05: **Mentorship and teamwork; the advisor-student relationship**

February 10, 2012

Announcements

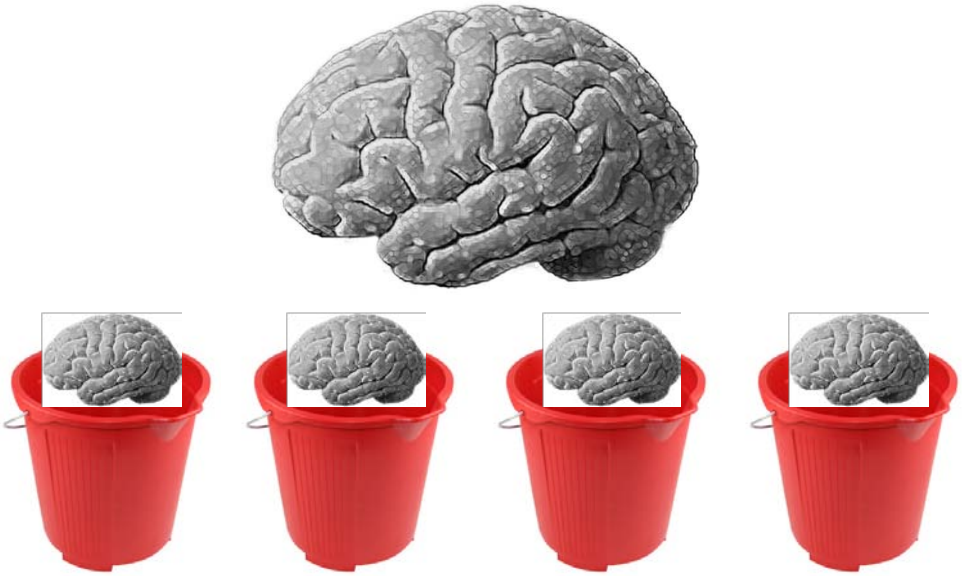
- Please do the midterm teaching evaluation online (open from Feb 8-14).
- I'll have comments on your lit surveys by Monday night.

Last week

- Defining a research question
- Time management
  - principles
  - tools
  - methods

"You'll be better equipped to undertake higher-focused thinking when the underlying tools and techniques [for "getting things done"] are part of your ongoing operational style"

-David Allen



"It's a waste of time and energy to keep thinking about something that you make no progress on"

