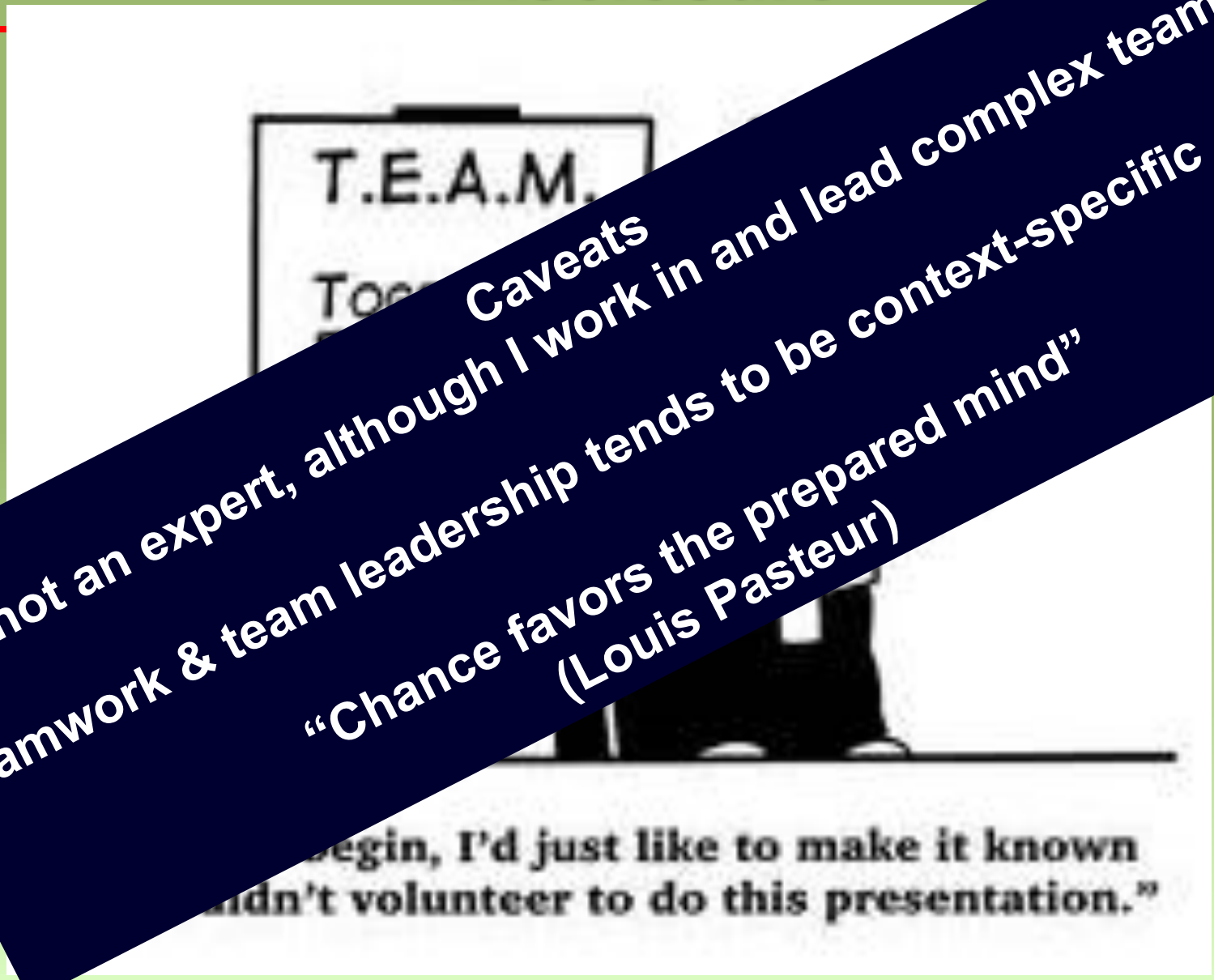
Team Science
&
The Science of Teams

Vasan Ramachandran, MD

Faculty development workshop

Dec 6th, 2011

Disclosure



Caveats

I am not an expert, although I work in and lead complex teams !

Teamwork & team leadership tends to be context-specific

"Chance favors the prepared mind"
(Louis Pasteur)

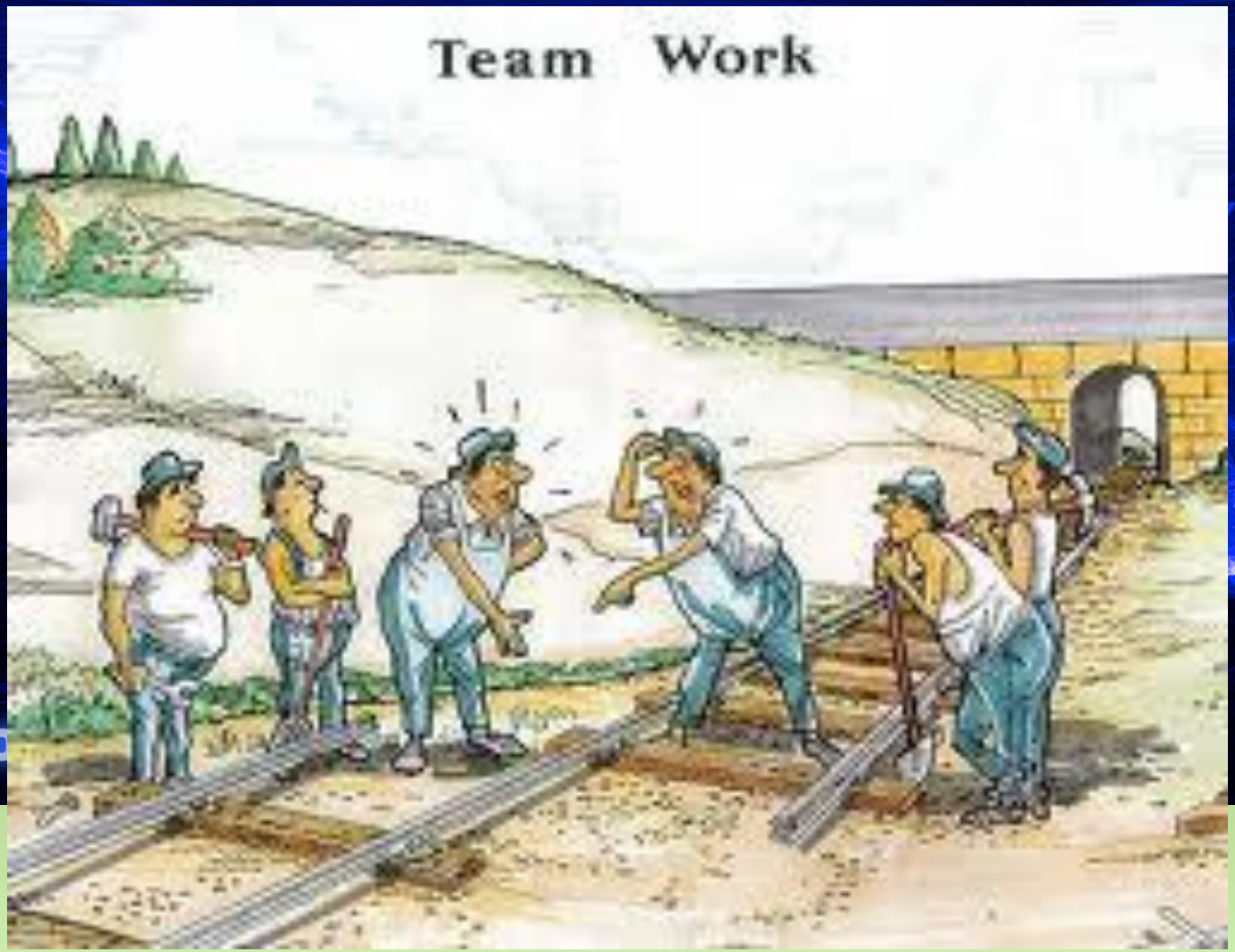
Some resources

- *Stokols et al. http://www.nordp.org/assets/resources-docs/rd-talks-ppt/science_of_team_science-overview.pdf*
- *Web sites with team building resources*
  - http://www.iamse.org/development/2007/was_103007_files/frame.htm
  - http://www.teambuildingportal.com/articles/systems
  - http://teamscience.nogginlabs.com/upload/launchcourse.php
  - http://www.cals.uidaho.edu/toolbox/workshops.htm
- Team Building, WHO 2007. available @ *www.who.int/entity/cancer/modules/Team%20building.pdf*
  - **Excellent resource for numerous weblinks and references**
- Tuckman, B.W. & Jensen, M.A.C. (1977) . Stages of small group development revisited.
- Some books.
  - Stephen Covey. The Third Alternative.
  - Peter Senge. The Fifth Discipline.
  - Deryl Leaming. Managing People.

