

Collaboration

CS 347

Michael Bernstein

Announcements

Quiz 2 today after lecture

Last time

Our default is to replicate offline social interaction; instead we ought to aim to go “**Beyond Being There**”. Create social spaces that could **only** thrive online

We struggle with **Grudin's Paradox**, where the people needed are those with the least incentive to contribute, and we struggle with **cold start**

Social media's effect on us depends on use:

- Directed interactions increase friendships and wellbeing, but liking does not

- Social media use does increase social capital in our communities

- We take in a broader news diet, but democracies struggle with polarization under social media

Today

CSCW and the Johansen Matrix

Distance Matters

The Socio-Technical Gap

Coordination at Scale

CSCW: Computer-supported cooperative work

The traditional definition...

Computer-supported: technology is mediating the conversation

Cooperative: typically teams or groups of coordinating people

Work: tasks, as opposed to play or socializing

Johansen's time-space matrix

[Johansen 1988]

Time

Same time

Different time

Same place

Space

Different place



Implication: the design will need to look very different depending on the quadrant that you're in

Design considerations differ by quadrant

Time

Same time

Different time

Same place

Managing shared,
simultaneous
ownership
Backchannels

Visibility and
permissions
controls

Space

Different place

Awareness
indicators
Presentation
controls

Tools for managing
inbox overload
Filters, tools for
managing your self-
presentation

Match your
design to the
quadrant

Distance Matters

Coworker communication

[Kraut et al. 1988]

Studied communication between collaborating researchers at Bell Labs

Distance between offices and probability of research collaboration		
Office location	Total pairs	% collaborating
same corridor	243	10.3
same floor	1038	1.9
different floor	1736	.3
different buildings	1261	.4

Result: Very significant falloff in collaboration as people get further apart. Even between same corridor and same floor.

Distance matters

[Olson and Olson 2000]

“If, as it is said to be not unlikely in the near future, the principle of sight is applied to the telephone as well as that of sound, earth will be in truth a paradise, and distance will lose its enchantment by being abolished altogether.”

– Arthur Mee, 1898

But...colocated software engineering teams outperformed the company average by 2x. Why?

Distance matters

[Olson and Olson 2000]

The big idea behind this paper: why is distance collaboration so much worse?

This paper is the face that launched a thousand ships in CSCW—
analogous to The Computer for the 21st Century in interaction—cited as
motivation for nearly every study of remote collaboration

The Olsons's identified failures:

Common ground: knowledge that people have in common and know
they have in common

Coupling: how complex the work interdependencies are

Surely not even today?

The tools have improved – Zoom, GitHub, Slack, Asana — does distance really still matter?

You're not the first one to ask this question...

Distance Matters

Gary M. Olson and Judith S. Olson
University of Michigan

SOFTWARE PROCESS IMPROVEMENT AND PRACTICE
Softw. Process Improv. Pract. 2008; 13: 493–510
Published online 3 November 2008 in Wiley InterScience
(www.interscience.wiley.com) DOI: 10.1002/spip.401

Does Distance Still Matter?

Timo Wolf,^{*,†} Thanh Nguyen and Daniela Damian
Software Engineering InterAction Lab (SEGA1), Department of Computer Science, University of Victoria, Victoria, BC Canada

Does Distance Still Matter? Revisiting Collaborative Distributed Software Design

PERNILLE BJØRN, IT University of Copenhagen
MORTEN ESBENSEN, RASMUS ESKILDSEN
IT University of Copenhagen

FOCUS: COLLABORATIVE MODELING

Does Distance Still Matter?

Revisiting Collaborative Distributed Software Design

There are two important challenges to making CSE successful. Almost two decades ago, Gary Olson and Judith Olson raised these challenges:

- *technological challenges* raised by the need for efficient, effective remote-collaboration tools and media; and
- *social challenges* raised by differences in local context, culture, language, and trust between collaborators.

They predicted that future technological advances will reduce the

Surely not even today?

THE UPSHOT | Do Chance Meetings at the Office Boost Innovation? There's No Evidence of It.

At the same time, technology — like Zoom, Slack and Google Docs — has made idea generation as effective online, researchers said. Judith Olson, a professor of computer science at the University of California, Irvine, has studied the effect of distance on teamwork for three decades. Distance matters much less now, she said: “Because of the technology these days, we’re actually inching closer and closer to replicating the office.”

[New York Times 2021]

Yes, even today.

A national lab, remote during COVID: tools let groups **collaborate fluidly within teams**, but **broke collaboration across teams** [Hu et al. 2022]

20 million papers and 4 million patents: remote teams were **less likely to produce breakthroughs**; remote members were more often doing execution than conception [Lin et al. 2023]

Engineers at a Fortune 500 firm: sitting near teammates brought **18% more code feedback**, mostly to juniors; seniors wrote less code [Emanuel et al. 2026]

The Socio-Technical Gap

Why are collaboration and social tools resiliently difficult to get right? Will distance ever not matter?

The intellectual challenge of social computing [Ackerman 2000]

“The social-technical gap is **the divide between what we know we *must* support socially and what we *can* support technically.**”

The social sciences teach us mechanisms that are important for effective social interaction. But we lack designs that facilitate those mechanisms.

Intuitively: we know how to throw parties IRL, but generally not how to provide those same mechanisms online.

Socio-technical gap in collaboration tools

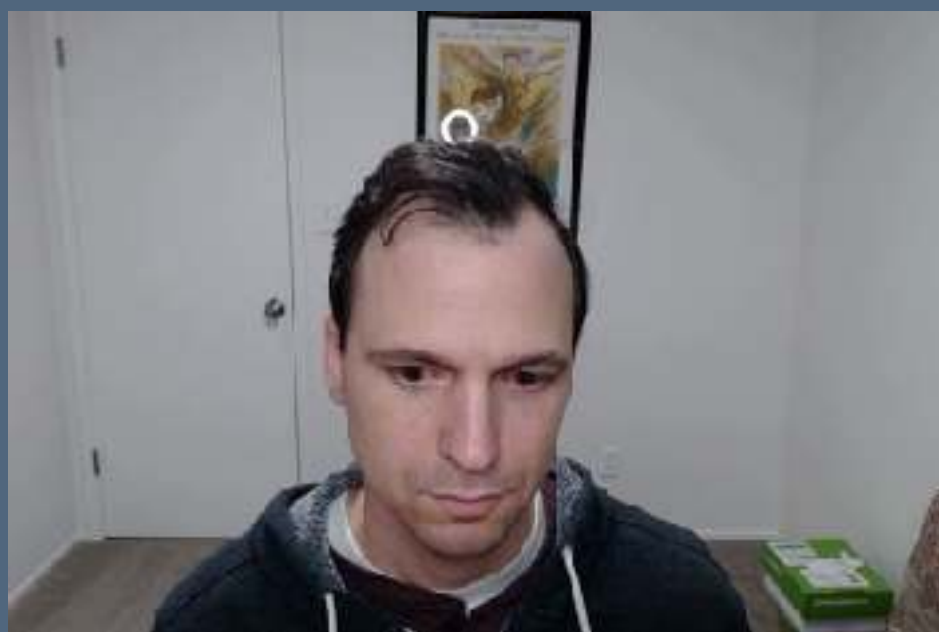
Social sciences: effective collaboration requires that people be aware of what on the team others are up to [Mathieu et al. 2000]

But how do we support awareness, in practice, with technology?

