

Cognition and Semiotics

MA Cognitive Semiotics, Spring 2019

Lecture 4
Monday Sep 21st

Overview

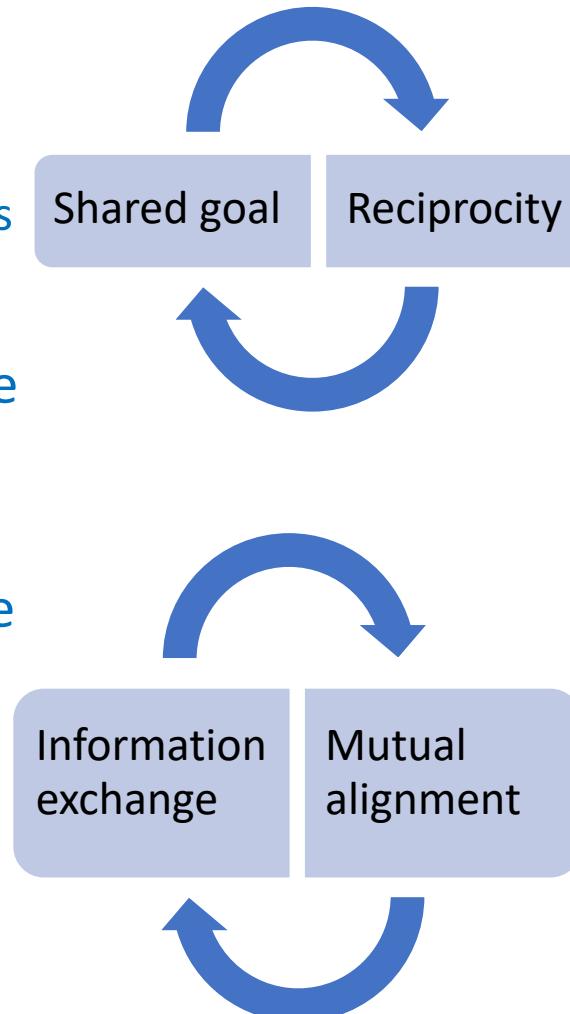
- Today's lecture: **Group and crowd cognition II**
 - Quick recap of
 - Shared goals, reciprocity and alignment
 - Taxonomy of interaction types (feedback)
 - Group/Wisdom of crowds research
 - The role of language
 - Problems in group interaction
 - Diversity vs similarity
 - In class experiment (demo)
 - Wisdom of debating crowds paper
 - Summing up

Concepts and notions ahead:

- **Interaction types, channels & models**
- Shared goal and reciprocity
- Mutual alignment
- Taxonomy of interactions
- **Group interaction and wisdom of the crowds**
- Signal averaging
- Information pooling
- Weighted majority rule
- Reliability marker
- Discussion, debate, deliberation
- Recalibration
- Groupthink
- Correlated information
- Hearing, conformity, social influence
- Shared information bias
- Group polarization
- Information cascades
- Diversity
- **Wisdom of crowds of crowds**
- Convergence (bias/variance)
- Between-group sampling
- Experimental design
- Summary

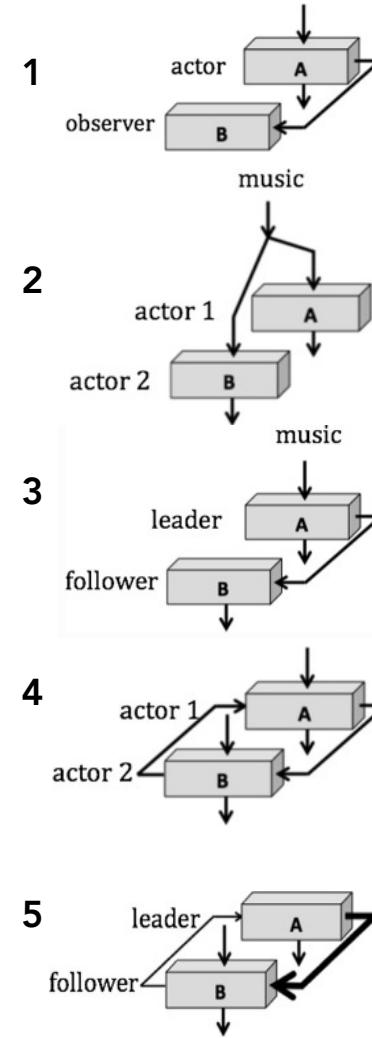
Interaction types, channels & models

- Human sociality is explained by, the unique capacity to share mental states; “shared intentionality”
 - Central importance to know how exactly individuals interact and adapt to each other
- Step away from the notion of shared goals as the paradigm case of social interaction
 - and regarding reciprocity as a (important) consequence of joint action – too narrow!
- Focus on the nature of the information exchange between interacting individuals – *irrespective of shared goals* – by varying degrees of alignment
- As such, bidirectional reciprocity (*mutual alignment*) is the primary requirement for ‘pure’ social interaction
 - Alignment may occur in any exchange, but only bidirectional information exchange results in *mutual alignment* and thus *social interaction*



Reminder: A taxonomy of interaction types

- A broad distinction can be made between **unidirectional** (1-3) and **bidirectional** (4-5) exchanges of information, which differ in regard to whether they involve **mutual adaptation**
- Suggests a **continuum** rather than in-or-out view (e.g. offline and online)
 - Alignment comes in degrees on a spectrum with higher resolution, analogous to sociality – and hence social interactions
- We avoid making assumptions about the representational states (shared representations of tasks, goals, modes)!



Group interaction and the wisdom of crowds:

- Can we benefit from the knowledge of many?



- If so, under what circumstances?

Condorcet's Jury Theorem

- Mathematician, the Enlightenment

Wikipedia: Condorcet believed that through the **use of our senses and communication with others**, knowledge could be compared and contrasted as a way of analyzing our systems of belief and understanding.

