation and Scale:**

   “Relationship depends on how the benefits of cooperation change with size”

2. **Cooperation and Formal structure:**

   “Structuring interactions around groups favours cooperation at scale”

   “A crucial function of formal organization is the promotion of large scale cooperation “