Let's start at the very beginning..
How many of You…

- Are part of a team ?
- Do cross-disciplinary research ?
- Have a collaboration you are unhappy with?
- Have had authorship issues on papers ?

Teams !!!



Team Science

- Teams & cross-disciplinary research
- Building a team
- Challenges to collaboration
- Conflict in teams
- Summary

Team science : A few observations

- Team science is an **art & a science**
  - It can be learnt & must be practiced
- Teams are **made of people**
  - They can be only as good as their constituents
- Teams are **intrinsically dysfunctional**
  - Things that make teams succeed are the ones that threaten them too!
- Teams are a lot of **fun** & **contribute to** personal & professional **growth**
  - Team science is a **choice**: bigger is not always better

Some definitions

- Teams: two or more people working **interdependently** (collaborating) towards a **shared common goal** or task

- Team building: **process** of gathering the 'right' people & getting them to work together to accomplish a goal/task

- Team management: **directing** a group of individuals to work as a **unit** to accomplish a goal/task

Groups vs. Teams

	Groups	Teams
Members	Independent	Interdependent
Goals	Individual	Shared
Identity	Individual (me)	Shared (we)
Leadership	Often single	Shared
Products	Individual	Collective
Reward	Individual	Collective
Cohesion	None/limited	Esprit
Conflict	Reactive	Expected/proactive

We are evolutionarily programmed for team work !

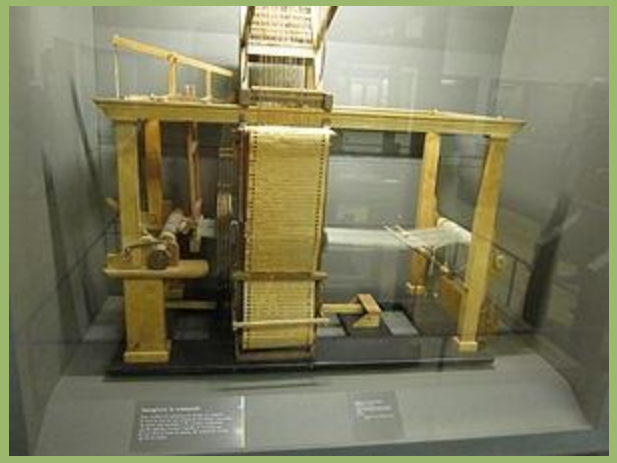
Teams seem to survive better than individuals !

Evolutionary theory of creativity

- David Campbell suggests th… ideas come in 3 steps
  - **Variation**
    - Different kind… …e
  - **Selection**
    - fil… … & focus on good ones (more …on
    - …old practices discarded & replaced by new paradigms

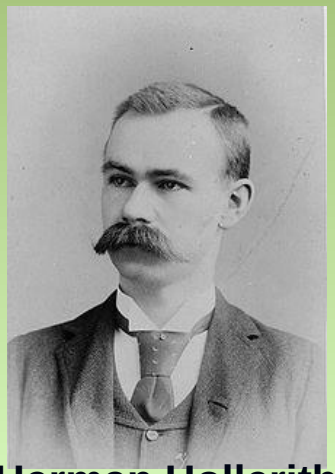
Diverse pool of ideas & multiple brains transcend individual limitations

We stand on the sholuders of giants



Basile Bouchon 1725 loom on display at the Musée des Arts et Métiers, Paris.

Hollerith card puncher used by the United States Census Bureau



Herman Hollerith
Father of IBM

Hollerith tabulating machine and sorter

Why team science ?

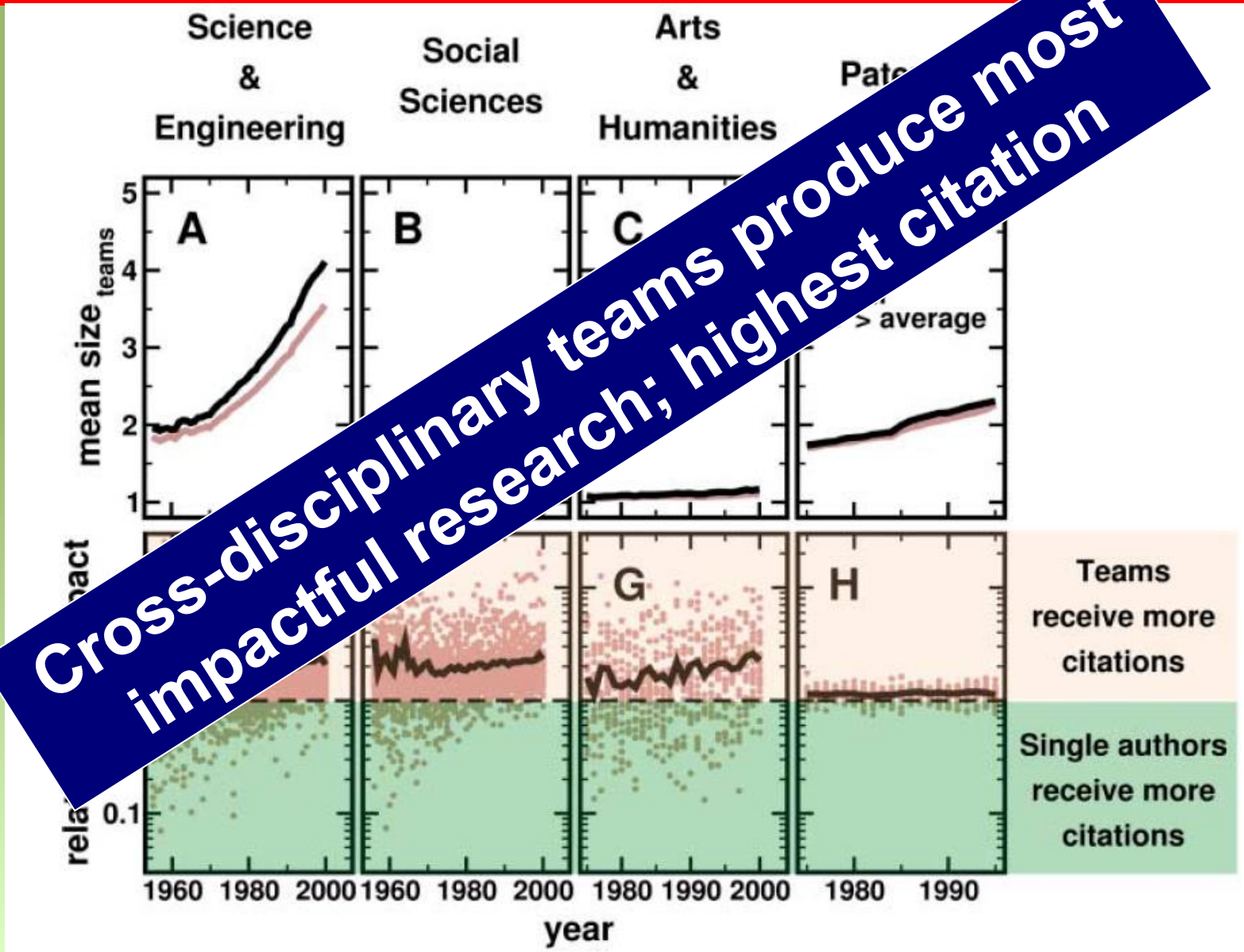
The Increasing Dominance of Teams in Production of Knowledge

Stefan Wuchty,[1]* Benjamin F. Jones,[2]* Brian Uzzi[1,2]*†

We have used 19.9 million papers over 5 decades and 2.1 million patents to demonstrate that teams increasingly dominate solo authors in the production of knowledge. Research is increasingly done in teams across nearly all fields. Teams typically produce more frequently cited research than individuals do, and this advantage has been increasing over time. Teams now also produce the exceptionally high-impact research, even where that distinction was once the domain of solo authors. These results are detailed for sciences and engineering, social sciences, arts and humanities, and patents, suggesting that the process of knowledge creation has fundamentally changed.