See “Condorcet’s Jury Theorem”



(1743-1794)

Condorcet's Jury Theorem

- First formulated (mathematically)

The **more people** involved in reaching a majority decision, **the better** the decision will be, as long as each member performs *better than chance*

Probability of correct majority vote:

1 - - 0,75

3 - - 0,85

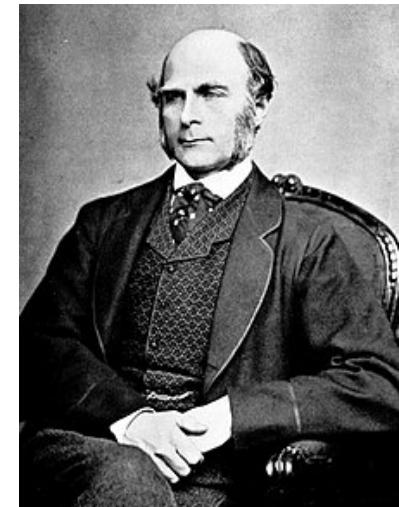
5 - - 0,90



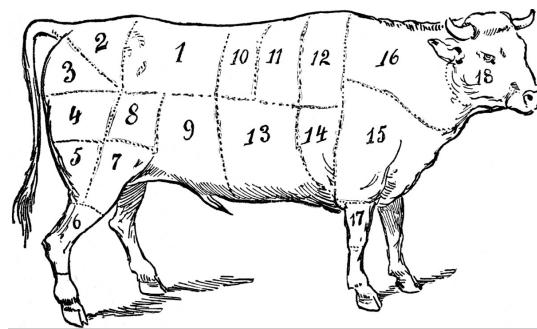
(1743-1794)

Galton's famous “Vox Populi” (1907)

- First empirical evidence of wisdom of crowds
- Prize competitions at fairs, e.g. “[Guess the weight of the ox](#)”
- Collected and [averaged individual entries](#)
- Average: 1,197lbs (real weight: 1,198lbs)
- Average guess outperformed best guess!

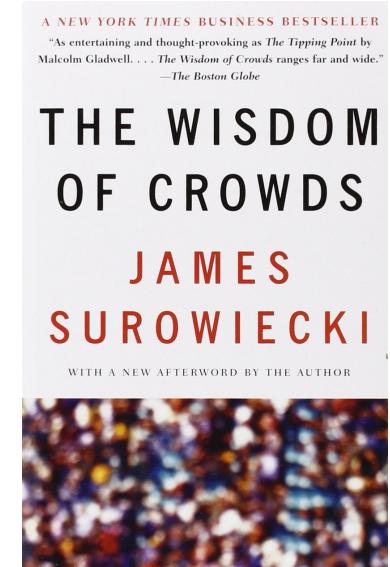


(1822-1911)



Benefits of groups and crowds

- Has since been hotly debated in academia
- Widely popularized by Surowiecki (2004) →
 - On the consequences for economics and politics
- Thus, an area with **implications for** social and perceptual **neuroscience**, social **psychology**, and quantitative as well as philosophical **economics**
- However, empirical work has *struggled* to show that collective decision-making can reach **optimality**, as expected from the ideal combination of individual independent estimates



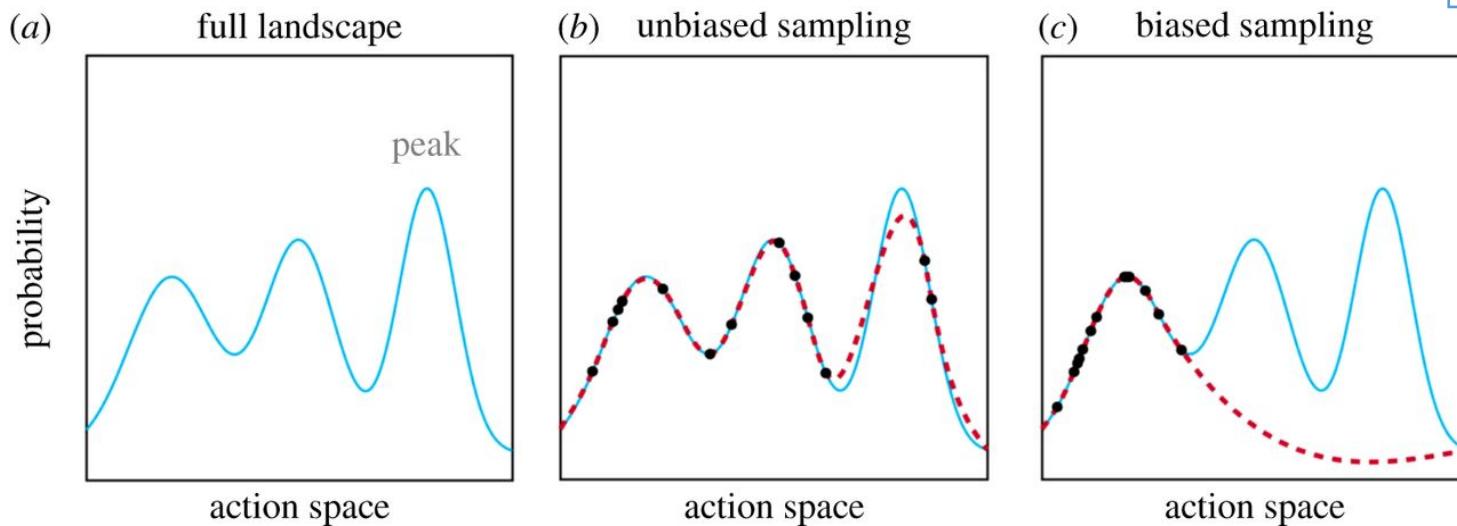
(2004)

How can the crowd be wise: Signal averaging (as group size increase)

- Pooling of information

- Pooling information from **independent** (unbiased) individuals cause uncorrelated errors to cancel out (**simple statistical averaging**)
- People have *different* priors and new evidence
 - but pooling *independently* in real-life is hard!

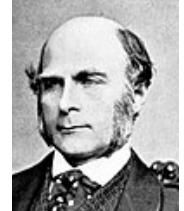
Independent
= unbiased
(have not
influenced
each other)



Weighting by reliability

Allow me to collect all your opinions (pool info) and compute the average!

