Benefiting from diversity:

what can we learn from agent-based models?

Hello!

I am Lukas Wallrich

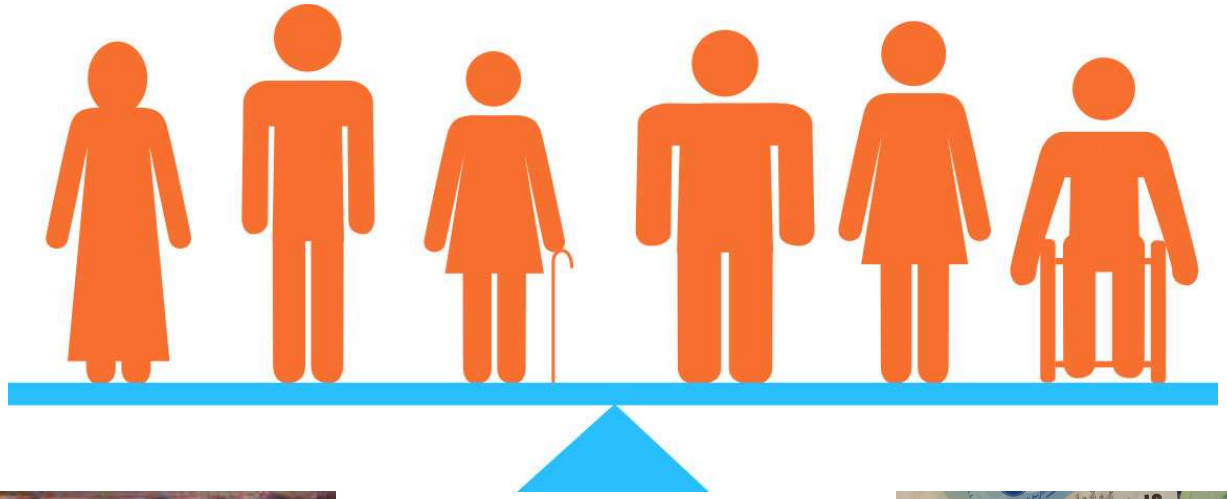
You can find me at

@lukaswallrich

l.wallrich@bbk.ac.uk

https://lukaswallrich.coffee

1 Benefiting from diversity?

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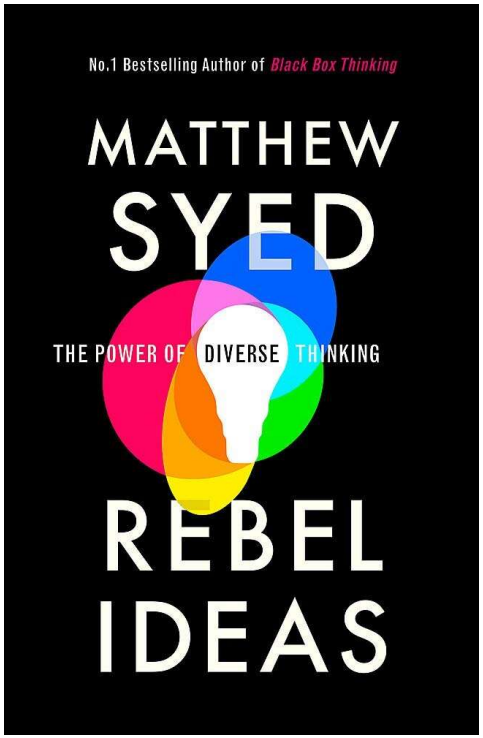
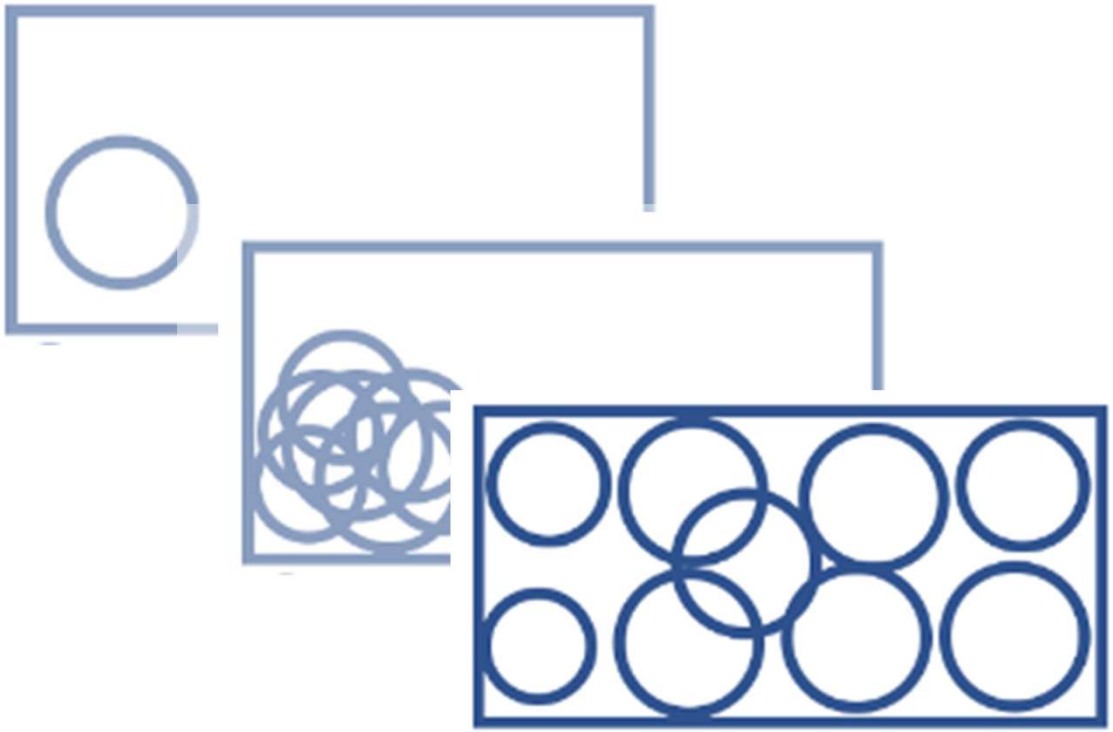
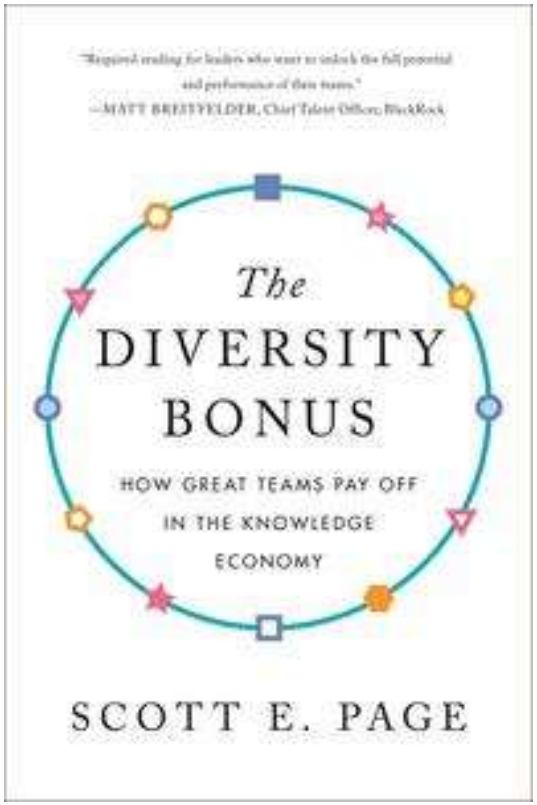
A team of rebels