18 MAY 2007 VOL 316 **SCIENCE** www.sciencemag.org

Why team science ?



Cross-disciplinary teams produce most impactful research; highest citation

Growth of multi-university teams

Multi-University Research Teams: Shifting Impact, Geography, and Stratification in Science

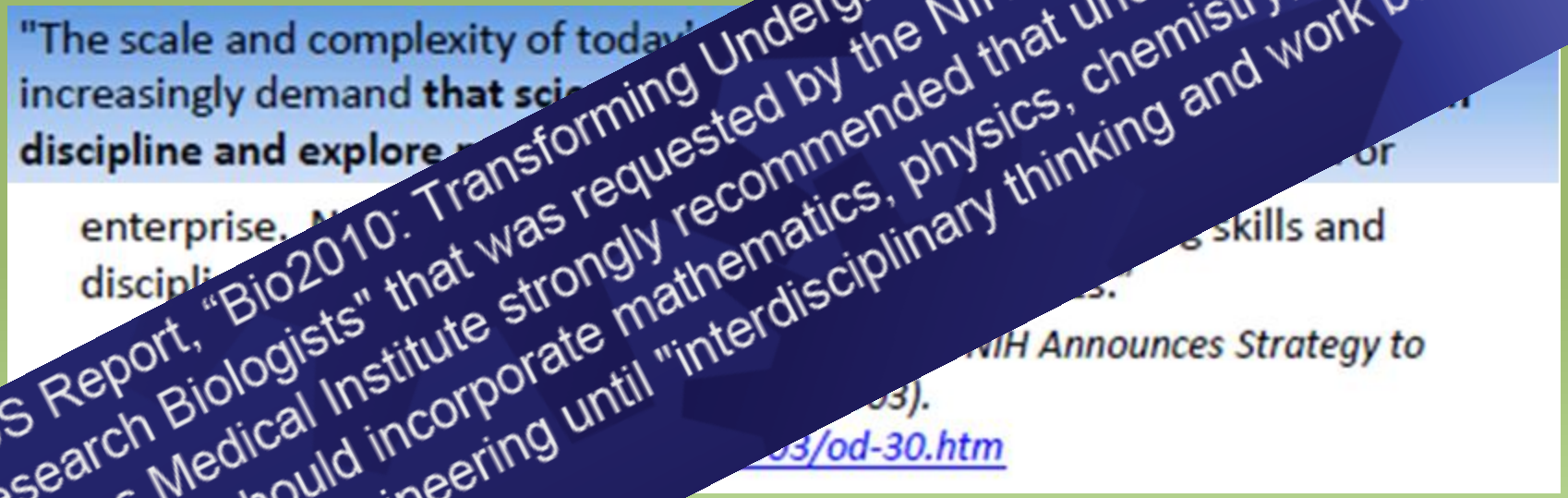
Benjamin F. Jones,[1,2]* Stefan Wuchty,[3]*† Brian Uzzi[1,3,4]*‡

www.sciencemag.org SCIENCE VOL 322 21 NOVEMBER 2008

- Fastest growing type of authorship structure
- Produce highest-impact papers when include top university
- Increasingly stratified by university rank
- **Such social stratification concentrates knowledge production in fewer centers of high impact science**

Why cross-disciplinary scien

- Your **funding** may depen


"The scale and complexity of toda
increasingly demand **that sci**
discipline and explore
enterprise.
discipli
skills and
NIH Announces Strategy to
03/od-30.htm

A US Report, "Bio2010: Transforming Undergraduate Education for Future Research Biologists" that was requested by the NIH and the Howard Hughes Medical Institute strongly recommended that undergraduate biology education should incorporate mathematics, physics, chemistry, computer science, and engineering until "interdisciplinary thinking and work become second nature."

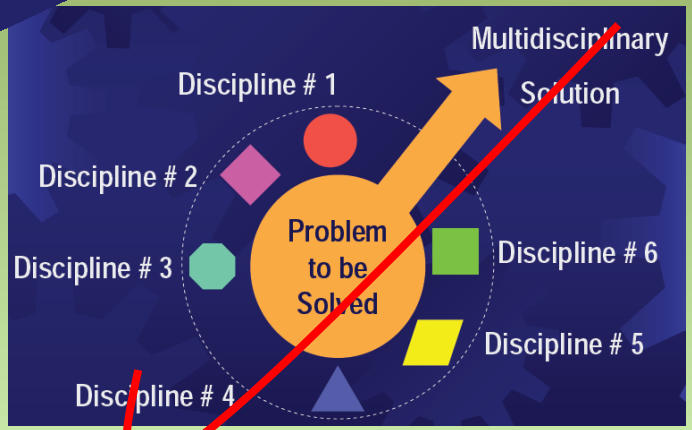
- lary science is also done by teams
- **of science today is done by teams !**

Why cross-disciplinary scie 2

Diversa

For instance the Human Genome Project, one of whose aims was to identify all the approximately 20,000-25,000 genes in
engineers.Bioinformatics, in particular, played a key role in the project.

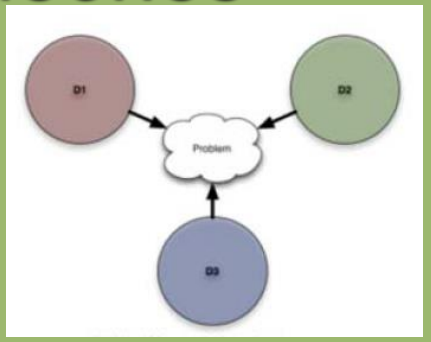
The case of HPV vaccine: initial acceptance only ~15%
Great science but missed social ecological context

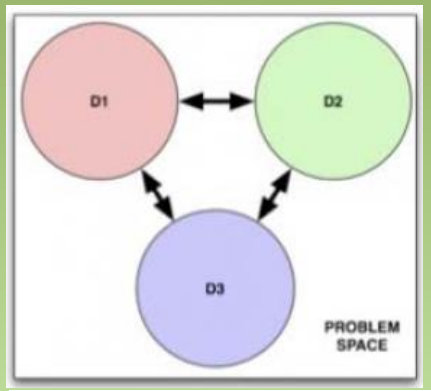


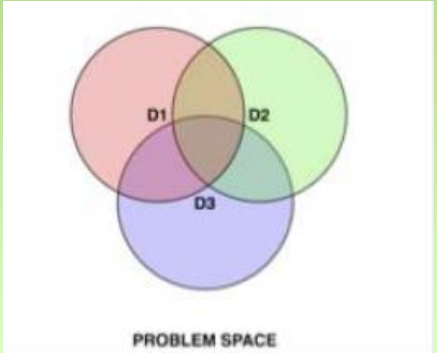
Innovation

Types of cross-disciplinary research

- Combines concepts, methods, theories
- **Multidisciplinary**
  - Independent, sequential
  - Task force
- **Interdisciplinary**
  - Joint, interactive
  - Share ideas over longer time
- **Transdisciplinary**
  - Integrative (LeDucq)
  - Shared conceptual product