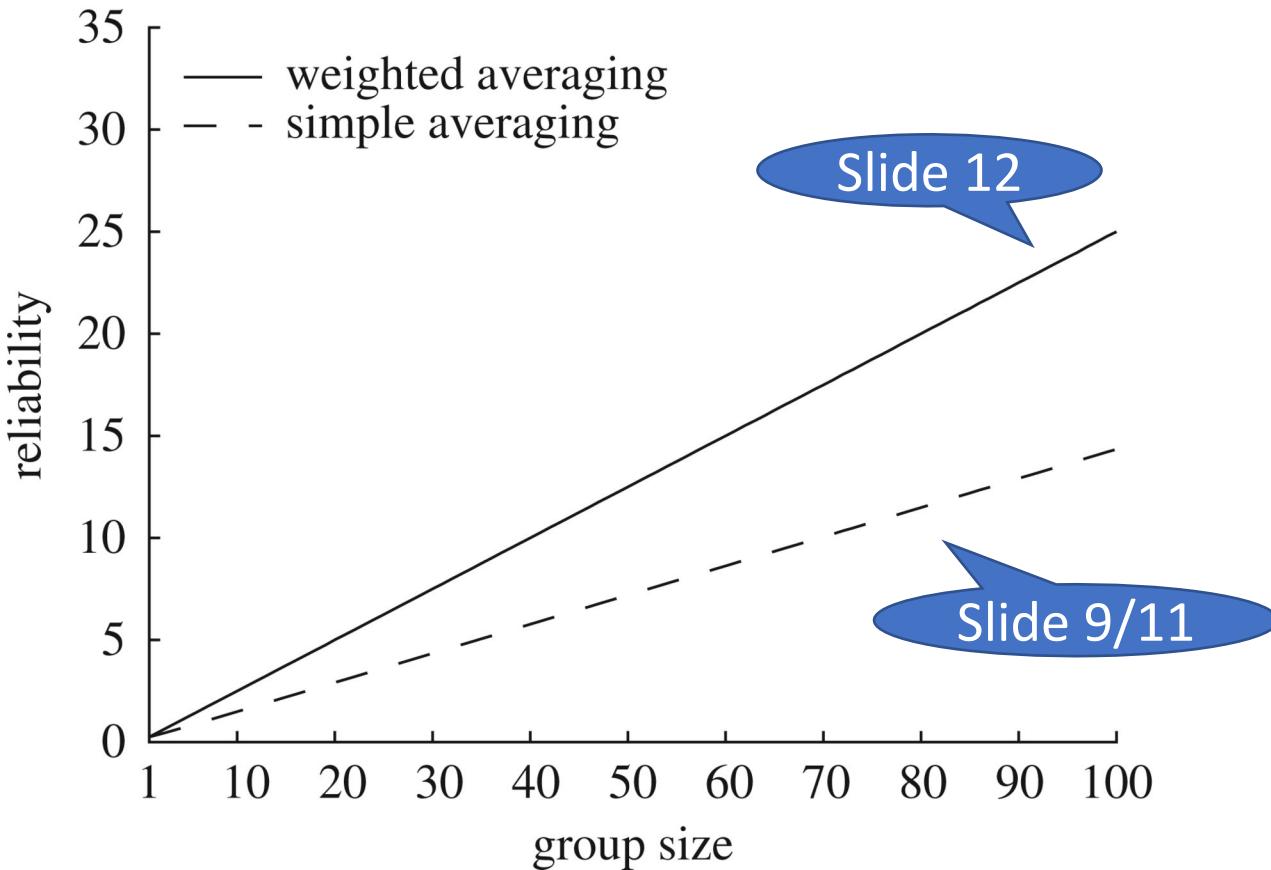
- A common strategy (without a Galton) is to select an action based on **Majority rule**
 - Most fair, but **depends a lot on the reliability** of each individual – or their information
- *Weighted majority rule* – based on a **reliability marker**, e.g.
 - Status, rank, seniority, experience, etc
 - Confidence (e.g. weighted confidence)
 - **Weighted averaging**
- Each with their benefits and weaknesses!



This should ring a bell

Weighting by reliability

- Reliability of pooled estimates:



Assuming that individual estimates vary in reliability and are uncorrelated

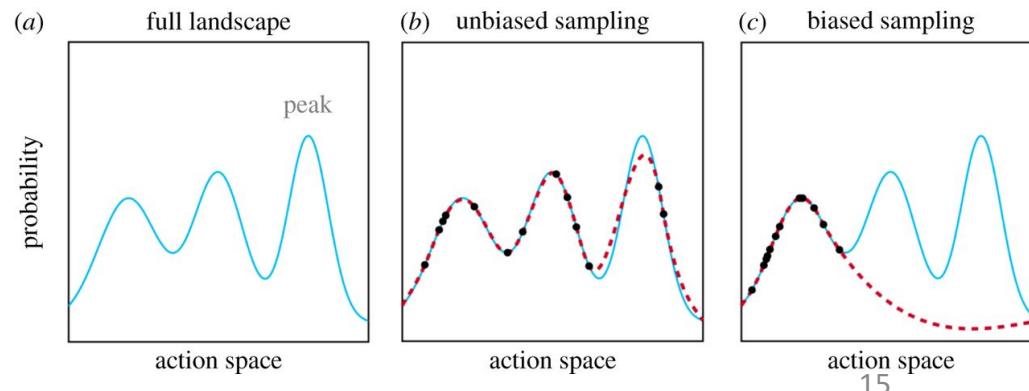
Remember:
Shared confidence weighting model?

Discussion: the role of language

- Discussion, debate, deliberation (without time pressure) is generally a good strategy, particularly for recalibrating markers of reliability
 - i.e. “leveling out” any markers that may not be reliable, e.g. over- or under-confidence, status (in different domain), etc.
 - *calibration* characterizes whether the stated confidence matches their likelihood of being correct (mapping)
 - FOR EXAMPLE: often overconfident for hard problems, but paradoxically, underconfident for easy; *hard-easy effect*
- Through e.g. arguments we can assess the evidence
 - More likely to listen to well-argued (good evidence) than opinions with mere high confidence
 - Recalibration decreases the probability of undue weight!