A diverse toolbox



Organizational Behavior and Human Decision Processes (2012)

Defying conventional wisdom: A meta-analytical examination of the differences between demographic and job-related diversity relationships with performance

van Dijk, Hans; van Engen, Marloes L.; van Knippenberg, Daan

Journal of Management Studies (2020)

The Relationship Between Team Deep-Level Diversity and Team Performance: A Meta-Analysis of the Main Effect, Moderators, and Mediating Mechanisms

Triana, María del Carmen; Kim, Kwanghyun; Byun, Seo-Young et. al.

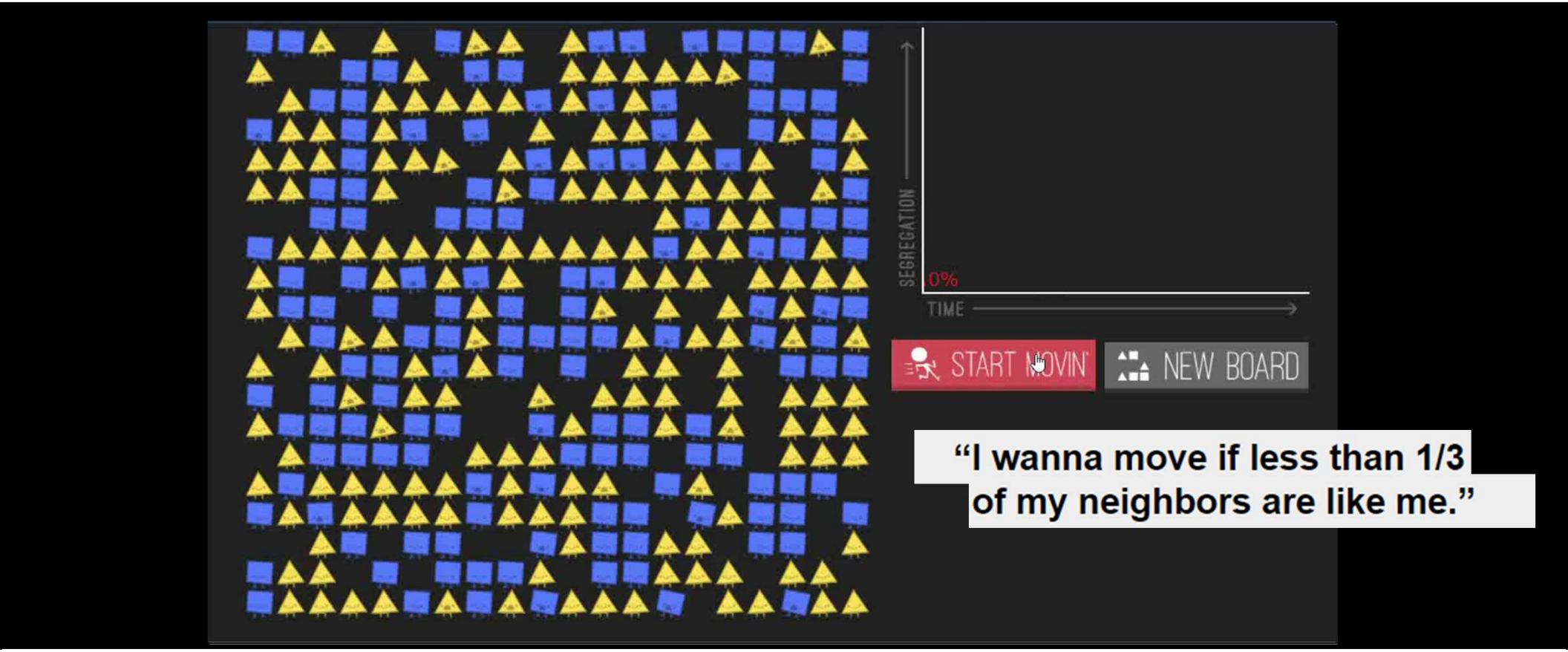
- Do the diversity benefits exist?
- How do they come about?
- What are barriers?