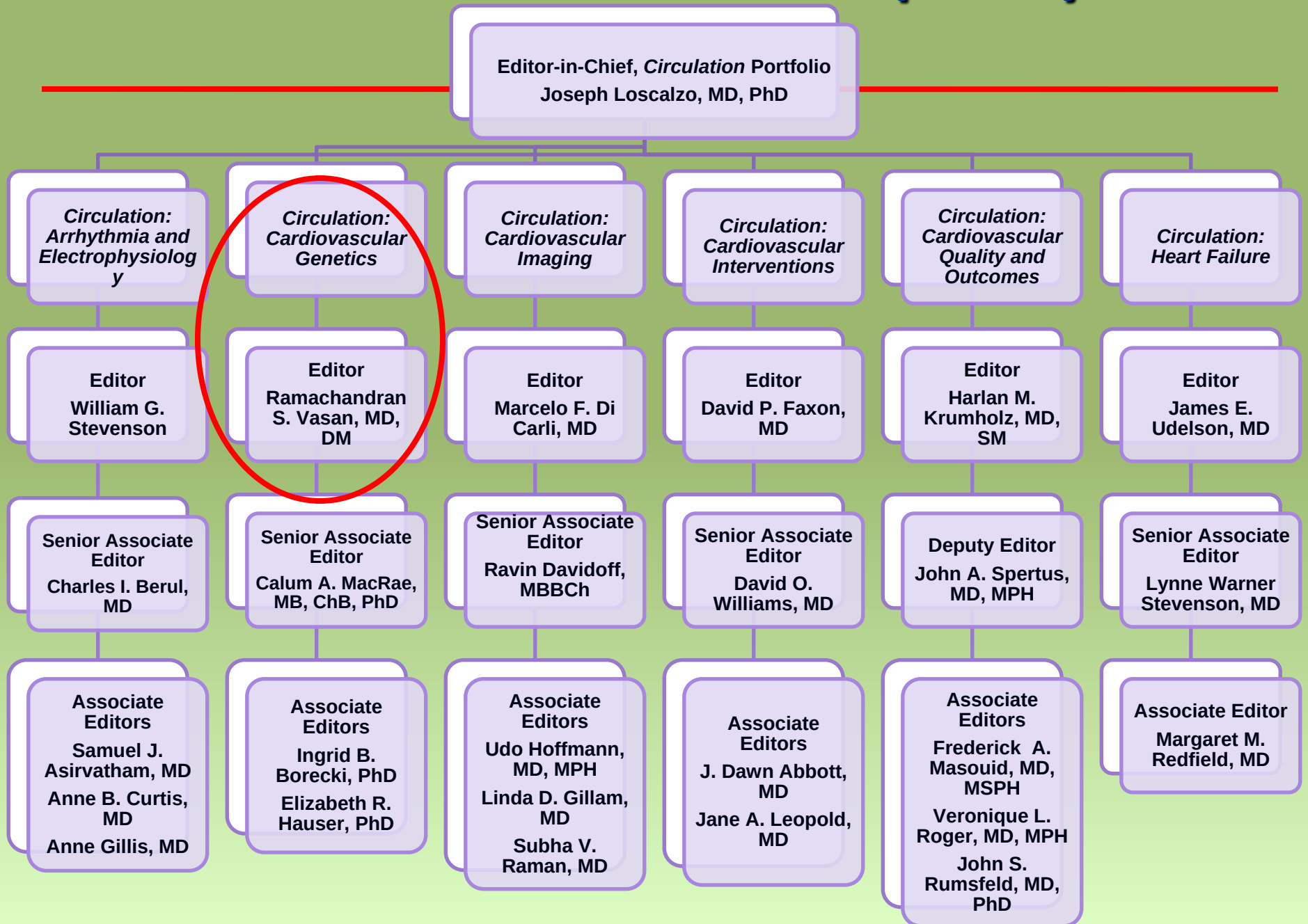




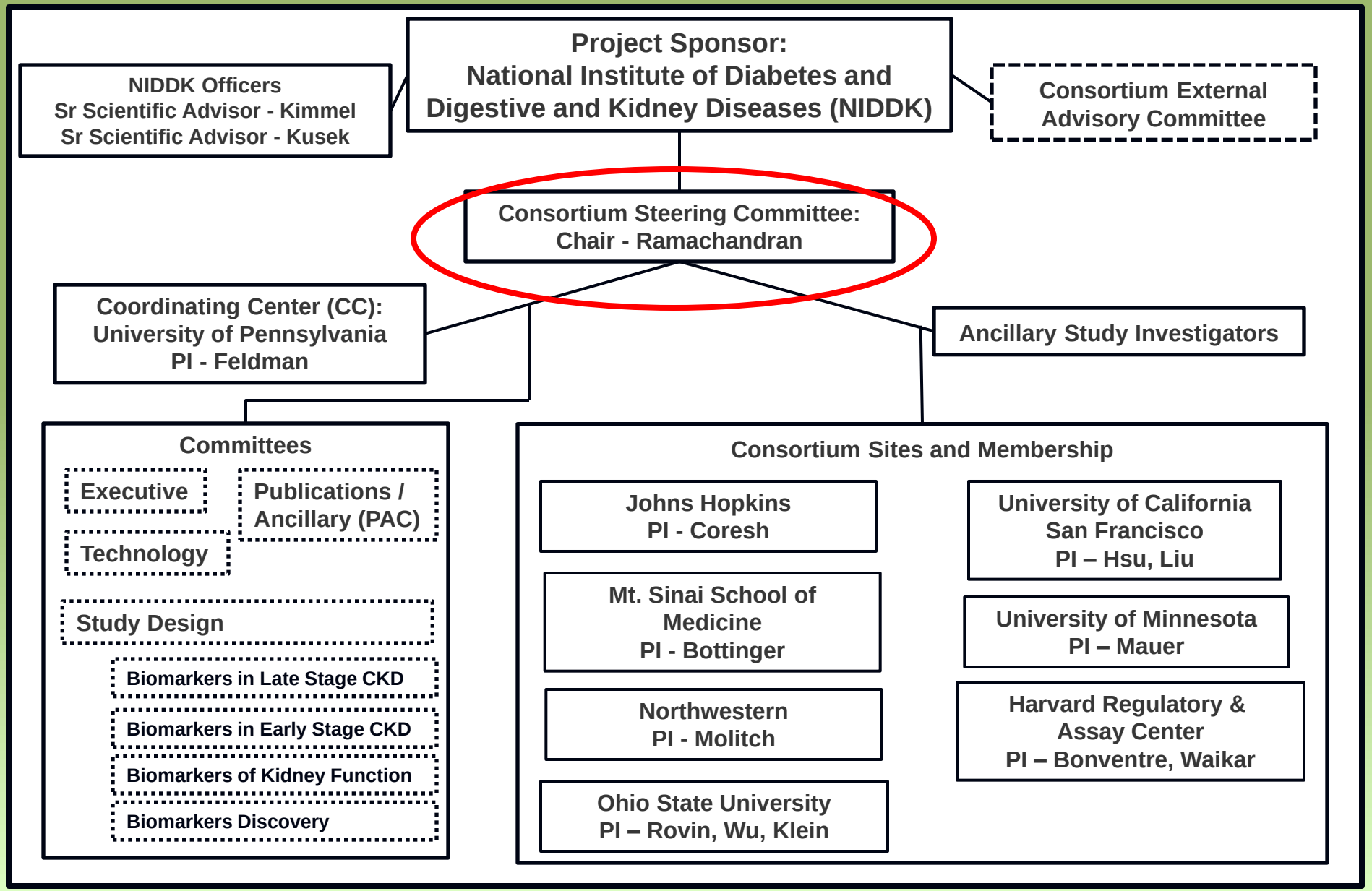


Rosenfield, P. L. (1992). Soc Sci Med, 35, 1343–1357

Circulation Journals: Multidisciplinary Team



CKD BioCon: InterDisciplinary Team



EchoSys: Transdisciplinary Team

HABC

PHS

Malmo

PROSPER

NOMAS
(Hispanics)

HyperGen

GENOA

EchoSys
(echo systems)

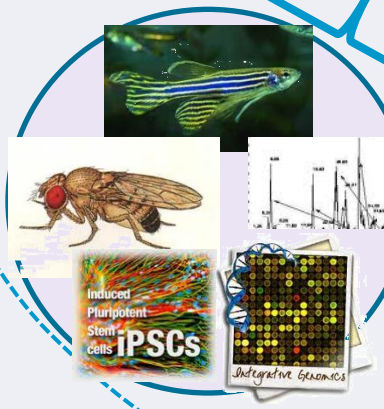
EchoGen Plus
(combined HF & Echo)

CHARGE HF
(2826 HF, 23,000 controls)

EchoGen
(N=30,000 EA)

CARE Echo
(N=7000; AA)

EchoTrans
(functional translation)