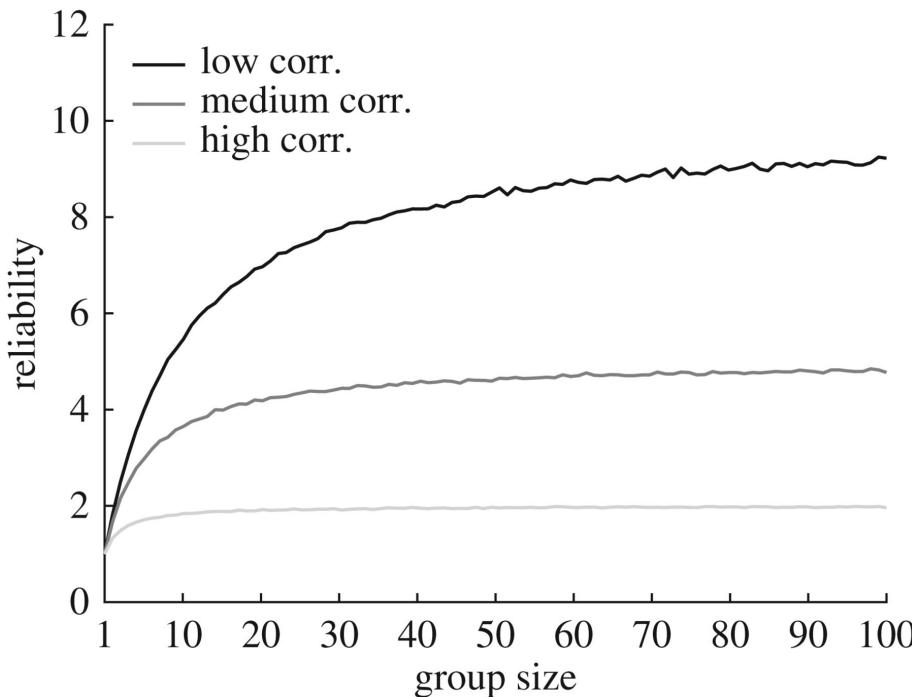
Discussion: the role of language

- Discussion generally is a good strategy for reaching better solutions e.g. for probabilities and reasoning
 - *The whole is greater than the sum of its (parts)* members working alone – across many domains
 - and transfers to *subsequent* individual contexts
- Allows for identification and mixture of exploiters and explores
 - And identification of other people's biases



The less bright side of (group) life

- We think as one: Information-limiting correlations
 - **Groupthink:** individuals become less independent, knowledge and priors are too similar, and they conform:



Groupthink

by William H. Whyte Jr.



thing has been taking
ry—and almost without
a country where “in-
dependence and self-reli-
tchword for three cen-
; now coming to be ac-

phenomena: recent public-opinion polls,
slick-magazine fiction, current best-sellers,
all document the same trend. Groupthink
is becoming a national philosophy.

Groupthink being a coinage—and, ad-
mittedly, a loaded one—a working defini-

Huxley's *Brave New W*
well's *Nineteen Eighty-
danger, however, is some
It is not that the layma
around by the social eng
he will become one him*

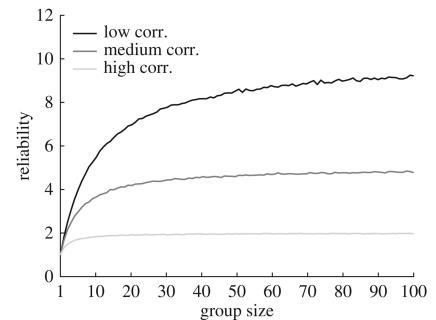
The less bright side of (group) life

- Sometimes unable (1) to avoid similar past experiences
 - birds of a feather tend to flock together
- Or (2) to acquire similar information about the world (evidence)
- Similar evidence results in *correlated information*, regardless of past experiences
 - Search engines, social media, filter bubbles, echo chambers, etc.

Note!

Similarity in priors
(past) and evidence

Similarity in *specific ability* or competence



Group members converge or adapt too much

- Another issue is that individuals may **actively adapt to each other's knowledge too strongly** through group interactions
 - ...*Hearding, conformity, etc*
- What kind of situations and/or biases might the authors be referring to?



Group members converge or adapt too much

Desire to fit in
the group: social
conformity

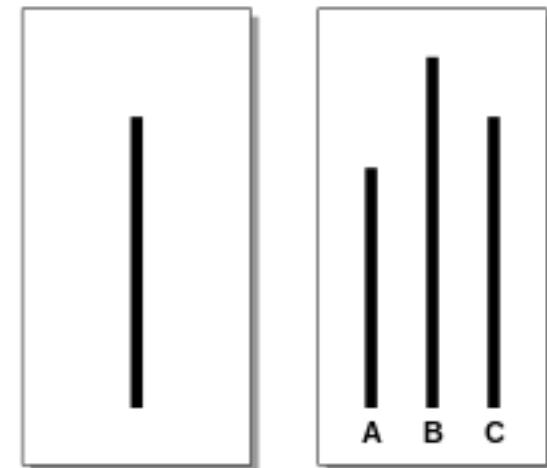


Shared information
bias (hidden profile)
and group polarization

Psychological
assumption: Believing
that others have better
knowledge →
Information cascade

Group members converge or adapt too much I

- **Conformity** (social influence):
 - Solomon Asch (1951) “Line” experiment
 - Conformed 40% of the time, despite privately knowing the answer
 - Hinders exploration/innovation, correlates information, facilitates group think



Group members converge or adapt too much II

- Believing others have better knowledge
 - Strategic copying (the most successful, the majority, etc.) can be advantageous, if used *selectively*
- Can conflict with own better evidence (instinct), but we assume that others act on good information, and follow irrationally
 - Can spread through group →
= Information Cascade
- What are some examples?