Socio-technical gap in collaboration tools

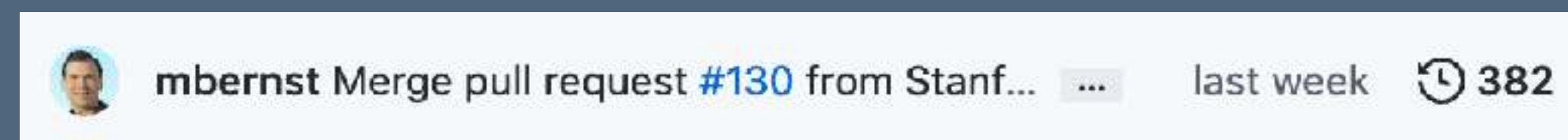
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Live feeds?

[Dourish and Bly 1992]



Activity indicators? [Biehl et al. 2007; Roseman and Greenberg 1996; Dabbish et al. 2012]

Gap: between the awareness we need, and what we know to build

Socio-technical gap in social media

Social sciences: social activity is nuanced, and people handle the details with remarkable fluidity and agility [Ackerman 2000; Garfinkel 1967; Heritage 1984; Suchman 1987]

The focused totality of decades of design & technological progress



...but what is a specific design that can better enable what we know to be effective interpersonal interaction?

Socio-technical gap in virtual reality

Social sciences: interpersonal distance carries meaning — intimate 1.5ft, personal 1.5–4ft, social 4–12ft, public 12-25ft [Hall 1966]

VR:

Socio-technical gap in virtual reality

Social sciences: interpersonal distance carries meaning — intimate < 1.5ft, personal 1.5–4ft, social 4–12ft, public 12-25ft [Hall 1966]

VR:



How do we smoothly trigger personal space cues in VR?

[Dy0ntae on YouTube]

**Collaboration beyond being
there: modern frontiers**

Foundation of CSCW, 1984

1985

Kraut et al., 1988
Collaboration falls off with distance
Johansen, 1988
Groupware's time-space matrix

1990

Ellis et al., 1991
Groupware: issues and experiences
McGrath, 1992
Call to research groups
Orlikowski, 1992
Organizational barriers to groupware

Grudin, 1994
Why groupware fails
Ellis & Wainer, 1994
Taxonomy of groupware

1995

1. Groups interacting with technologies

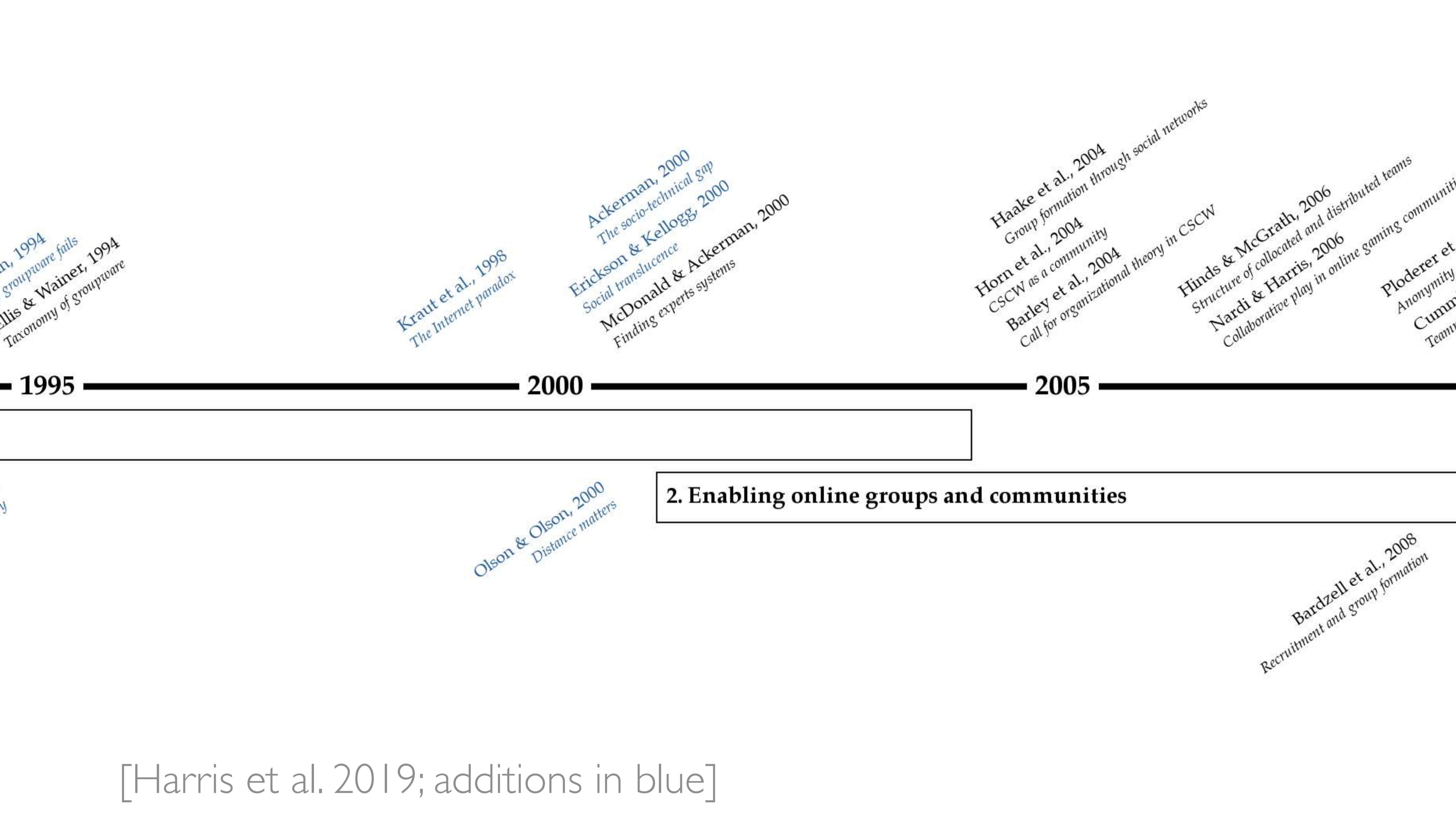
Nunamaker et al., 1991
Electronic meeting systems