Echoinf
(informatics)

Team Science

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- **Building a team**
- Challenges to collaboration
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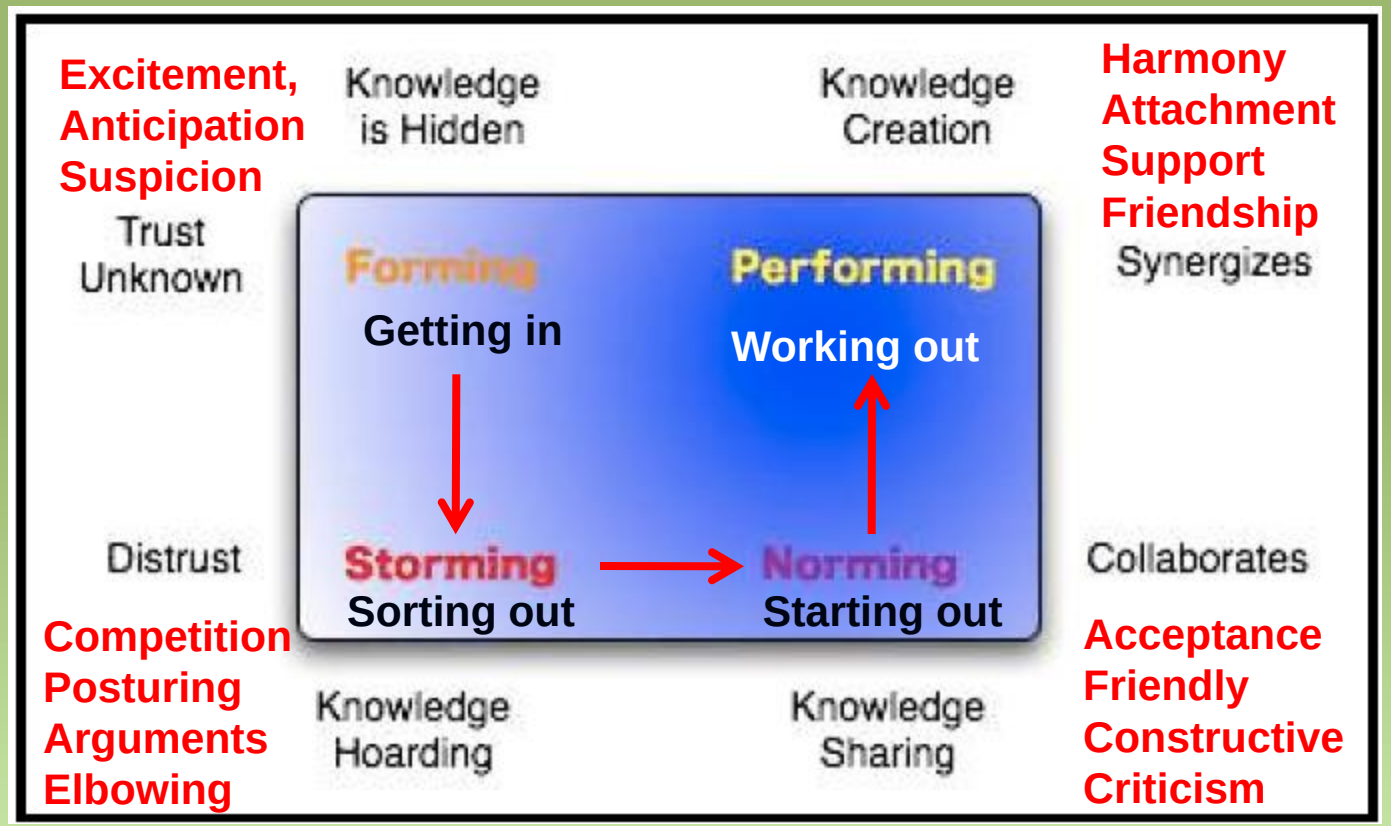
Team Building Stages
Role of Leader



Director

Member

Facilitator

Participant

Modified from: http://www.nwlink.com/~donclark/leader/leadtem2.html

A Good Team Leader

- Ca
  - S
  - T

ly

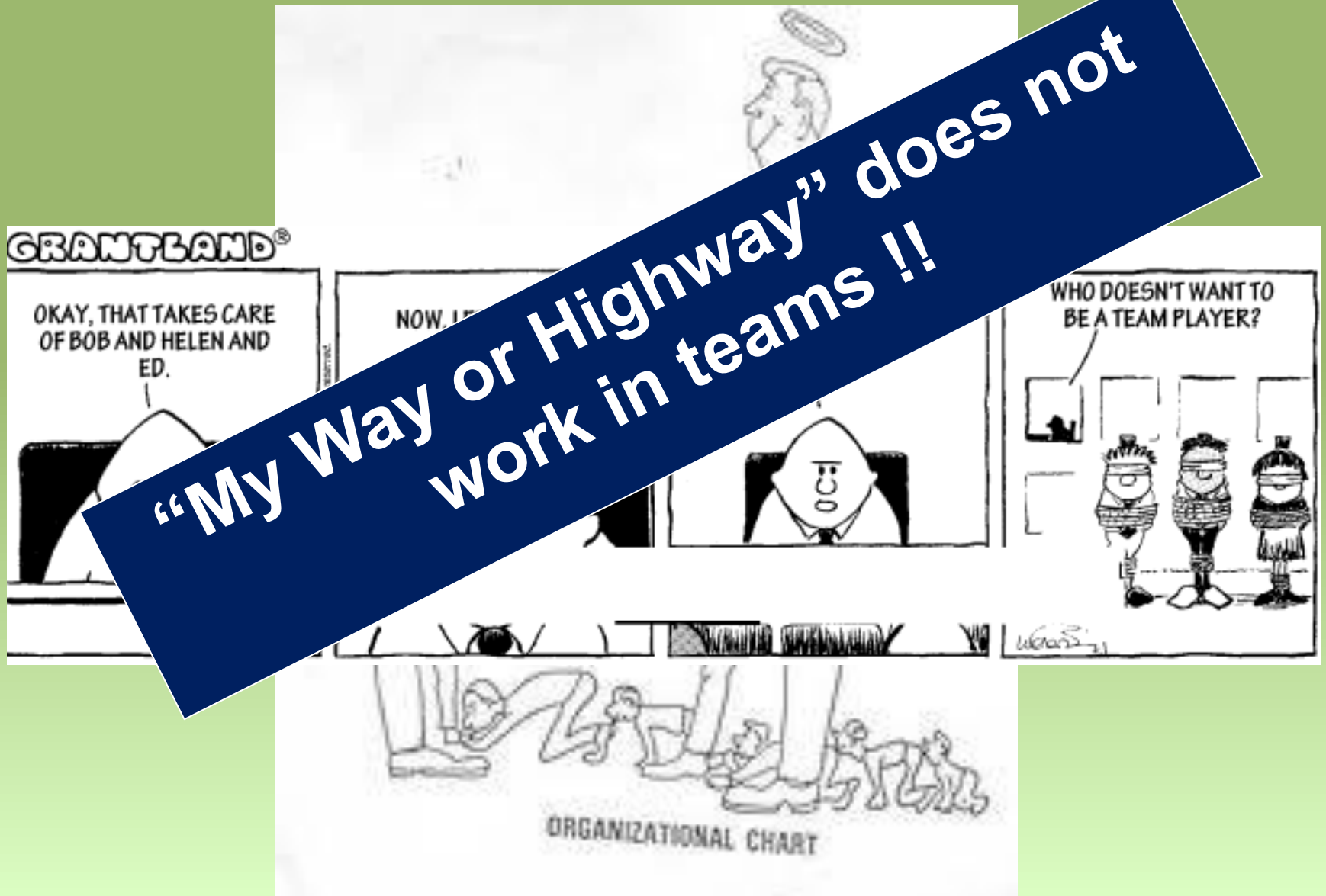
"I believe there are no bad leaders, only bad *followers*."