Group members converge or adapt too much III

- *Shared information bias*
 - Focusing *too much on information that is shared by all members*, overlooking essential (but minority) info
 - aka *Hidden profile effect* in the literature
- *Group polarization*
 - Taking the *initial preference held by the majority of a group*, and then *amplify* this preference beyond what individual members would have on their own, e.g. risk
- Both sensitive to time pressure, high-stake situations



Then what? Introducing diversity!

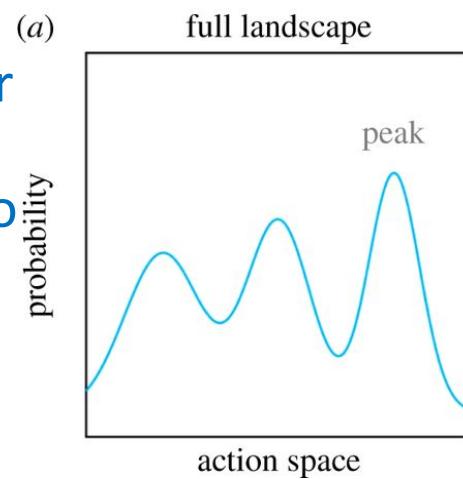
- What if we increase the diversity in groups that are interacting about decisions?
 - To avoid becoming too correlated
- (i) identity diversity and (ii) functional diversity in
 - (i) how people differ in characteristics (fx demographics)
 - (ii) how people cognitively represent and solve problems
- Helps us avoid the ‘convergence’ situations (slide 17)!
 - In theory, other ‘identities’ makes us re-consider our positions (our local peak),
 - and functional diversity makes the group explore more thoroughly the action space for other solutions

How much then?

But degree of such diversity is unclear!

Similarity in priors
(past) and evidence

Similarity in specific
ability competence



Limits of diversity



- Remember, ‘weighting by reliability’ works
 - But reliability of others, *who are different from us*, is hard
- May result in implicit shortcuts (**hidden biases**), e.g.
 - The more talkative on a topic, the more competent
 - Everything else equal, men are more competent
- **Reliability markers** reflect other factors
 - Status – readiness to take risks (see cartoon next slide)
 - Variation in personality, gender, culture can also often cause **inappropriate assessment of reliability & miscommunication**

HOW TO INFLUENCE OTHERS AND GET APPROVAL FROM YOUR GRANNY

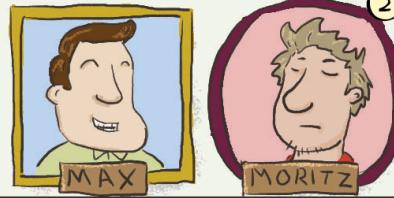
OR: REAL LIFE IMPLICATION OF BAYARRI AND DEGROOT : OPTIMAL REPORTING OF PREDICTIONS

GRANNY SMITH IS ON THE LOOKOUT FOR A NEW SMARTPHONE.

THIS OLD THING CANNOT EVEN RUN CANDY CRUSH ANYMORE.



THIS MAYBE A GOOD TIME TO CONSULT HER TWO GRANDSONS: MAX AND MORITZ.



AND THIS IS THEIR CHANCE TO MAKE A GOOD IMPRESSION - RUMOUR HAS IT THAT GRANNY IS ABOUT TO UPDATE HER WILL.



EVER SINCE MORITZ STEPPED ON GRANNY'S FLOWERBEDS IN THE AGE OF EIGHT HE CAN'T SEEM TO GET IT RIGHT. HIS WIFE IS A SNOB, AND HE IS THE WRONG KIND OF DOCTOR (PHILOSOPHY?!)



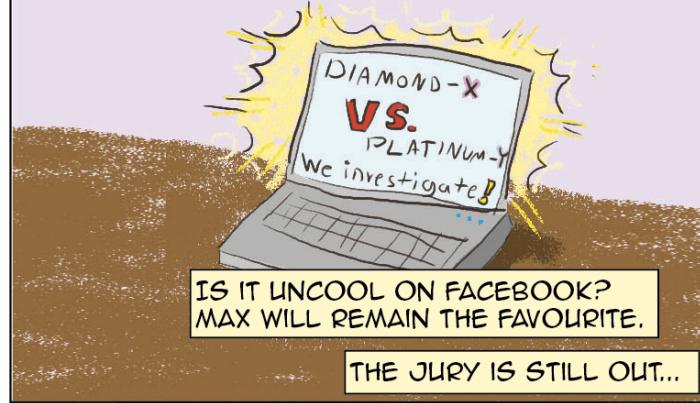
MORITZ DECIDES TO MAKE A STRONG IMPRESSION SO HE CAN BE NUMBER 1 IN HER WILL. IF SHE'S NOT IMPRESSED, THEN NEVER MIND... HE'S ALREADY AT THE BOTTOM OF HER LIST.



WELL, IT DEPENDS... SOME PEOPLE SAY THAT THE DIAMOND X-PHONE IS NOT THAT BAD, ON THE OTHER HAND...

MAX DECIDES ... WHAT IF THE DIAMOND X-PHONE IS LIKELY TO BREAK DOWN AT THE FIRST OPPORTUNITY? IT IS BETTER TO SAY SOMETHING VAGUE AND MILDLY HELPFUL, ANYTHING TO AVOID MAKING THE WRONG RECOMMENDATION.

(7) IS THE DIAMOND X-PHONE A BIG HIT? MORITZ WILL TRIUMPH.



- One may report higher confidence (strategically) when one is more ready to take risk...

Limits of diversity

- The complexity of **too diverse groups** is influential
 - perhaps one of the reasons why **we tend to feel more comfortable** in groups with similar background and cultural identity
- When increasing diversity, one should hold similarity constant (or be aware of the fact)
 - To avoid pooling inaccurate/incompetent sources
- However, **without past experience or feedback** we have seen that weighting by reliability is hard

Summing up

- Biases are the reality of our efficient cognitive system, but we can form groups of *moderate* diversity to level them out and accommodate them
 - But paying close attention to similarity in ability
- Biases can be harnessed by making them explicit through linguistic interaction,
 - Biases are more obvious to others (esp. diverse others)
 - Malleable; can be alleviated by deliberating other opinions (**local peaks**) and the reasons for our actions (sharing explicit metacognition)
- The balance between the benefits and limits of group interactions is non-trivial and *highly* relevant to society

And now for something completely different

Answering 4 general-knowledge questions

- Please find something to write with
1. First individually (no talking or cheating!)
 2. Discuss the **first 2 questions** in groups (in table rows) and give collective answers (you must **agree** and give **same** confidence)
 3. Opportunity to revise individual answers

Questions stage 1 - individual

1. What is the population size of Denmark?
2. How many calories are there in 200 grams of butter?
3. How high is the Himmelbjerg (above sea level)
4. How many people live in Aarhus?