Agent-based modeling

All models are wrong,
but some are useful

- George Box

Schelling (1971) … or the parable of polygons

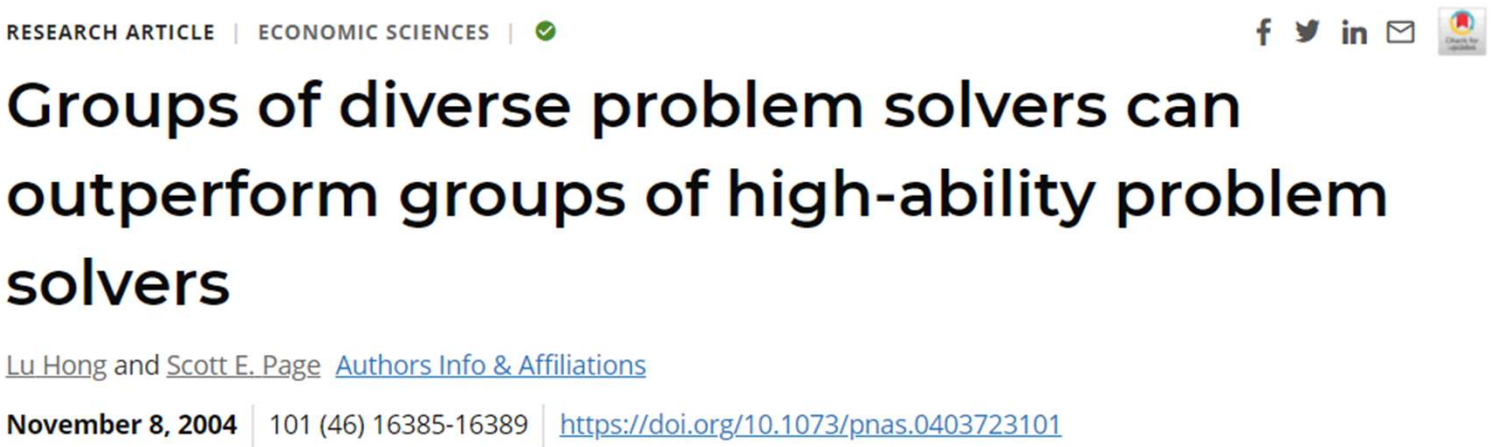


How to use this approach to *understand diversity benefits?*

2 Problem-solving as *hill-climbing*

Hong & Page (2004)

- Agents search for peak in *random* landscape
- Agents can have different heuristics (step sizes)



RESEARCH ARTICLE | ECONOMIC SCIENCES |

Groups of diverse problem solvers can outperform groups of high-ability problem solvers

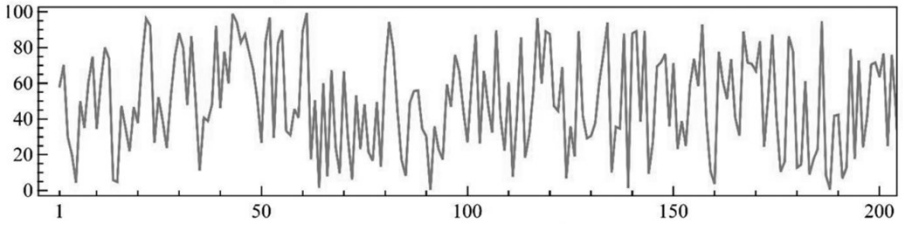
Lu Hong and Scott E. Page Authors Info & Affiliations

November 8, 2004 | 101 (46) 16385-16389 | https://doi.org/10.1073/pnas.0403723101

Special features

Random landscapes

→no expertise

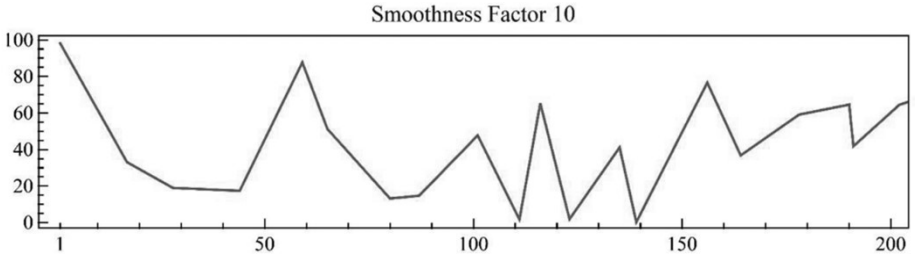


Relay approach

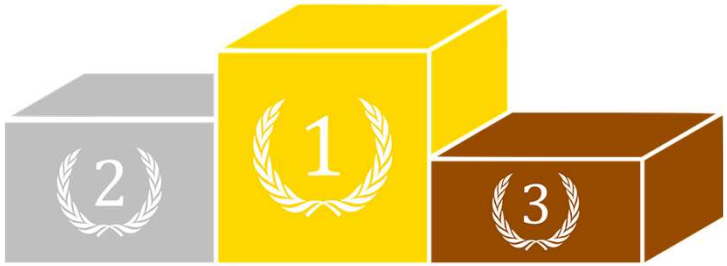
Diversity, Ability, and Expertise in Epistemic Communities

Grim et al. (2019)