Task needs of the Team Leader

Cognitive	Structural	Processual
• Inspires • Motivates • Shared vision • Prioritizes • Invites members • Kicks off initial meeting	• Visible • Administrative liaison • Acquires funding • Sets timeline • Defines rules of engagement	• Defines Processes • Mediates conflict • Secures 'buy in' from stakeholders • Negotiates political maze

- Must have confidence of team
- Seen as fair, good decision maker, consultative & consensual style, non-hierarchical
- Humble, human, & role model due to experience
- **Charismatic leaders are not necessarily the best, though charisma always helps !**

A good Leader makes all the difference



"My Way or Highway" does not work in teams !!

Selecting team members

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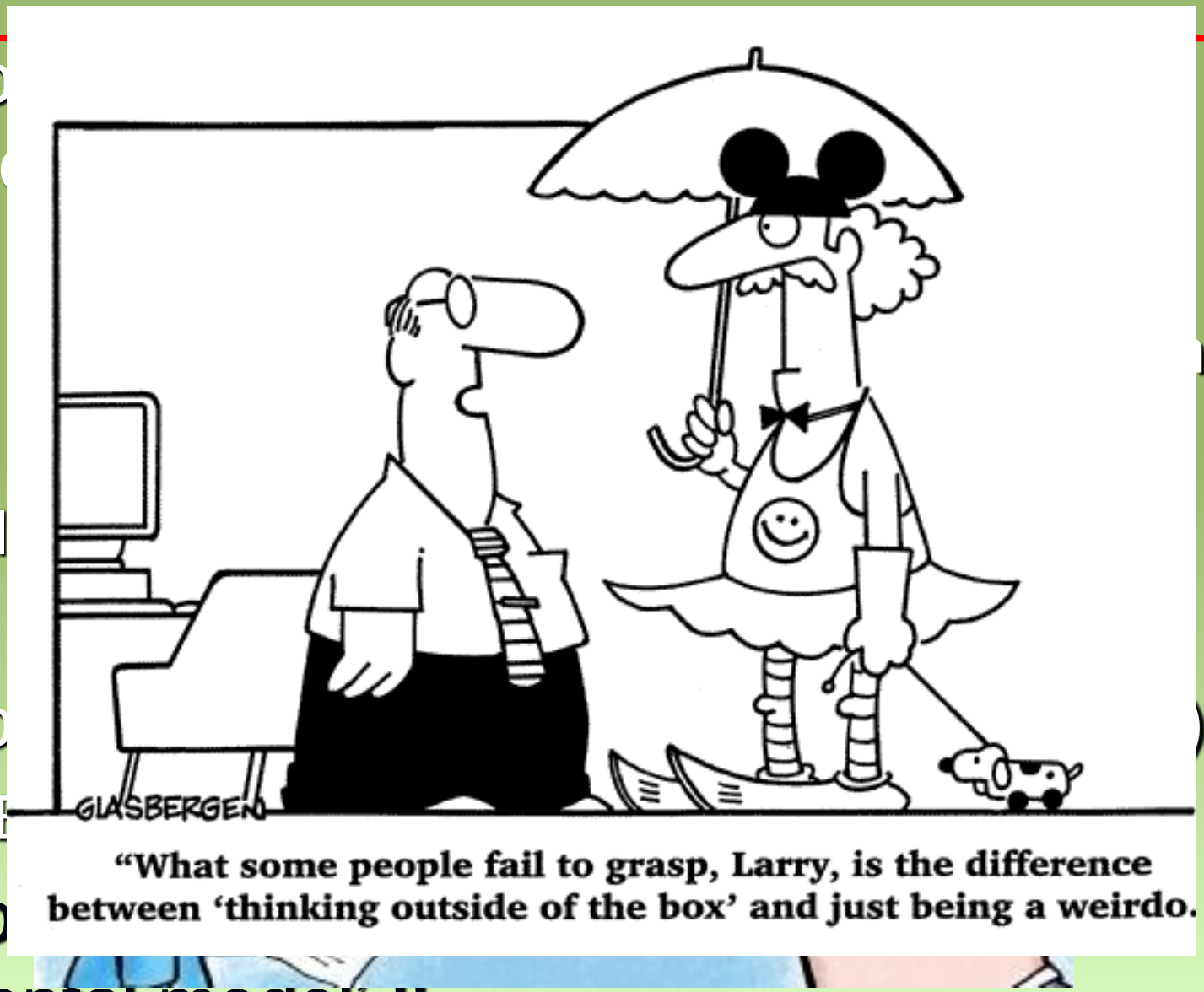
- Co mental model' !!



Selecting ‘Cohesive’ team members

- Trinity: cognition, attitude, beh

The ‘No Surprises’ Rule

Thinking		Doing
• knowledge • open-m • fairne	• usiastic • Constructive • Supportive • Cooperative	• Task completion • Coordination • F/U • Monitoring

- Conesion builds trust
- More trust→less conflict→ less bureaucracy & more FUN !

Assembling a team: Questions to ask

- Team should match research question !!!
- Skill set (but never forget the generalist)
- Research fluency
- Collaborative fluency
- Leadership experience
- Core values
- Compatibility

Team Mix

- Mix of experience & expertise
- Mix of personality traits (MBTI)
  - ‘go getter’ vs. ‘look before you leap’
  - Sprinter vs. plodder
  - Risk taker vs. cautious
- Thinking pattern (HBDI)
  - Creative vs. pragmatic
  - Dreamer vs. logical
  - Spontaneous vs. organized

Assembling a team: Correlates

- Physical proximity helps
  - 50 meters/30 yard rule
- Tendency for ‘homophily’ (‘ we tend to like people like ourselves’)
  - downside is no ‘creative friction’ essential for good team science
- Geographic proximity helps
  - Challenge of varying time zones
- **Training locally vs. searching globally**

Things to assess in teams before starting

- Collaborative readiness
- Skill set
- Experienced leadership
- Funding
- Institutional support

- Software to assess collaborativeness (**Collaboration wizard @UCI**)
- Technology to identify collaborators

Assembling creative teams

- Team performance is influenced by 3 variables:
  - Team size
  - % of newcomers in team (is a positive) !
  - Tendency of incumbents to repeat previous collaborations (is a negative) !!
- **Team assembly mechanisms determine both structure & performance of teams**

Science. 2005 April 29; 308(5722): 697–702.

Team Assembly Mechanisms Determine Collaboration Network Structure and Team Performance

Roger Guimerà[1,*], **Brian Uzzi**[2,*], **Jarrett Spiro**[3], and **Luís A. Nunes Amaral**[1,†]

Team Constitution: Network Theory

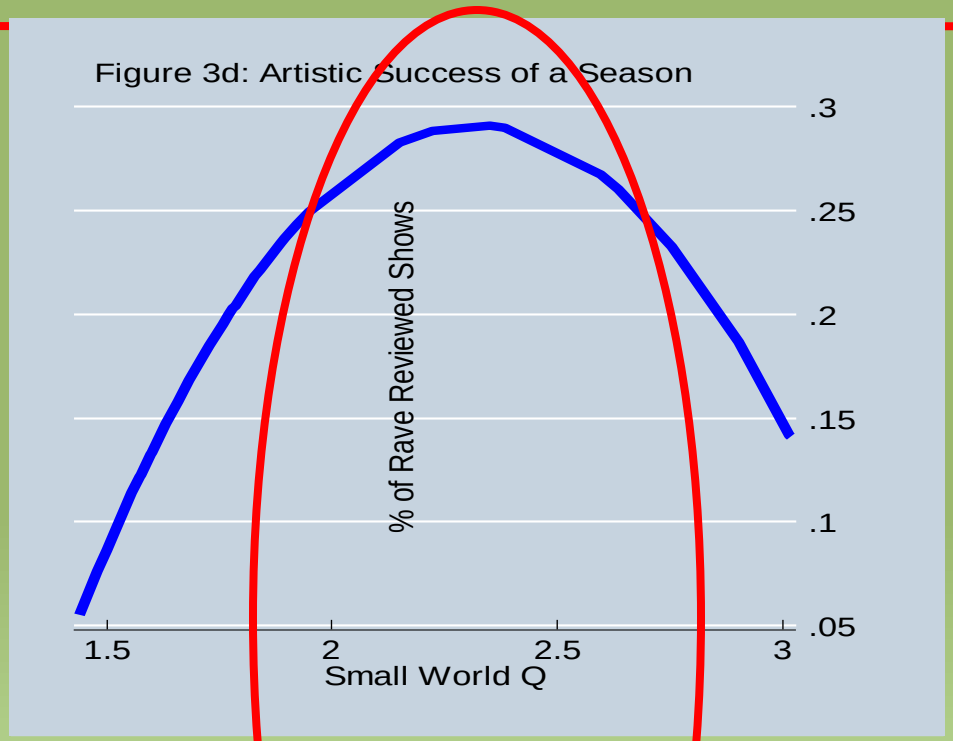
- Network typography affects artistic production
- Combinations of newcomers and incumbents most successful
- Predominance of incumbents less innovative
  - Shared experiences homogenizes pool of knowledge
- A person's network makes a substantial difference in likelihood of success
- Teams that are not too closely knit nor too pocketed seem to work best