Questions stage 2 - collective

1. What is the population size of Denmark?
2. How many calories are there in 200 grams of butter?
3. How high is the Himmelbjerg (above sea level)
4. How many people live in Aarhus?

Questions stage 3 - revise

1. What is the population size of Denmark?
2. How many calories are there in 200 grams of butter?
3. How high is the Himmelbjerg (above sea level)
4. How many people live in Aarhus?

And the right answers are...

	<i>STAGE 1</i>	<i>STAGE 2</i>	<i>STAGE 3</i>	
Real answer:	Initial average:	Group estimate:	Revised average:	
• Q1: 5,806,000	5,74	6.056.000	6,040	We expect more accuracy
• Q2: 1480 kcal	477	543	572,72	
• Q3: 147m	568	no debate	565	Here, not so much!
• Q4: 336,411	358.000	no debate	401,454	
• ? = insert the average of the whole class				

Wisdom of crowds demo

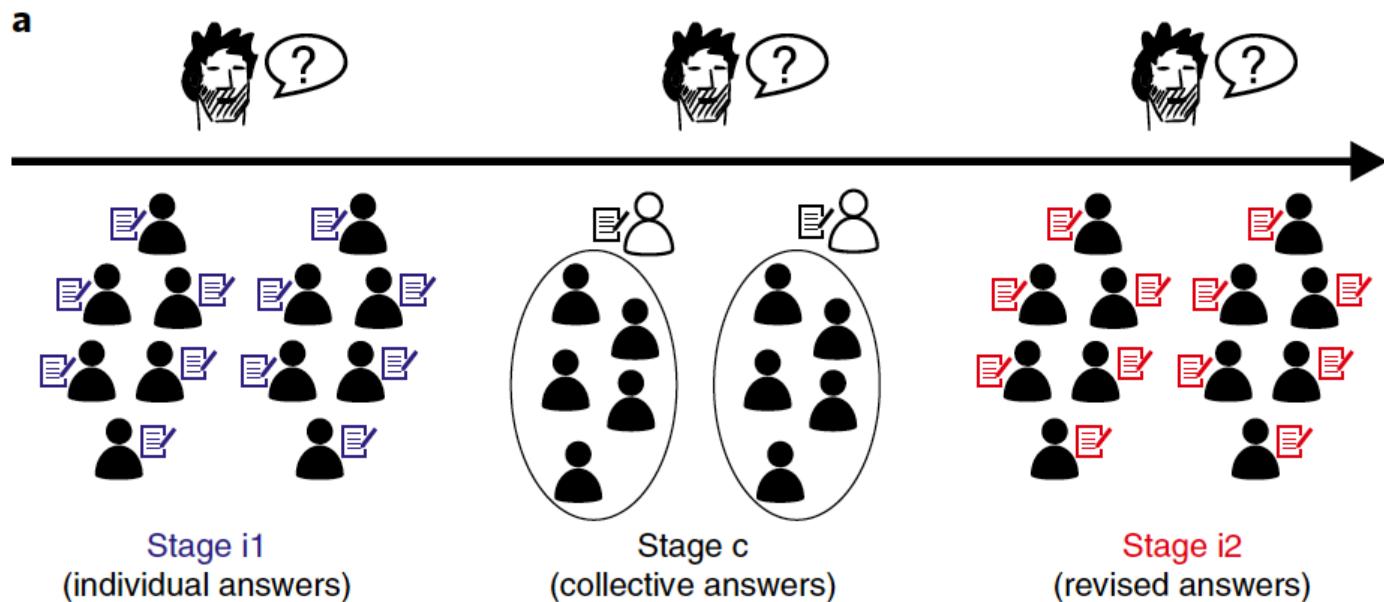
- Do you think your group, *in retrospect*, did indeed experience any group biases (SIB)? What were the markers of reliability?
- Also, did the ‘debates’ work?
 - What did you say?
 - What did you listen to?
 - Did you note any differences between answers when giving your revised estimates?

Wisdom of large crowds paper

- Rarely see *independent opinions* in large groups due to:
 - Social influence (prior talk), conformity, correlated information, etc.
- Can result in *information cascades* and *reinforcing of negative implicit biases*
- However, “social interaction” in these empirical studies is most often operationalized as *participants observing others’ actions*
 - without bidirectional linguistic interaction (discussing, deliberating)