- **Smoothed** landscapes



- **Tournament** strategy



RESCIENCE C

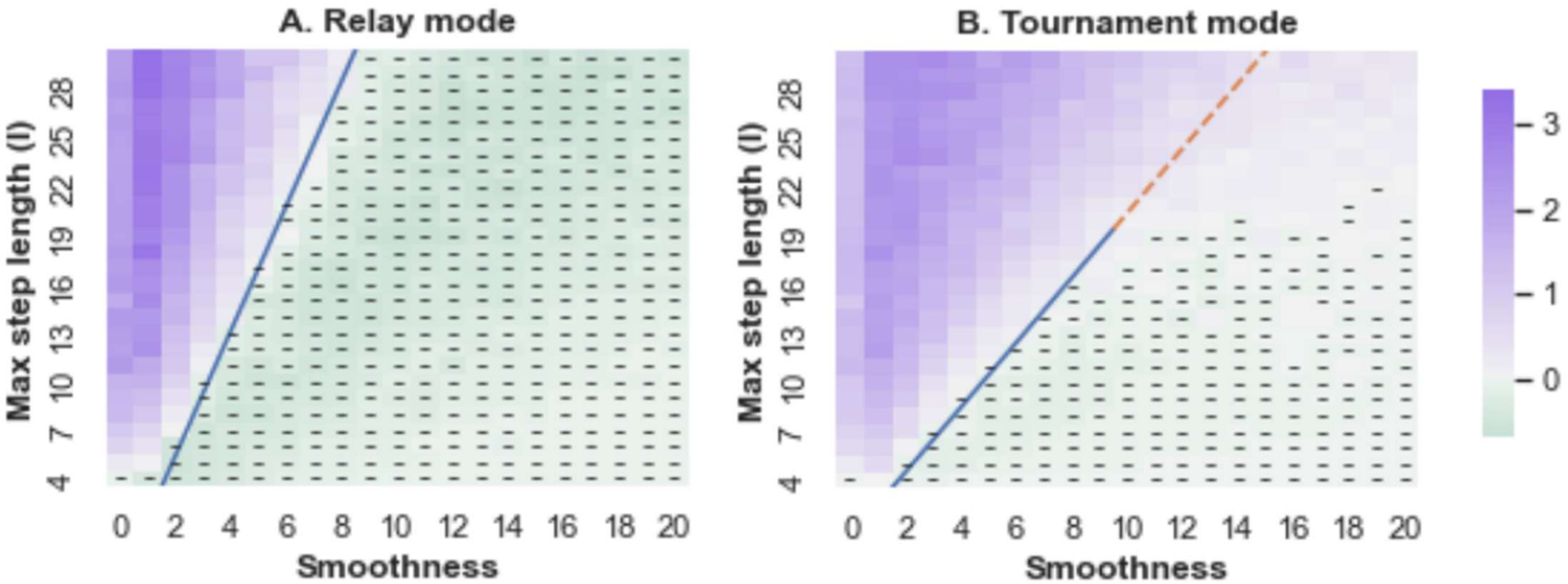
UNDER REVIEW

Replication / Social Psychology

[Re] Groups of diverse problem-solvers outperform groups of highest-ability problem-solvers - most of the time

Lukas Wallrich[1]

[1] Department of Organisational Psychology, Birkbeck, University of London, London, United Kingdom


A. Relay mode
B. Tournament mode
Max step length (l)
4
7
10
13
16
19
22
25
28
Smoothness
0
2
4
6
8
10
12
14
16
18
20
3
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The upside of diversity

Strategy	Random team performance		Winning margins			
			Random team		high-ability team	
	Win rate (%)	Mean margin	Mean	Max	Mean	Max
Relay	25.9	0.14	1.50	3.32	0.34	0.69
Tournament	60.0	0.54	0.93	2.58	0.06	0.21

So what?

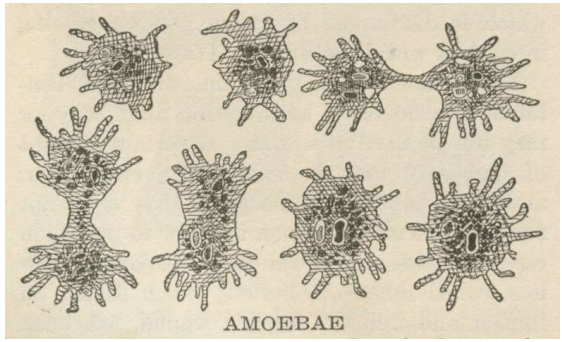
- (Any) diversity is **powerful** when there is no expertise
- When there is expertise: need a lot of diversity

- Diversity needs to be **maintained** in the process – relay leads to convergence

- Diversity has **greater upside** than downside – and comes with random (free) selection