Hollan & Stornetta, 1992
Beyond being there

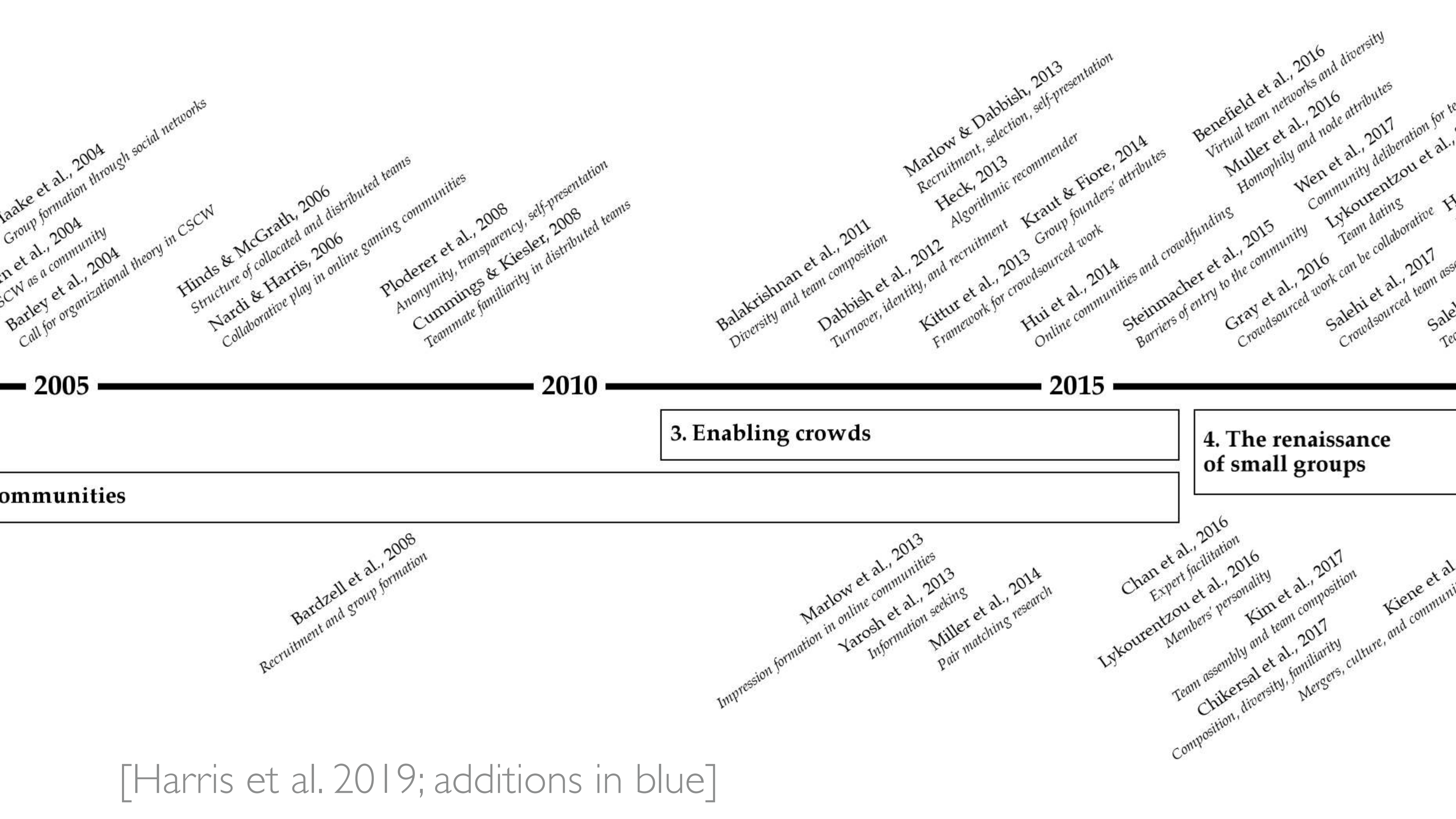
Dourish & Bly, 1992
Awareness through media spaces

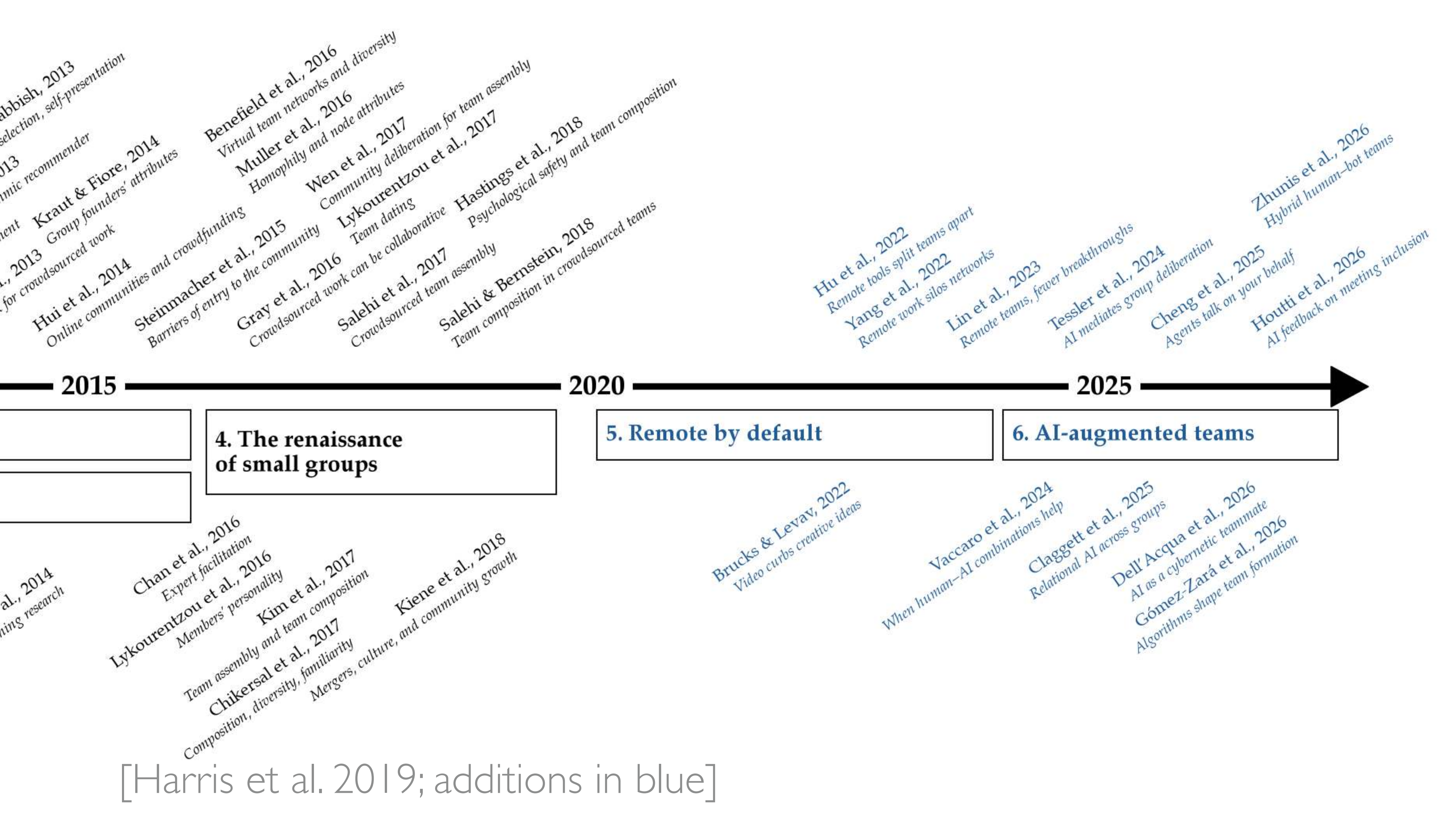
Malone & Crowston, 1994
Coordination theory

[Harris et al. 2019; additions in blue]



[Harris et al. 2019; additions in blue]





What's in team performance?