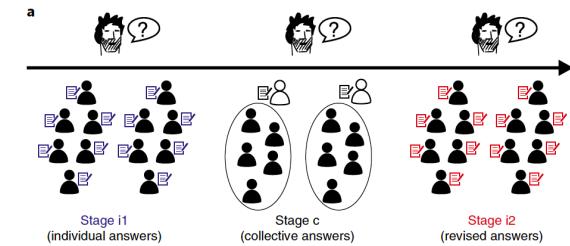
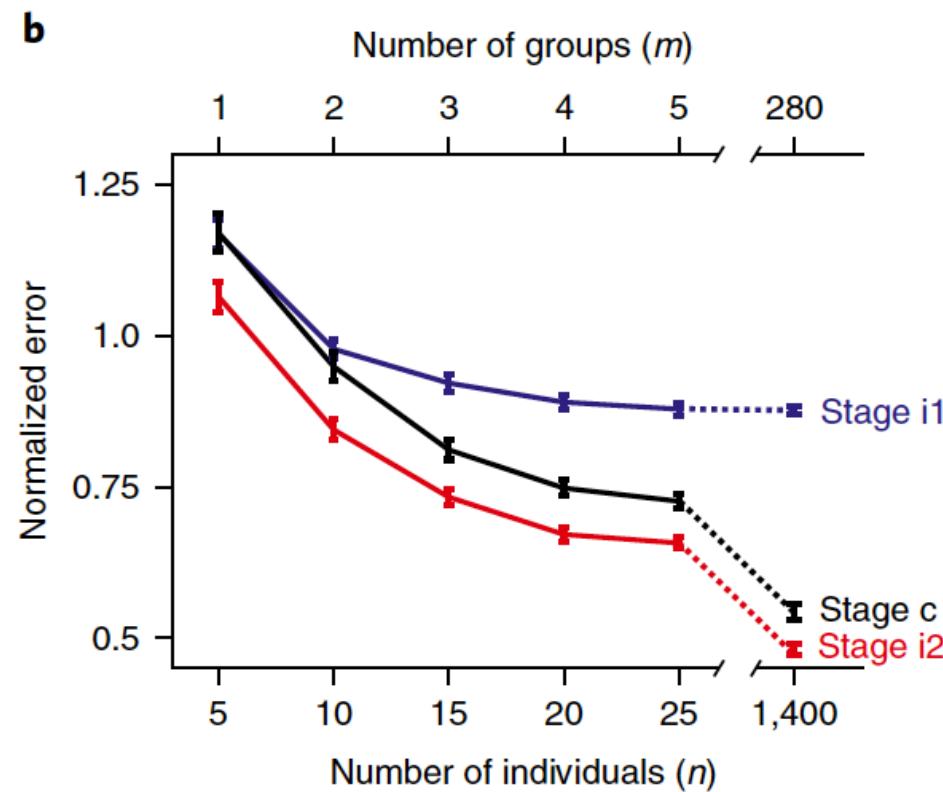
Wisdom of large crowds paper

- Should members be kept as independent as possible and aggregate their uninfluenced, individual opinions?
 - Or can crowds be any wiser if they *debated* their choices?
- Large crowd ($N = 5,180$, (2,468 female)) at TedX event



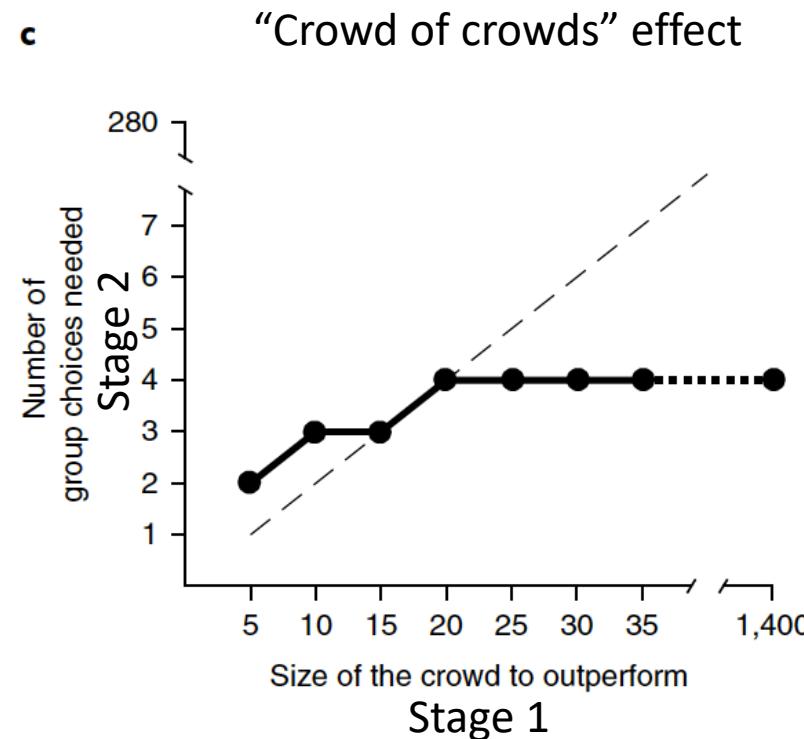
Wisdom of large crowds results I

- Averaging the initial estimates led to more accuracy
 - (shown as a significant *decrease in collective error*)



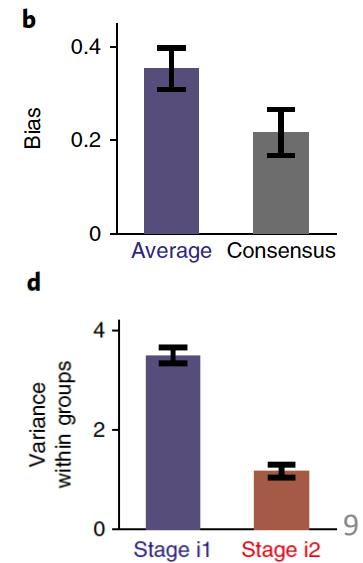
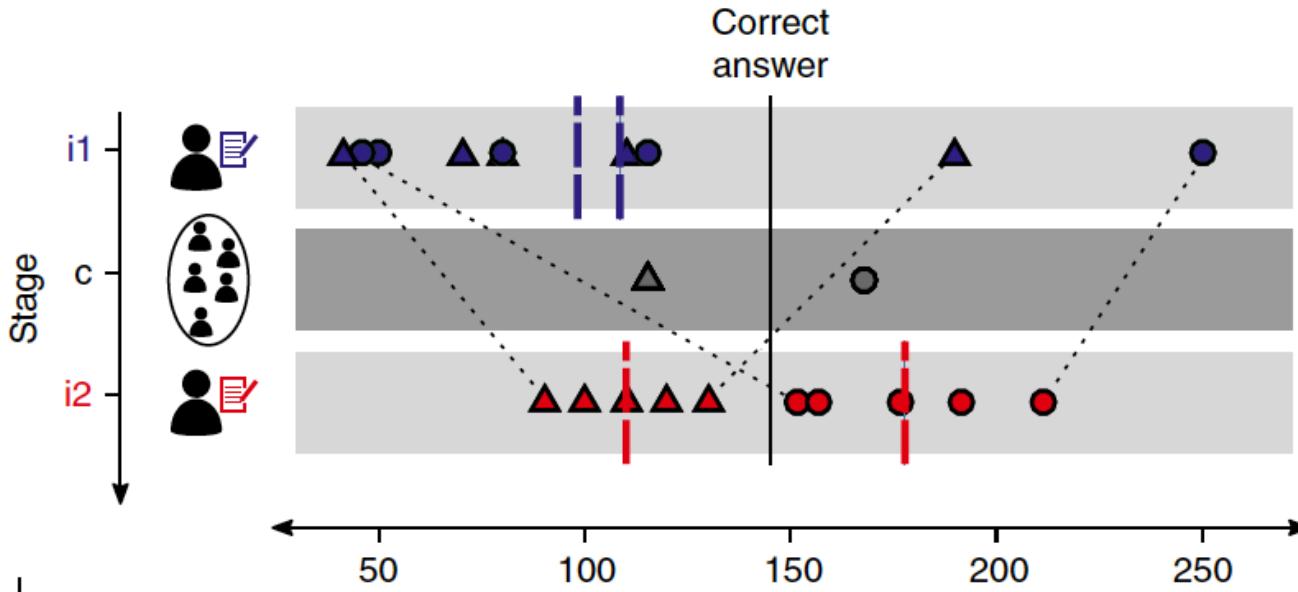
Wisdom of large crowds results II