3 Problem-solving as *procreation*


Evolution is the most successful
problem solving strategy


AMOEBAE

A more complicated problem

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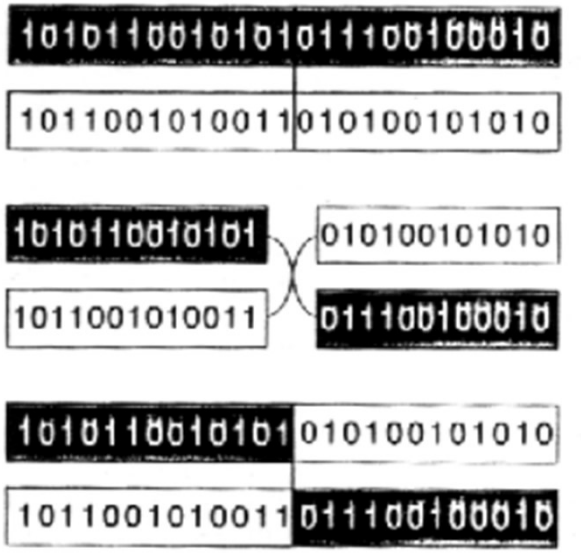
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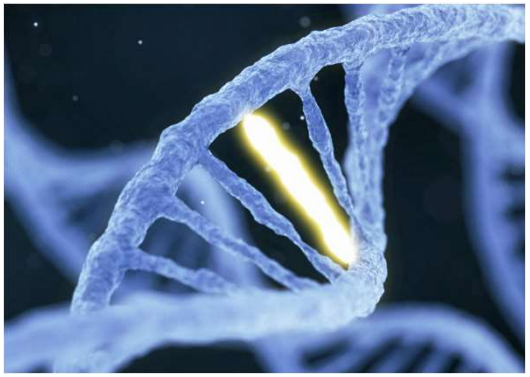

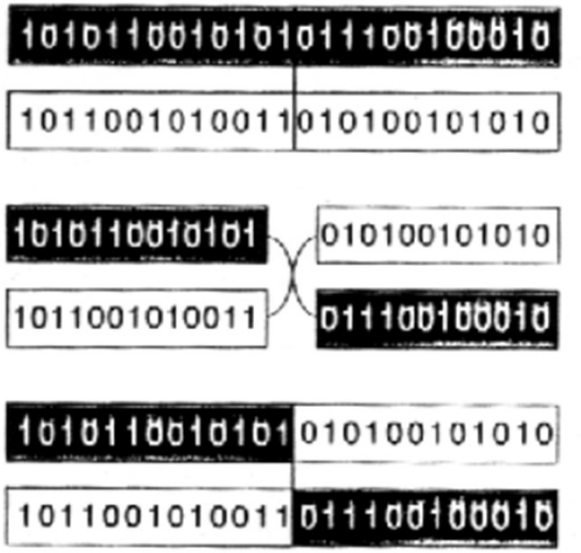
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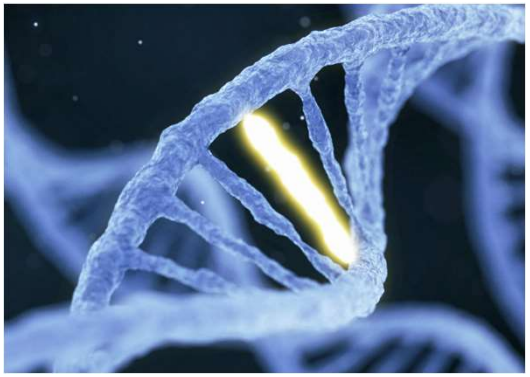