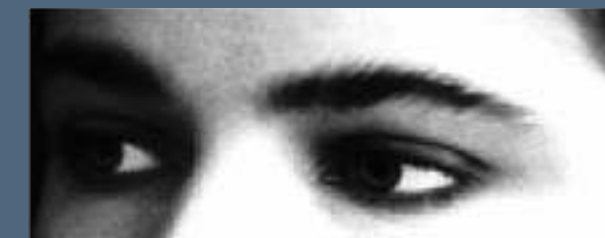
[Woolley et al. 2010; Riedl et al. 2021]

Across tasks, from brainstorming to coordination, groups show a stable “collective intelligence” factor. Guess what predicts it?

Members' individual skill matters, but less than process

What matters most is how they collaborate: matching members to tasks, and ensuring nothing falls through cracks

The average social sensitivity of group members



...and, since women on average are higher social sensitivity, ↑% of women in the group predicted success

This lecture could have been an email [Cao et al. 2021]

Microsoft researchers investigated their own employees' own multitasking during remote meetings: e.g., are they using Outlook while in a Microsoft Teams meeting?

Consistently ~30% of meetings involve email multitasking. The odds go up by 2x if the meeting is at least ten people and by 3x if the meeting is ~1 hr long

Multitasking does not always mean disengagement: often, it's communication with colleagues or finishing other work: "It needs to happen or you can't get all your work done"

Open questions

Can we bring the right people together, given the task?

People initially say they want experts and sociable teammates, but ultimately are likely to choose prior social connections [Gómez-Zarà et al. 2019]

Can we help them flag potentially explosive meltdowns early?

As little as 70 seconds of text chat can enable an algorithm to flag teams that may want to break up later [Cao et al. 2020; Zhang et al. 2018]

Can we aid effective organization strategies?

What is the best way for teams to organize?

[Zhou, Valentine and Bernstein 2018]

Should teams be flat or hierarchical? Encouraging or critical?
Enforcing equal turn-taking?

Unfortunately, organizational behavior research has demonstrated that **there exist no universal answers** to these questions. They are contingent on the people and the task.

What if you could continuously give feedback on how the team is going, and a system helped your team identify better strategies?

[Redacted]

[Redacted]

[Redacted]

[Redacted]



feifei 9:21 AM
hello



landay 9:21 AM
hi



wootters 9:21 AM
Hi everyone!



goal-robot APP 9:21 AM

INSTRUCTIONS

- [Redacted]
- [Redacted]
- [Redacted]

SUBMISSION

- [Redacted]
- [Redacted]



[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]



goal-robot

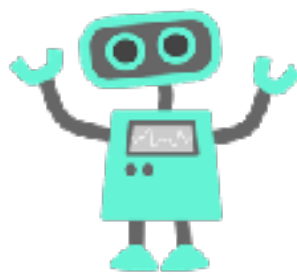
APP

9:21 AM

END OF ROUND

[Redacted]

<feedback to DreamTeam system>



dreamteam-robot 9:21 AM

This round change the following...

Be super cheery! Make sure to write encouraging comments to all your teammates, despite any losses!

+

<feedback>

Time 

The resulting teams outperform managers, collective decision making, and traditional multi-armed bandit searches.



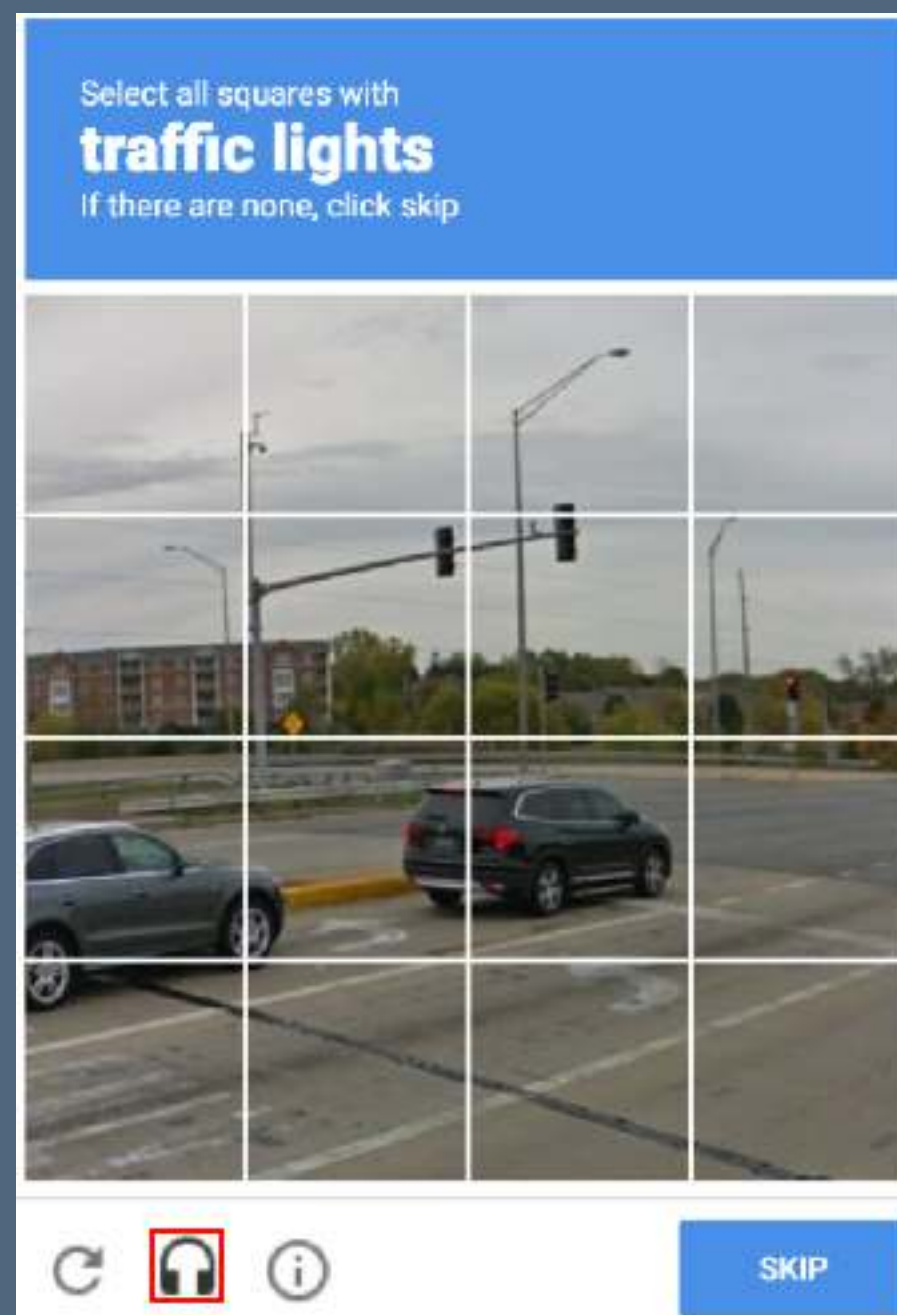
Time 

Coordination at scale:
crowdsourcing

Large-scale contributions

“Well, If we can’t coordinate in small groups, instead let’s highly structure our activities and open them up to massive scale.”