-David Allen

Break a big problem into smaller ones

- http://www.youtube.com/watch?v=oZBzIJF6pNg

Have a flexible path in mind

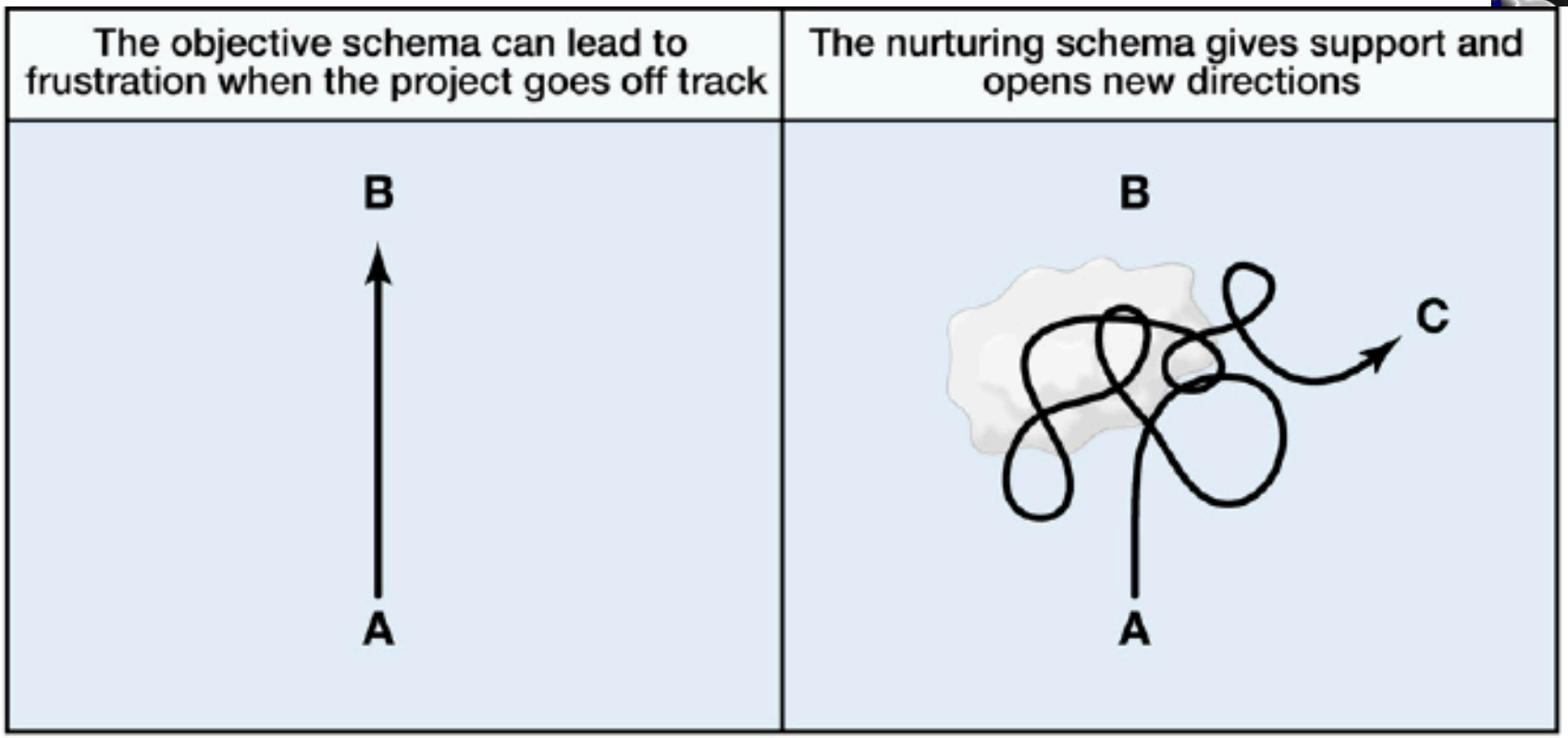


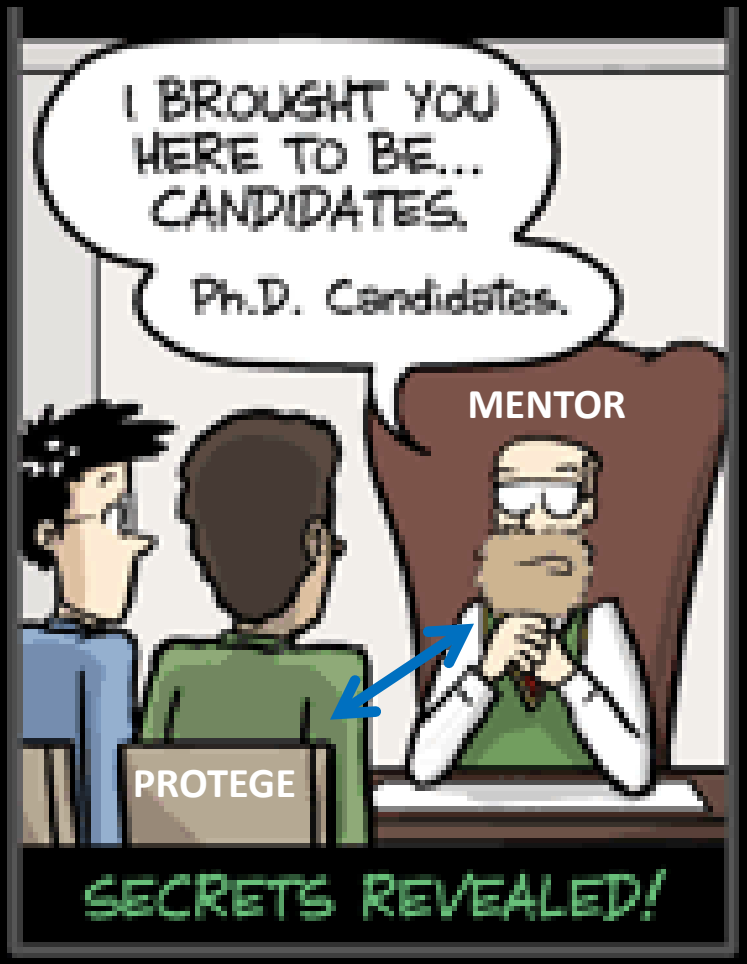
Figure 2. The Objective and Nurturing Schemas of Research
The nurturing schema includes "the cloud"—a period of time in which basic assumptions break down.