Guimera R et al Science 2005

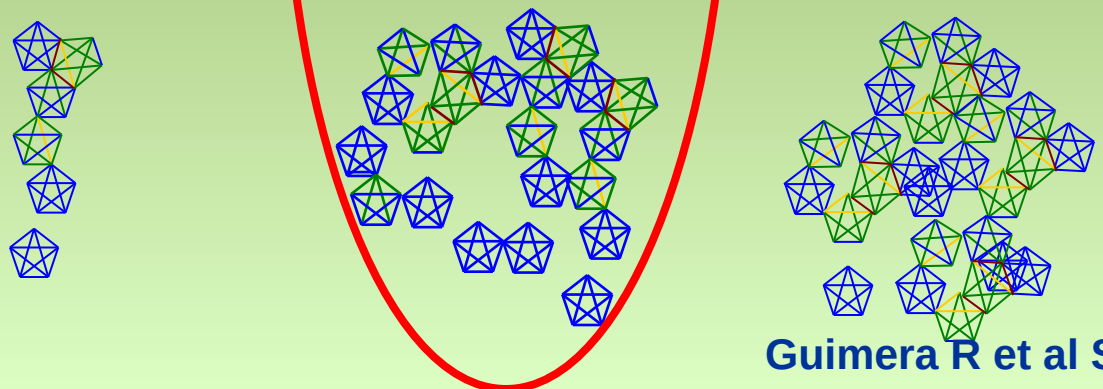
Small World Effect on Performance

Financial Success of Musicals

Artistic Success of Musicals

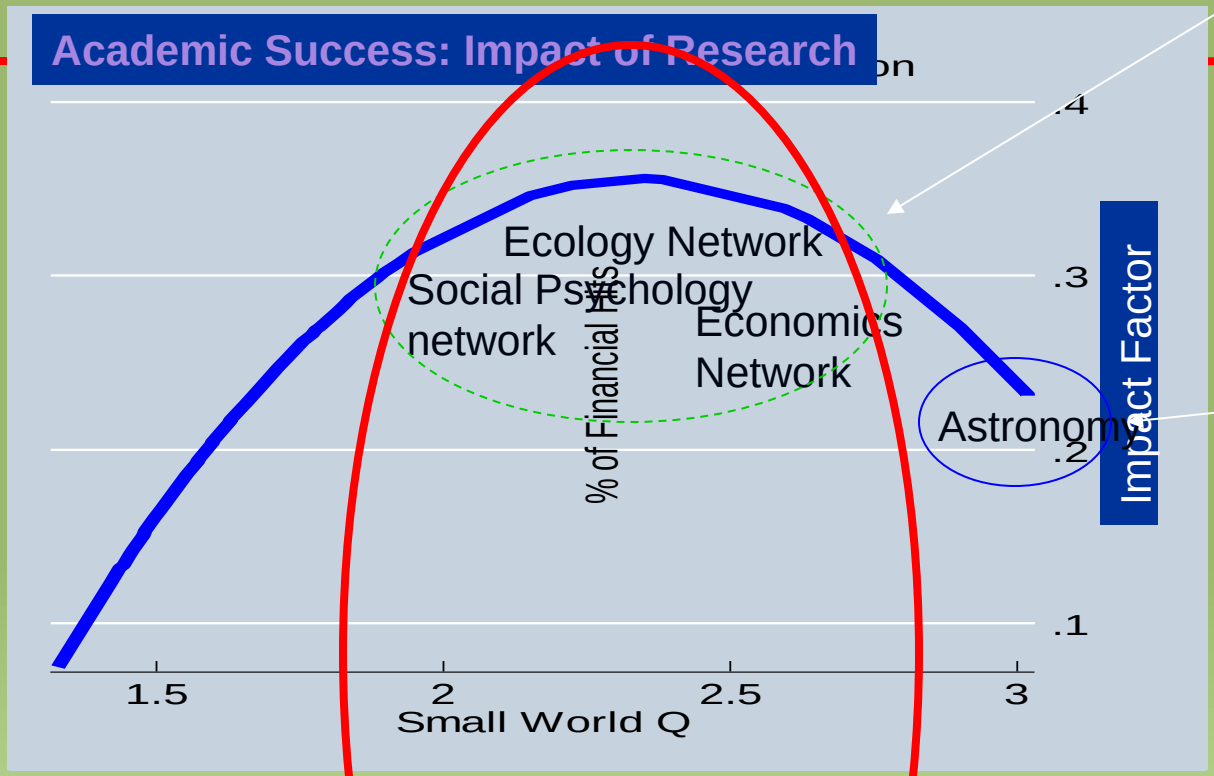


- Newcomer-Newcomer link
- Newcomer-Incumbent link
- Incumbent-Incumbent link
- Incumbent-Repeated ink



Guimera R et al Science 2005

Small World Effect on Performance



Comparably high Impact factors

Lowest impact Factor

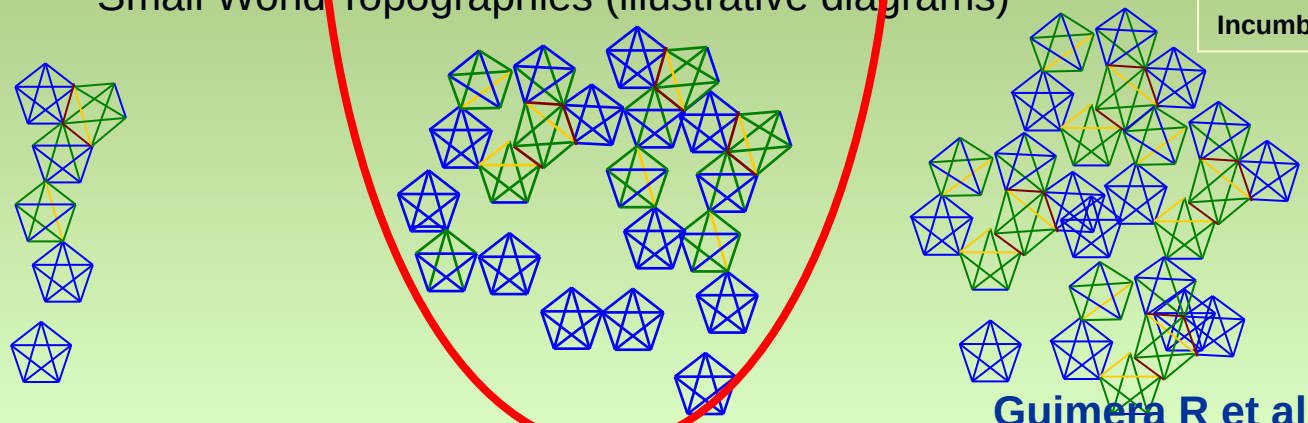
Newcomer-Newcomer link

Newcomer-Incumbent link

Incumbent-Incumbent link

Incumbent-Repeated ink

Small World Topographies (illustrative diagrams)



Guimera R et al Science 2005

Initial steps to ‘teaming’

- Establish vocabulary
- Evaluate needs of each member
- ‘Ability-task’ match up
- Define goals
- Establish process/decision-making structure
- Clarify expectations, including authorship

Don’t take out the ‘I’ in ‘We’

- ‘I’ & ‘We’ are complementary in teamwork !
- ‘I’ essential for:
  - Personal development
  - Self esteem
  - Motivation
  - Involvement & performance & quality of work
- **“I” represents belief in self & quest for accomplishment. ‘We’ represents commitment & allegiance to team effort**

Team communication

- Face-to-
- Videoco
- Telecon
- Intranet
- Internet
  - E-mail
  - Texting
  - Twitter

Why e-mail is imperfect for team science !