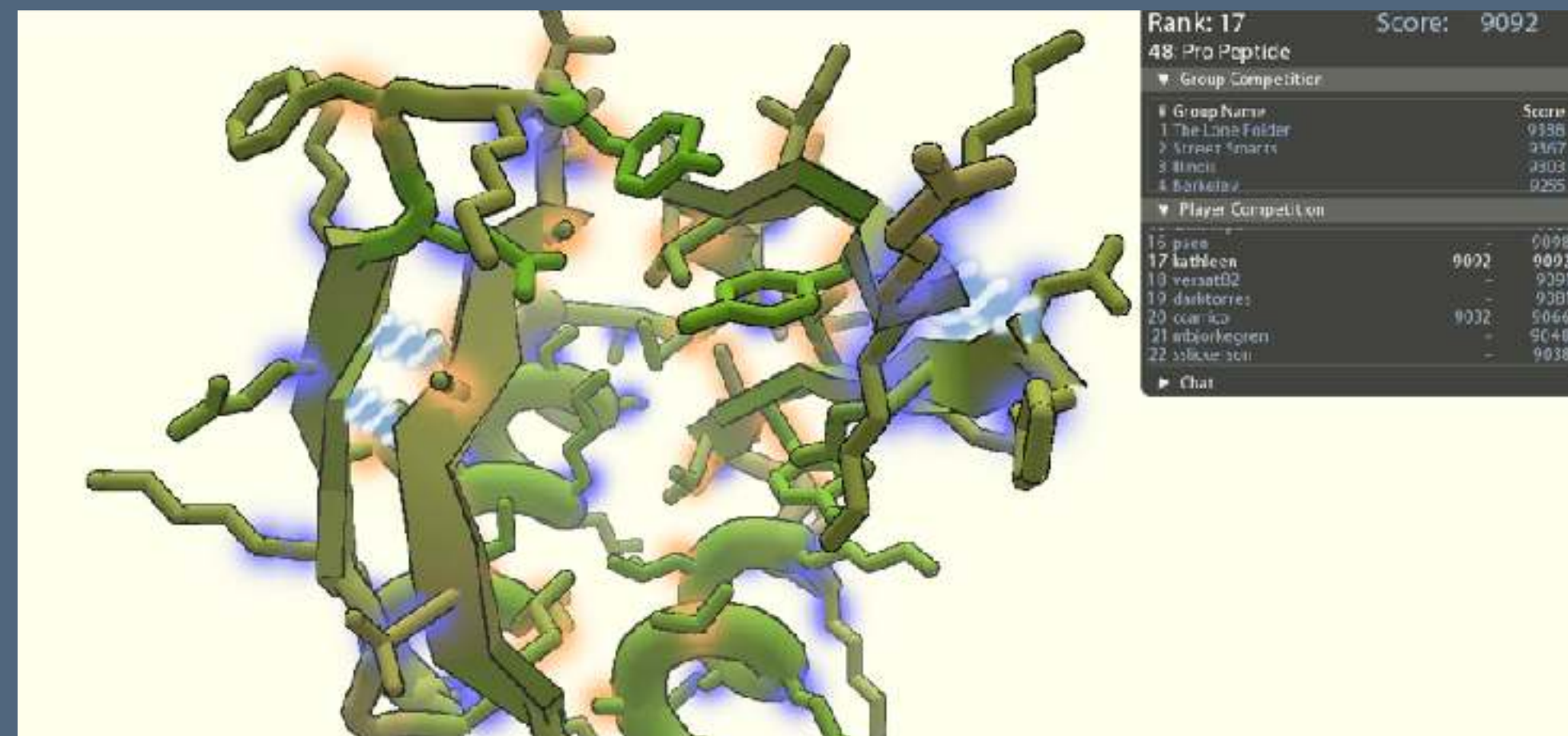
“Let’s call that crowdsourcing.”



Large-scale contributions

“What if people don’t want to volunteer?”

“Well, we could make it fun or incentivize them.”



Rank: 17	Score: 9092
48 Pro Peptide	
▼ Group Competition	
Group Name	Score
1 The Line Folder	9336
2 Street Smarts	9307
3 Alchem	9303
4 Barkley	9255
▼ Player Competition	
15 pree	9098
17 kathleen	9092
19 verant02	9091
19 daktories	9081
20 caraco	9032
21 anjorkegren	9048
22 sblaze stn	9038
► Chat	

kaggle

[Cooper et al. 2010]

[von Ahn and Dabbish 2004]

Crowdsourcing as Beyond Being There

Crowdsourcing gives up on having high common ground and coupling (vis a vis Olson), in favor of structured activities at scale

“Write a complete encyclopedia article” → “Fix this typo”

“Create a complete operating system” → “Try to fix this issue/bug”

“Train a machine learning algorithm” → “Label this image”

What crowdsourcing loses in coordination from in-person collaboration, it gains in sheer scale — going beyond being there

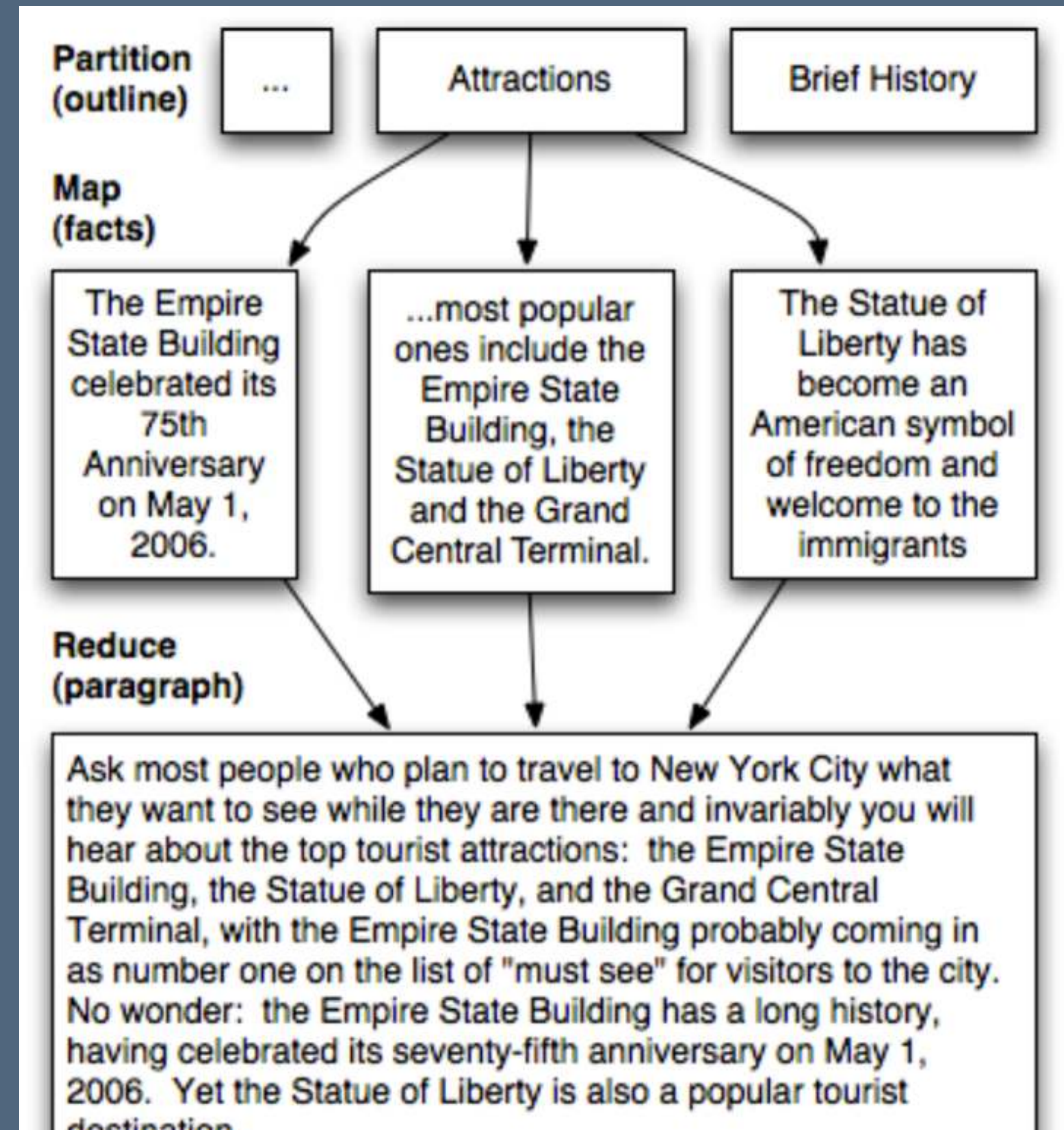
Crowdsourcing workflows

[Kittur et al. 2011]