"and with this schema we have more space to see that problem C exists and may be more worthwhile than continuing to plod toward B"

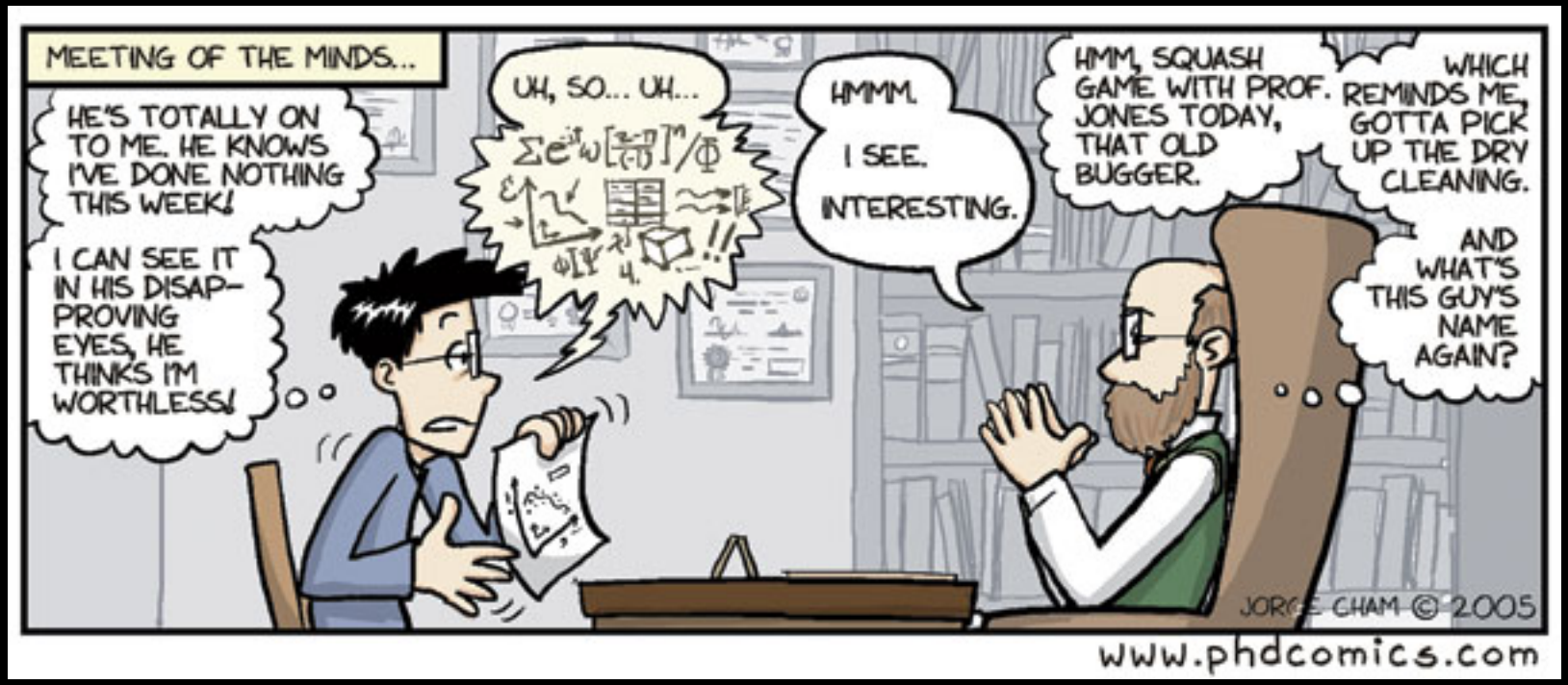
→ I think this is directly important to the advisor-student relationship.