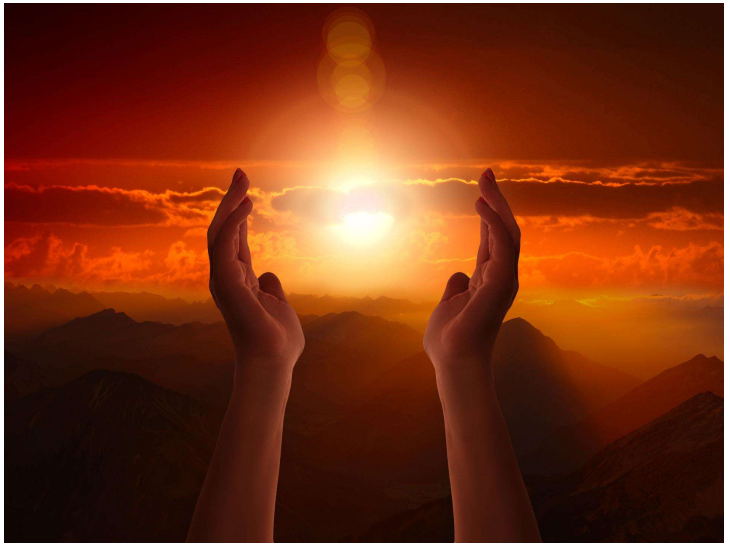

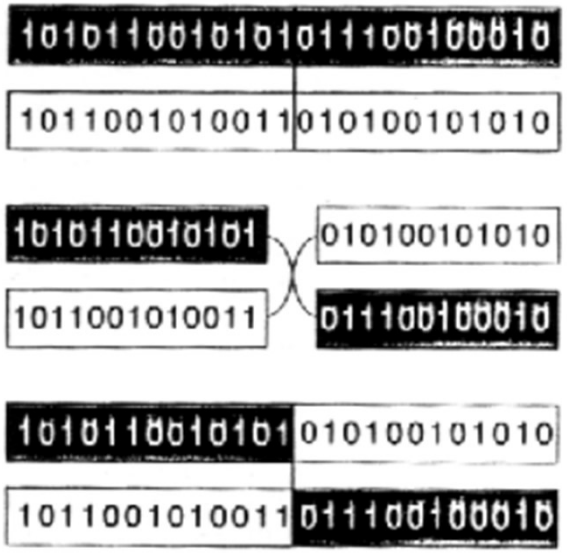
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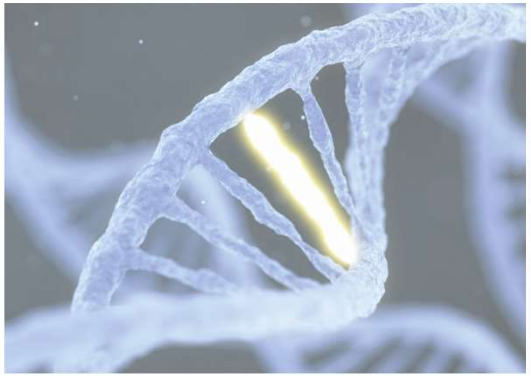
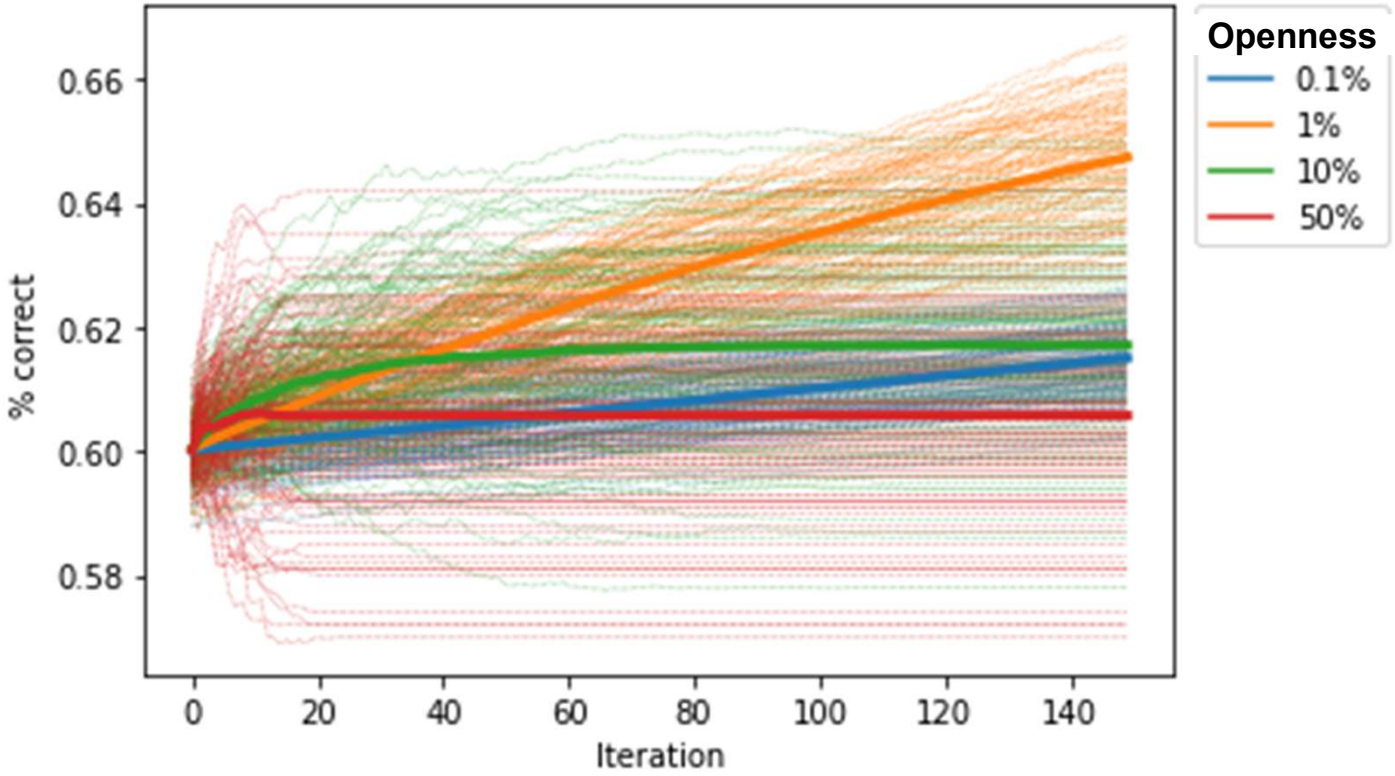


My basic model

- Agents **take a guess** at the start (60% accurate)

- Each round:
  - **Meet** one other agent in their team of 12
  - Randomly **combine** their guess with the other's (by taking a random chunk of specified length)
  - **Take a vote** in their team whether new guess is better than old guess – if so, update their guess