- The thin dashed line shows the number of groups corresponding to each crowd size (5 per group).
 - When the solid line is **below the dashed line**, it indicates that averaging the group consensus outperforms averaging individuals
- Averaging **4** collective decisions leads to estimates that are **significantly more accurate** than the wisdom of crowds of any size (e.g. 1,400 initial estimates)



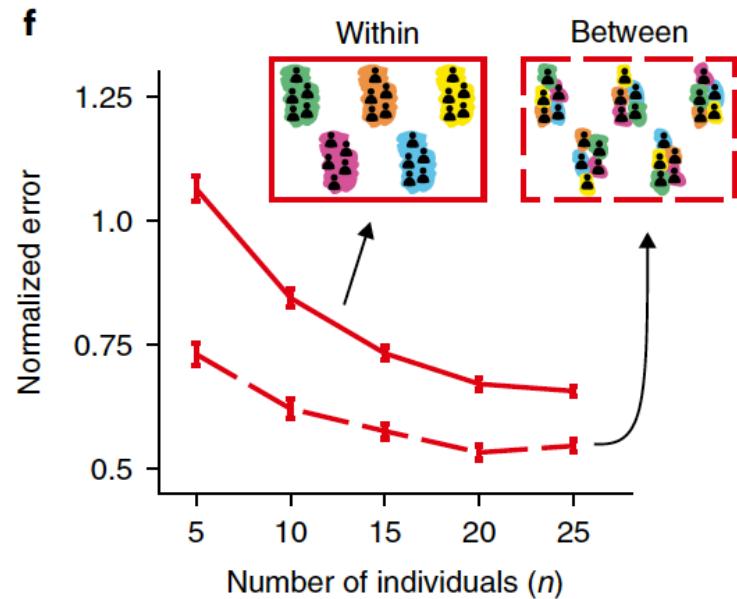
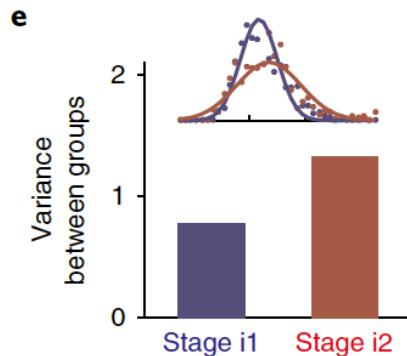
Wisdom of large crowds results

- Taken together, bidirectional social interaction brings remarkable benefits in accuracy and efficiency to the wisdom of crowds
 - How could social interaction, which is expected to instigate herding, have improved collective estimates?
 - Consensus decisions were less biased than initial, and revised responses converged: smaller variance



Wisdom of large crowds results III

- However, interaction actually increased the variance of responses **between groups** (e)
 - consensus decisions typically more extreme than the average individual choice; '*group polarization*'
- **Introducing diversity** and **breaking the local correlations**: Sampling opinions from different groups bring even larger benefits to the crowd (f)



Wisdom of large crowds results IV

- Second experiment *in the lab* ($N = 100$), and given a questionnaire about deliberation procedure(s)
- consistent with research in collaborative learning showing that 'think–pair–share' strategies and peer discussion can increase understanding

Deliberation procedure	Question 1	Question 2	Question 3	Question 4
We shared arguments and reasoned together	8.0 ± 0.2 (10)	7.5 ± 0.2 (10)	7.9 ± 0.2 (10)	7.4 ± 0.3 (8)
We followed the individuals who verbally expressed higher confidence during the debate	6.4 ± 0.3 (8)	6.0 ± 0.3 (8)	6.1 ± 0.3 (8)	6.9 ± 0.3 (10)

Groups and large crowds in sum

- Biases can be harnessed by making them explicit through linguistic interaction,
 - Biases are more obvious to (diverse) others
 - Malleable; can be alleviated by deliberating other local peaks and the reasons for our actions (sharing explicit metacognition)
 - Recalibration!
- Wisdom of crowds can be increased by simple face-to-face linguistic interaction within groups (can become less biased)
 - A way of pooling estimates without majority rules!
- Something is going on in the linguistic interactions (debates) that actually reduces variance (and bias) and converges the communicated guesses – sounds familiar?

Recap – concepts and notions

- **Interaction types, channels & models**
- Shared goal and reciprocity
- Mutual alignment
- Taxonomy of interactions
- **Group interaction and wisdom of the crowds**
- Signal averaging
- Information pooling
- Weighted majority rule
- Reliability marker
- Discussion, debate, deliberation
- Recalibration
- Groupthink
- Correlated information
- Hearing, conformity, social influence
- Shared information bias
- Group polarization
- Information cascades
- Diversity
- Wisdom of crowds of crowds
- Convergence (bias/variance)
- Between-group sampling
- Experimental design

See you next time