Alon, *Molecular Cell* 35, 2009.

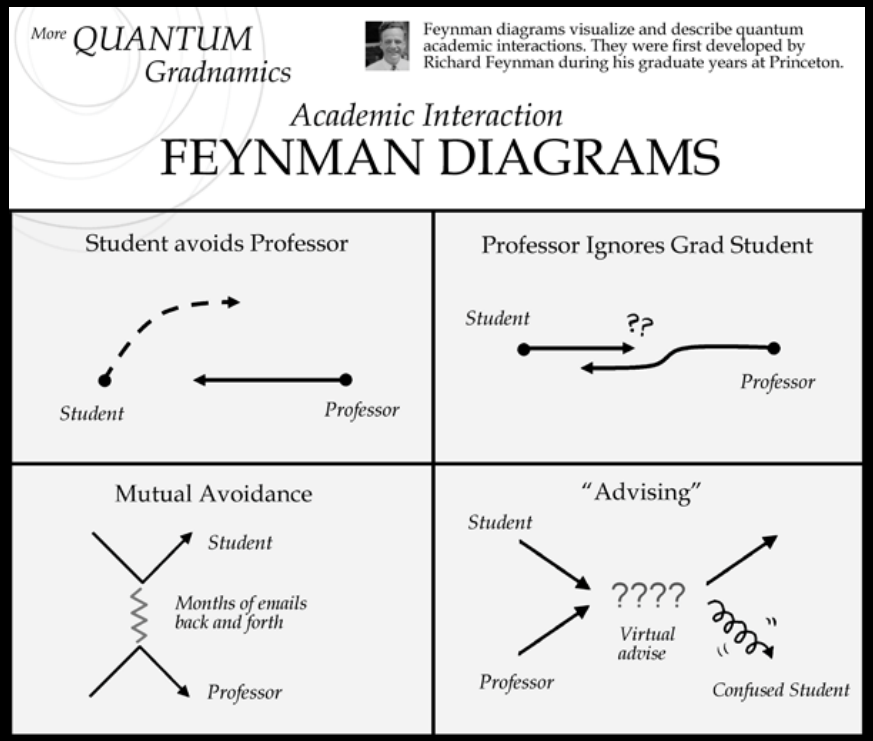
The advisor-student relationship is very important, and an advisor should be more than a “boss”.

