Team Science & The Science of Teams

Vasan Ramachandran, MD
Faculty development workshop
Dec 6th, 2011
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://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


- **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?
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

<table>
<thead>
<tr>
<th></th>
<th>Groups</th>
<th>Teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Members</td>
<td>Independent</td>
<td>Interdependent</td>
</tr>
<tr>
<td>Goals</td>
<td>Individual</td>
<td>Shared</td>
</tr>
<tr>
<td>Identity</td>
<td>Individual (me)</td>
<td>Shared (we)</td>
</tr>
<tr>
<td>Leadership</td>
<td>Often single</td>
<td>Shared</td>
</tr>
<tr>
<td>Products</td>
<td>Individual</td>
<td>Collective</td>
</tr>
<tr>
<td>Reward</td>
<td>Individual</td>
<td>Collective</td>
</tr>
<tr>
<td>Cohesion</td>
<td>None/limited</td>
<td>Esprit</td>
</tr>
<tr>
<td>Conflict</td>
<td>Reactive</td>
<td>Expected/proactive</td>
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</tbody>
</table>
We are evolutionarily programmed for team work!

Teams seem to survive better than individuals!
Evolutionary theory of creativity

- David Campbell suggests that ideas come in 3 steps:
  - **Variation**
    - Different kinds of change
  - **Selection**
    - Filter & focus on good ones (more emphasis on)
  - Old practices discarded & replaced by new paradigms
Why team science?

The Increasing Dominance of Teams in Production of Knowledge

Stefan Wuchty,1* Benjamin F. Jones,2* Brian Uzzi1,2*†

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
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, Stefan Wuchty, Brian Uzzi

- 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 science?

- Your funding may depend on it.

"The scale and complexity of today's research increasingly demand that science be done as a cross-discipline and explore new enterprise. NIH Announces Strategy to Encourage Innovation and Support the Next Generation of Scientists. NIH BIO2010: Transforming Undergraduate Education for Future Research Biologists." (NIH BIO2010)

- Scientific inquiry is also done by teams.

- Some of science today is done by teams!
The case of HPV vaccine: initial acceptance only ~15%. Great science but missed social ecological context.
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

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Getting in

Sorting out

Starting out

Working out

Director

Facilitator

Participant

Member

Excitement,
Anticipation
Suspicion

Knowledge
is Hidden

Knowledge
Creation

Harmony
Attachment
Support
Synergizes

Trust
Unknown

Distrust

Competition
Posturing
Arguments
Elbowing

Acceptance
Friendly
Constructive
Criticism

Forming

Getting in

Storming

Sorting out

Performing

Working out

Norming

Starting out

Facilitator

Participant

Modified from: http://www.nwlink.com/~donclark/leader/leadtem2.html
A Good Team Leader

- Caters to 2 kinds of needs:
  - Socio-emotional needs
    - Cognitive appraisal of emotional information
    - Understands feelings, responds appropriately
    - Social adeptness
  - Task needs
    - Cognitive
    - Structural
    - Processual
Task needs of the Team Leader

Cognitive
- Inspires
- Motivates
- Shared vision
- Prioritizes
- Invites members
- Kicks off initial meeting

Structural
- Visible
- Administrative liaison
- Acquires funding
- Sets timeline
- Defines rules of engagement

Processual
- 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!
Selecting team members

- Complementarity of skills: differentiation & specialization
  - technical
  - executive: problem solving; decision making
  - interpersonal
  - Internationalization & commercialization

- Cohesion (shared mental model & work)
  - Breeds respect and trust

- Complementarity conflicts with ‘shared mental model’!!
Selecting ‘Cohesive’ team members

- Trinity: cognition, attitude, behavior
  - knowledge sharing
  - openness
  - fairness

- Enthusiastic
- 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 Guimerà1,*, Brian Uzzi2,*, Jarrett Spiro3, and Luís A. Nunes Amaral1,†
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
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-face always best, when possible
- Videoconferencing (visual cues)
- Teleconferencing (audio)
- 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

<table>
<thead>
<tr>
<th>Don’ts</th>
<th>Do’s</th>
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<tbody>
<tr>
<td>Overly critical</td>
<td>Be objective</td>
</tr>
<tr>
<td>Not listening</td>
<td>Unbiased judgment</td>
</tr>
<tr>
<td>Hogging all attention</td>
<td>Be tactful &amp; respectful</td>
</tr>
<tr>
<td>Talking down</td>
<td>‘Do unto others’…</td>
</tr>
<tr>
<td>Emotional outbursts</td>
<td>Interactive</td>
</tr>
<tr>
<td>Interpersonal prejudice</td>
<td>2-way street</td>
</tr>
<tr>
<td></td>
<td>Appreciate diversity</td>
</tr>
<tr>
<td></td>
<td>heterophily</td>
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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
Periodic team engagement

- Retreats
- Team-wide attendance at conferences
- Social team activities
- Regular meetings to discuss milestones
Team Science

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Paradox of promotion standards in an era of collaborations

<table>
<thead>
<tr>
<th>Traditional</th>
<th>Collaborative</th>
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</thead>
<tbody>
<tr>
<td>Independent work</td>
<td>Interdependent work</td>
</tr>
<tr>
<td>No. of publications</td>
<td>Scientific contributions</td>
</tr>
<tr>
<td>PI status</td>
<td>Contributions to multi-investigator work</td>
</tr>
<tr>
<td>First author</td>
<td>Mission critical work</td>
</tr>
<tr>
<td>Peer reviewed funding</td>
<td>Leadership in teams</td>
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Several universities have changed their promotions standards to accommodate contemporary needs for recognizing & rewarding collaborations.

We face the paradox where we know collaboration is critical but we reward individual efforts (e.g., Nobel prize).
Big Dog-Small Dog: how junior investigators should approach collaborations

- Collaborations easier for senior scientists
  - they are not evaluated: can take risks
- Junior scientists have the ‘time-value’ tension
  - Avoid major responsibilities unless rewards can be clearly negotiated
  - Be aware of promotions criteria
  - Mentor must advocate
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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

- Position, addition, deletion
- Disagreements are natural part of collaboration; how you navigate disputes makes a difference
- Upward management for seniors
- Downward management for juniors
- Best addressed early
  - Don’t let the sun set on disputes
  - But don’t speak when emotionally charged
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

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