How might we crowdsource more complex, interdependent outcomes?

Crowdsourcing as a map-reduce process

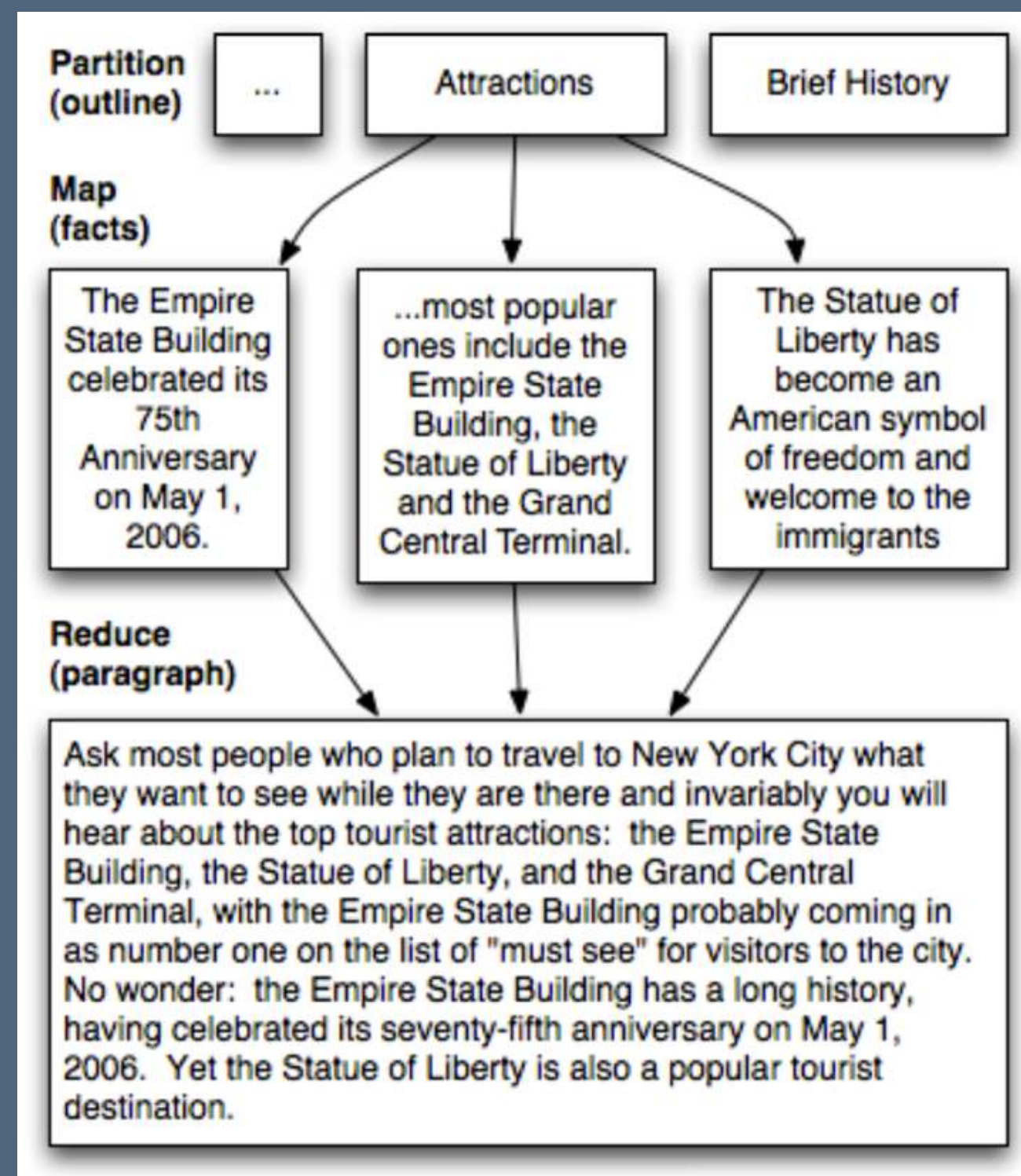
To write a Wikipedia page, partition on topics, map to find facts and then reduce into a paragraph



Crowd work → LLM chains

[Kittur et al. 2011; Wu et al. 2022; Grunde-McLaughlin et al. 2025]