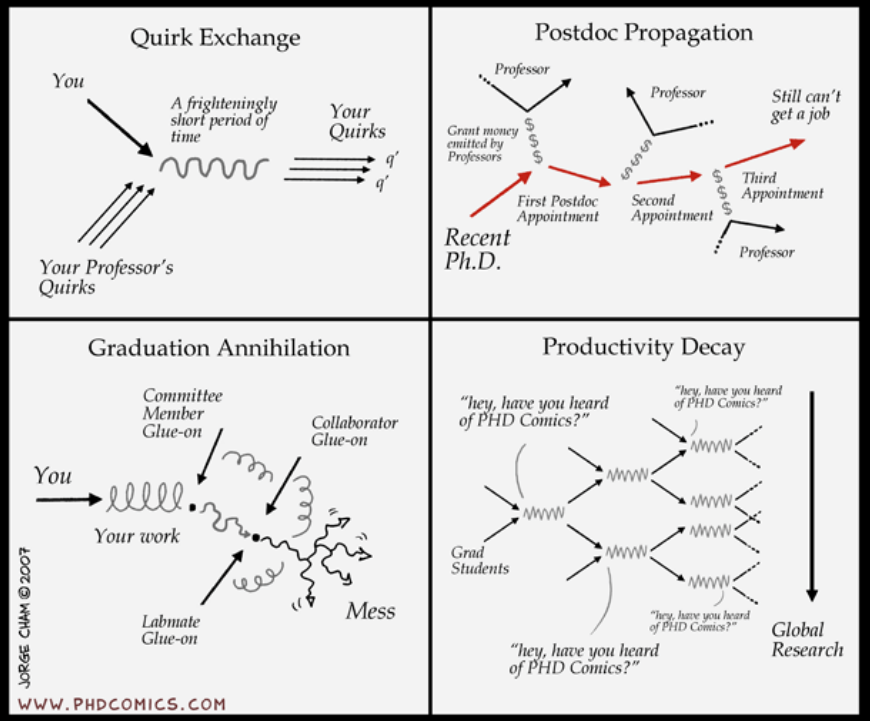


Sometimes communication is not clear, but expectations should be.



Does this really happen? It shouldn't!





The Chronicle of Higher Education
From the issue dated August 9, 2002

http://chronicle.com/weekly/v48/i48/48b01601.htm

POINT OF VIEW
Treating Graduate Students With Dignity
By BRIAN P. COPPOLA

Most of the students are convinced that faculty members were coerced by the system of traditional faculty roles and rewards to take on, over time, unattractive personae to be successful as professors. They fear that following the path to the professoriate will present them with an inevitable dilemma: to advance, they would have to become a person they dislike. It appears to them that the choices for responsibly serving as mentors to graduate students like themselves (say, letting a student take an extra course) would conflict with the choices for personal survival as professors (the student would not help produce as many research papers).

Yet the graduate students avoid revealing themselves, their doubts, and their criticisms about the way research is conducted to their "bosses" for an obvious reason: fear of retaliation. The retaliation could take the form of withheld trust and respect, or more-concrete punishments, like unsupportive letters of reference or fewer opportunities to have one's work showcased or even acknowledged.

Goals/themes for today

- Understand the roles of the advisor and student as mentor and mentee, and *openly* discuss our views and experiences
- Interpret findings from research on mentorship
- Emphasize both directions of advising and mentorship, and view yourself both as a mentor and a mentee
  - Your advisor will (or should) like to know how to
    - do what you need to be a successful and productive student
    - Help develop your own career interests while being most valuable to your shared interests
  - You should be aware of what drives your advisor's priorities/time/agenda, and if you are not, it can help to try to find out
  - View this in your role as a mentee, and as a mentor such as to an undergradute student
- Review some effective practices for meetings, teamwork, and collaboration

What is the role of a research advisor?

- Both a "boss" and a "mentor"

- "…the advisor is correctly seen as the significant other for the student's journey" [Paglis]

- From the Rackham mentoring guide:

  - "…an agreement in principle between the advisor and advisee"
    - **it's vital that mutual expectations are clear**

  - "A relationship of mutual trust and respect should be established between mentors and graduate students to foster healthy interactions and encourage individual growth"

Some questions

- Why did you choose your advisor?
- Why did your advisor choose you?
- In what ways are advisors different?
- How do you assess the quality of an advisor-student relationship?

Do you want to be a professor?

Is this surprising?

A surprising finding was the lack of any relationship between adviser mentoring and Time 3 research career commitment. The notion of a successful senior role model who influences a protégé to follow a similar career path is a popular one in our culture. Previous research on the graduate school experience, however, suggests exposure to the realities of a professor's life during graduate study actually may be turning some students away from pursuing a research-oriented academic career. Comments from graduate students in this four-year qualitative study indicate that observing the pressures and conflicting demands of their advisers left them questioning whether it was possible to achieve work/life balance as a faculty member in a research university (Austin, 2002).

try context to our academic setting. Alternatively, this finding may simply reflect an overwhelming self-selection effect. Doctoral study, which typically requires a time commitment of four or more years with minimal financial rewards, may be undertaken mostly by those who thoroughly explore beforehand what the training and subsequent career will be like, in the process developing a strong and unwavering commitment to their choice. Subsequent contact with a faculty mentor may have little reinforcing effect, and, as noted above, for some students even a negative effect, on their attitude about their career choice.

Paglis et al. *Research in Higher Education* 47(4) 451-476, 2006.

Questionnaire

from: Paglis et al. *Research in Higher Education* 47(4) 451-476, 2006.