Initial results – mean accuracy of agents

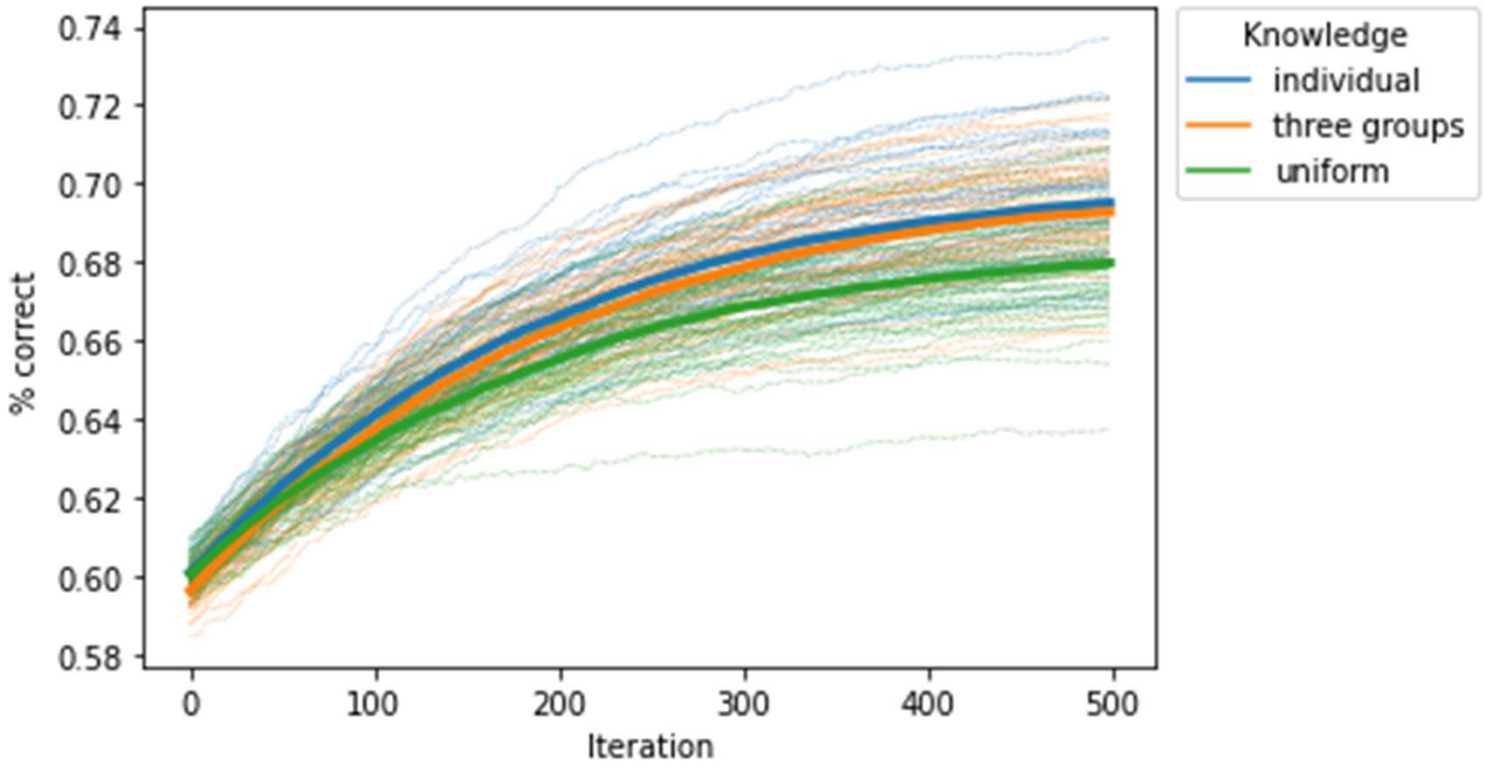


Adding cognitive diversity

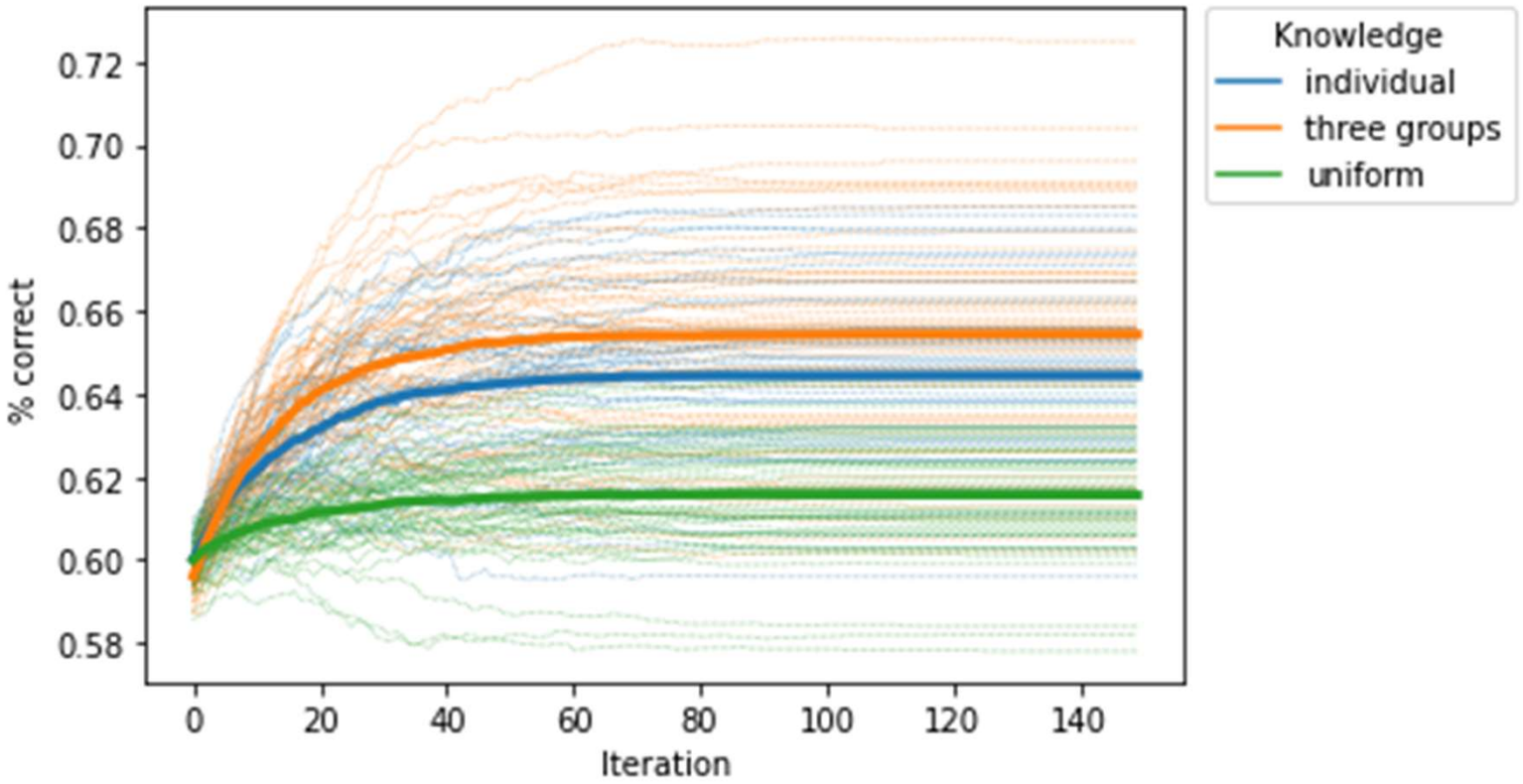
- Agents now tend to know about **different parts** of the solution

- Still 60% accurate on average –
  but now based on different distributions
  - Either group-based (e.g., from different functions)
  - Or individual (e.g., own experiences)

With 1% openness it takes a while



With 10% openness the pattern is clear



So what?