Crowd workers, 2011

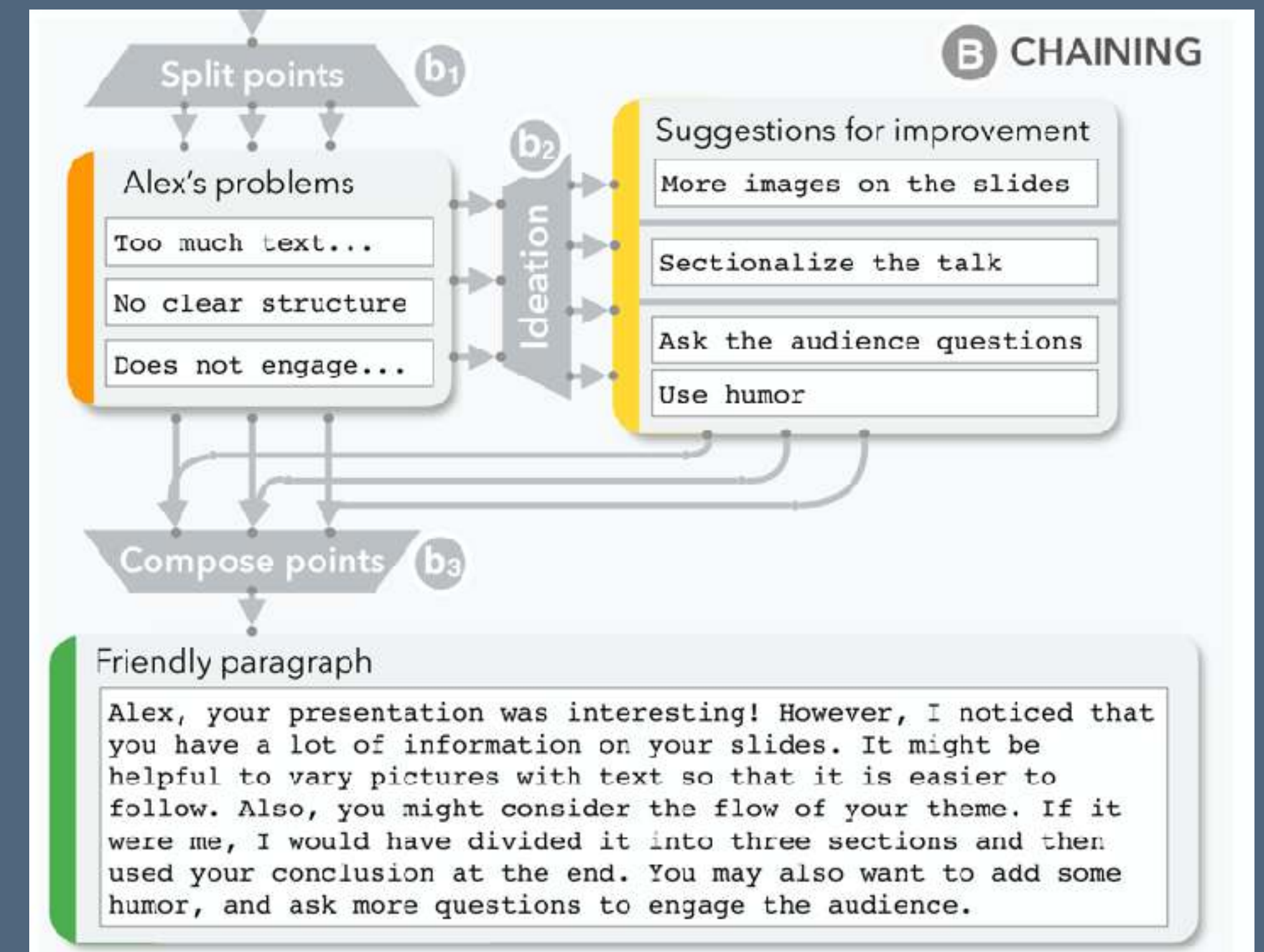


partition ↔ split

map ↔ ideate

reduce ↔ compose

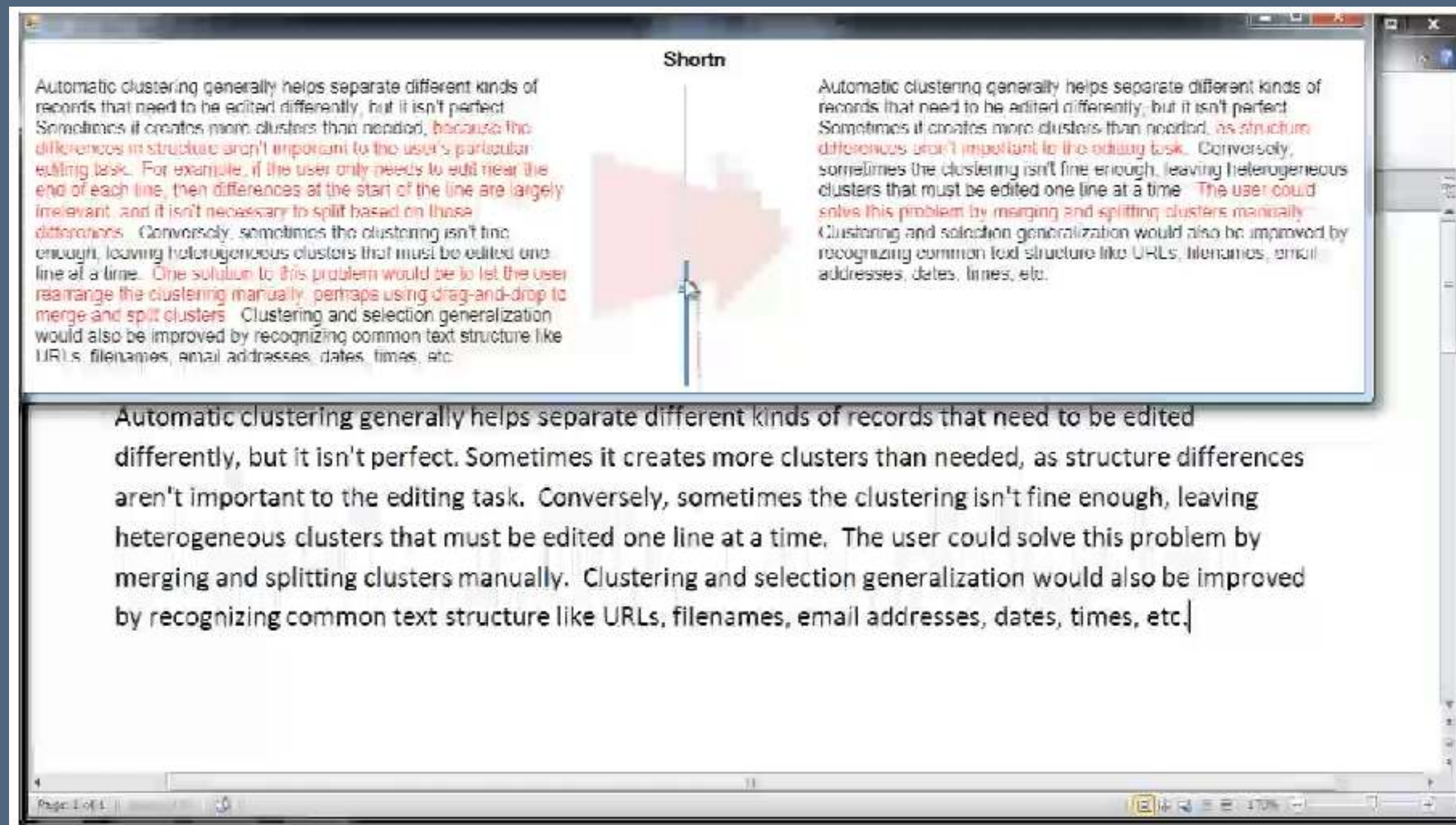
LLM calls, 2022



“Chains address LLM errors analogously to the way crowdsourcing workflows address human error.”

[Grunde-McLaughlin et al. 2025]

Crowd-powered applications



[Bernstein et al. 2010]

[Bigham et al. 2010]

What temperature is my oven set to?



(69s) it looks like 425 degrees but the image is difficult to see.
(84s) 400
(122s) 450

Can you please tell me what this can is?