- Not group memory (comes from one person's outbox)
- Fragmented conversation
- Poor contextualization
- Assumes common needs same for all members
- Exclusion of people who are 'left off' the list
- **Poor support for creative processes (ranking)**
- **Huge volume of non-urgent information**

Good team meetings

- Advance notice
- Concrete agenda
- Constructive interaction
  - Meeting
  - Listening
  - Speaking
  - Dialogue & healthy debate
- Decision making
- **Action plan formulated**

Behavioral patterns in team meetings

Don'ts

- Overly critical
- Not listening
- Hogging all attention
- Talking down
- Emotional outbursts
- Interpersonal prejudice

Do's

- Be objective
  - Unbiased judgment
- Be tactful & respectful
  - 'Do unto others'…
- Interactive
  - 2-way street
- Appreciate diversity
  - **heterophily**

Sustaining team engagement

- Recognition
  - Acknowledge collaborators always (headshots in slides)
  - Give students a chance to present
  - Recognize good effort independent of outcome
- **A 'successful' project that leads to an unhappy team in not an overall success!**
- Even if project is scientifically unsuccessful, the team may be successful !!
- **Beware of boomerang effects when attempting to change behavior**

- R
- T
- S
- R

" Keep up with us, Rafferty . . we're not talking about passing the budget, we're talking about passing the BUCK. "

TEAMWORK... means never having to take all the blame yourself.

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Paradox of promotion standards in an era of collaborations

Traditional	Collab
Independent work	Int work
No. of publications	ontributions
PI status	ibutions to multi-investigator work
First auth	Mission critical work
Peer	ing Leadership in teams

We face the paradox where we know collaboration is critical but we reward individual efforts (e.g., Nobel prize)

al universities have changed their omotions standards to accommodate contemporary needs for recognizing & rewarding collaborations

Big Dog … vestigators … s… …tions

- Colla… …scientists
  - they… …sks
- Junio… …alue' tensio…
  - Avo… …rewards can…
  - Be…
  - Me…

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Academic Conflict & Sayre's Law

- On 20 December 1973, the *Wall Street Journal* quoted Sayre as: **"Academic politics is the most vicious and bitter form of politics, because the stakes are so low."**

Sayre's law : "In any dispute the intensity of feeling is inversely proportional to the value of the issues at stake."
By way of corollary, it adds: "That is why academic politics are so bitter."
Wallace Stanley Sayre (1905-1972), U.S. political scientist & professor at Columbia University.

Kinds of conflicts in teams

- Task-related
  - How best to do something
  - Is actually good !
- Relationship-related
  - Related to power (PI-ship; authorship)
  - Tone of voice or style
  - **Non-sharing of information**

Authorship conflicts

- Best avoided by being proactive
- Decide authorship early on in the project
- Negotiate but be aware of multiple perspectives; **ICJME criteria are rough guide**
- Remember work proportions shift during project
- There are more projects with same team
- Clear communication on this issue is key
  - **Fair, open, transparent, flexible**

Authorship conflicts

"Fifty-seven authors, and neither one of us was included."

Authorship conflicts

- Best addressed face-to-face (no e-mail)
- Neutral venue best, if possible
- Prepare for this ‘difficult conversation’
  - Initially may be uncomfortable
- Be flexible
- If face-to-face does not resolve, seek conflict mediation
- Talk to another mentor you trust
- **Ombudsperson as a last resort**

Misattribution biases in authorship conflicts

- Self-serving (ego-centric) bias
  - motivated to see ourselves in a positive light
  - Overestimate contributions to success & underestimate role in failures
- Availability heuristic
  - Our attribution appears more obvious than others
  - Not easy to take into consideration other perspectives & anchor them in one's own estimation metric

Mentor-mentee conflicts

- Exce
- Not
- Com

The Matthew Effect in Science

In papers coauthored by men of decidedly unequal reputation, another laureate in physics reports, "the man who's best known gets more credit, an inordinate amount of credit." In the words of a laureate in chemistry: "When people see my name on a paper, they are apt to remember *it* and not to remember the other names." And a

Science, 159(3810): 56-63, January 5, 1968

For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath.

Collaboration challenges: some scenarios

- You do most of the work, senior author wants credit: in publications, in press, in national committees
- Who will lead the follow-up work after initial ‘home run’?
- Who will be the PI on next grant ?
- Project with ‘Core’ group & ‘ancillary group’ !

Collaboration challenges: some scenarios

- Coinvestigator starts leaving you off e-mails & does not share data ?
- Your collaborator promises, but does not deliver
- Different groups disagree on who should be the first / last author on a manuscript: Group 1: phenotypers; group B: genotypers & PI.

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Secrets to 'winning' teams

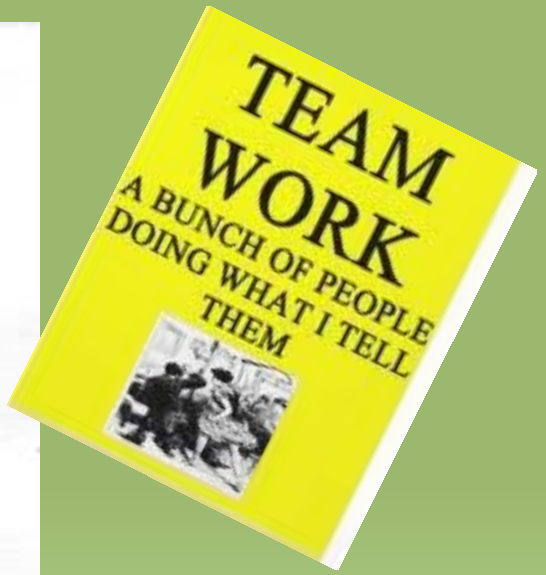
- Mission clarity and faith (overall)
  - Shared mental model
- Goal clarity (project-specific)
  - What and by when
- Appropriate mix of skill sets to address question at hand, including good leadership
- Role clarity
  - Identification & matching
  - Who does 'what, when, how, why'
- **Good communication**

Secrets to 'winning' teams

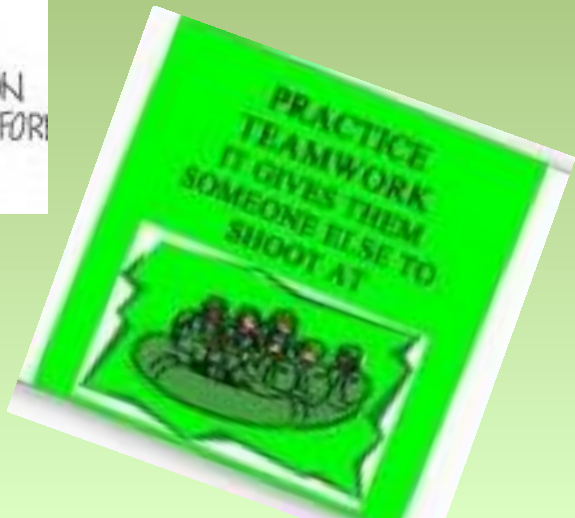
- Cohesion & knowledge sharing
- Process clarity (ground rules)
- Performance metrics clear
  - Recognition & reward
  - Feedback mechanisms
- Conflict averting and resolution
- Appraisal/evaluation mechanism
- Ongoing team building activities
- Funding, resources, institutional support

Thank you !


SALES
"IT'S PLACE-THE-BLAME DAY. WE'LL START ON MY LEFT AND IT'D BETTER STOP SOMEPLACE BEFOR IT COMES AROUND TO ME!"


TEAM WORK
A BUNCH OF PEOPLE DOING WHAT I TELL THEM


PRIDE
COMMITMENT
TEAMWORK
WORDS WE USE IN ORDER TO GET YOU TO WORK FOR FREE


PRACTICE TEAMWORK IT GIVES THEM SOMEONE ELSE TO SHOOT AT