- **Teams outperform any individual** by pooling their knowledge
- **Diverse teams do better** over time
- Need to maintain diversity – again, **too much convergence is wasteful**
- (Omniscient leaders are very helpful)

Why does the voting work?

Wisdom of crowds (Galton)

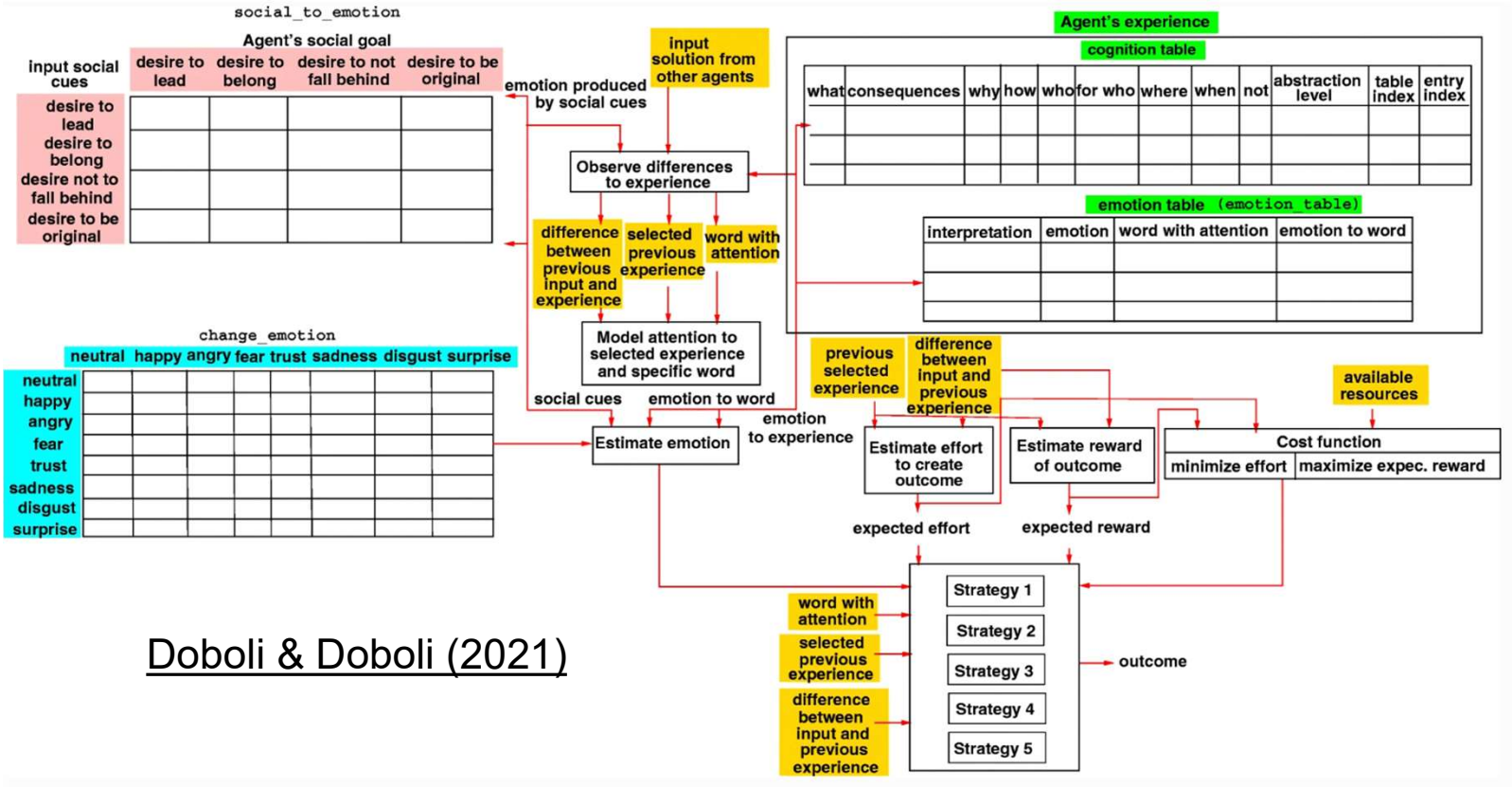
Diversity prediction theorem (Page)

Diversity in predictions reduces collective error

NB: any awareness of knowledge areas would further boost performance

What's next?

NOT THAT!



Doboli & Doboli (2021)

But …

- Further explore impact of **communication barriers** and **biases**
- Consider whether **maximum diversity** is best
- Consider how external information (e.g., experiments) and meta-cognition can support **evaluation of ideas**

Thanks!

Any questions ?

You can find me at

- @lukaswallrich
- l.wallrich@bbk.ac.uk
- https://lukaswallrich.coffee

Credits

Special thanks to all the people who made and released these awesome resources for free:

- Presentation template by SlidesCarnival
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