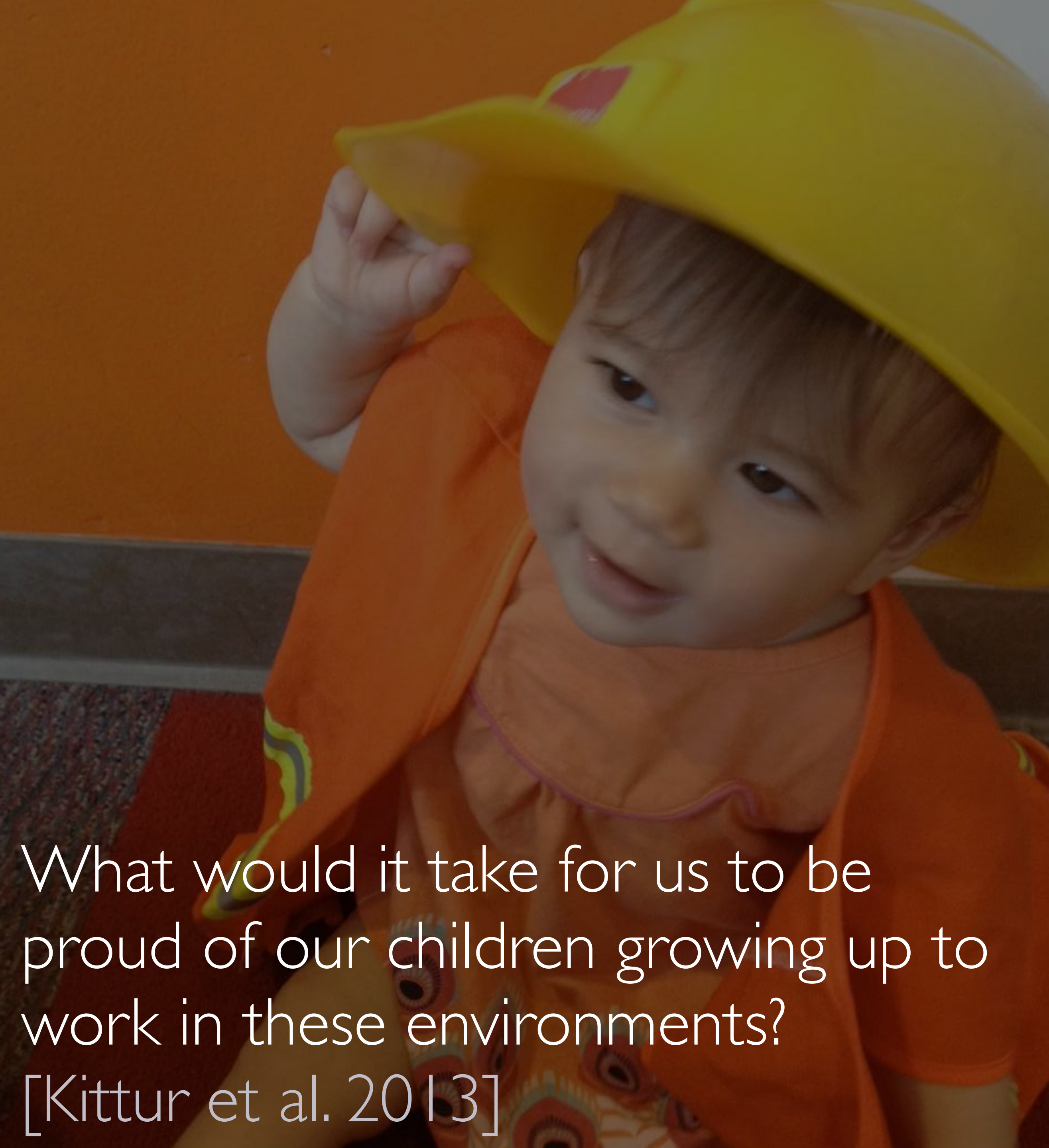


(183s) chickpeas.
(514s) beans
(552s) Goya Beans

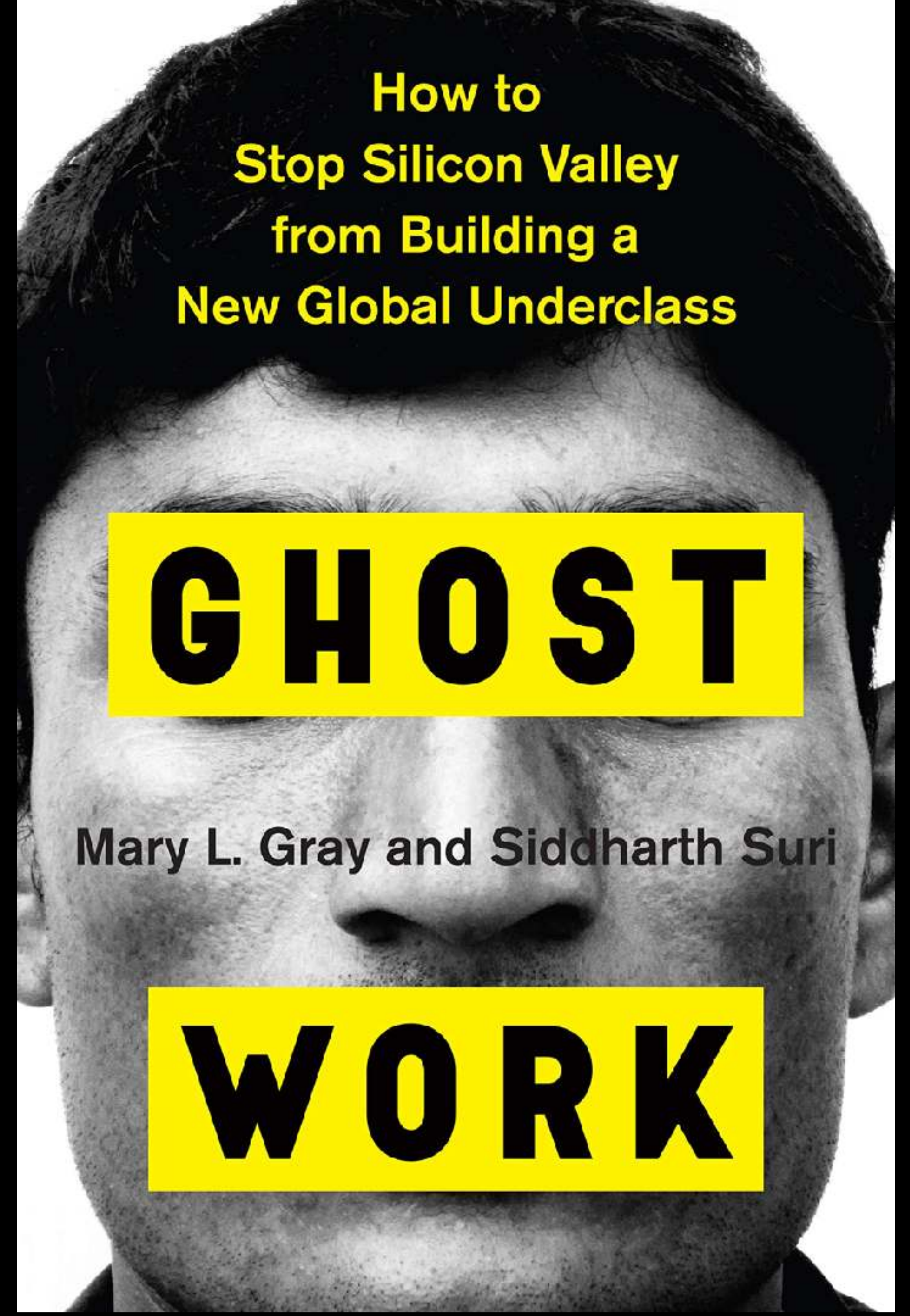
What kind of drink does this can hold?



(91s) Energy
(99s) no can in the picture
(247s) energy drink



What would it take for us to be
proud of our children growing up to
work in these environments?
[Kittur et al. 2013]



How to
Stop Silicon Valley
from Building a
New Global Underclass

GHOST

Mary L. Gray and Siddharth Suri

WORK

Summary

Collaboration is hard: **distance matters**.

Tools can try to mitigate the effects of distance, but we are limited by the **socio-technical gap**.

Aiming to go beyond being there, **crowdsourcing** gives up on tight teamwork in favor of structured contributions through open call and at massive scale

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