Types of mentoring [Paglis]

- Psychosocial mentoring

> from their advisers (Luna and Cullen, 1998). Specifically, *psychosocial mentoring* contributes to the protégé's sense of competence, confidence, and effectiveness in his or her role. Mentor behaviors that fall in this category include role modeling, conveying respect and acceptance, counseling when fears and anxiety emerge, and offering informal friendship.

"the adviser's sharing of his or her own early experiences in dealing with the frustrations and challenges of conducting academic research can help students persevere and develop resilience" … "…help them get past transition challenges that are standing in the way of fully focusing on skill development and effective performance"

Types of mentoring [Paglis]

- Career-related mentoring

Career-related mentoring involves those activities that help prepare the protégé for career advancement, such as challenging assignments, introductions and exposure to professional colleagues, and protection from risks (Kram, 1983, 1985; Noe, 1988). These activities are conceptualized as a range of functions, rather than as discrete, 'either-or', forms of mentoring. For example, as a mentor–protégé relationship reaches a mature or 'cultivation' phase, the range of psychosocial and career-related functions provided by the mentor expands to a maximum (Kram, 1983).

With respect to *career-related* mentoring and its influence on productivity, advisers may provide introductions to more advanced students and to faculty within and outside the home institution who are working in similar research areas. This exposure can stimulate new research projects and collaboration opportunities. Advisers can also assist in preparing students for their research careers by assigning them challenging research assistant assignments, such as a literature search on a particular issue, which helps them develop and hone important skills. In some programs, advisers serve a critical mentoring role in protecting their students from risks (e.g., intradepartmental faculty conflicts, excessive teaching assistant obligations, etc.) that could hinder their advancement and productivity. Finally, mentoring through *research collaboration* gives students co-authorship opportunities, and perhaps access to data, to help them achieve productivity results in the form of conference papers, grant proposals, and journal article submissions.

Paglis et al. *Research in Higher Education* 47(4) 451-476, 2006.

Types of mentoring [Paglis]

- Research collaboration

In addition to these two mentoring functions, we added a third—*research collaboration.* As mentioned earlier, this is an aspect of mentoring unique to the graduate school setting that should be included in order to form a more complete picture of the mentoring that occurs in adviser--student relationships. Inviting students to work with the adviser on research projects is a well-established aspect of mentoring in doctoral programs that is believed to be important to protégés' success (Bargar and Mayo-Chamberlain, 1983; Busch, 1985; Cameron and Blackburn, 1981). It is a context-specific activity that complements the career-related function, above. Advisers invite Ph.D. students to work jointly with them on research projects that typically have a published journal article as the final goal—the key that opens the door to job placement for those pursuing a research career.

and productivity. Finally, mentoring through *research collaboration* gives students co-authorship opportunities, and perhaps access to data, to help them achieve productivity results in the form of conference papers, grant proposals, and journal article submissions.

Paglis et al. *Research in Higher Education* 47(4) 451-476, 2006.

How to measure outcomes of mentorship?

- Survey Ph.D. students at different stages (year 0, 2, 5.5)
- Design questions to test three hypotheses:

Hypothesis 1: After controlling for indicators of students' initial ability to perform and research self-efficacy, adviser mentoring will be positively related to productivity 5 1/2 years after they begin their doctoral programs.

Hypothesis 2: After controlling for students' initial level of research career commitment, adviser mentoring will be positively related to career commitment 5 1/2 years after they begin their doctoral programs.

Hypothesis 3: After controlling for students' research self-efficacy at entry and productivity midway through the doctoral program, adviser mentoring will be positively related to research self-efficacy 5 1/2 years after they begin their doctoral programs.

*self efficacy: people get involved in the activities that they judge themselves capable of handling; once engaged, their efficacy beliefs influence how much effort they devote to the task and how long they persist in the face of obstacles.

Paglis et al. *Research in Higher Education* 47(4) 451-476, 2006.

Results (t = 0 → t = 5.5)

TABLE 2. Descriptive Statistics, Correlations, and Reliabilities

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Verbal GRE (T1)	122.3	25.2	–											
2. Quantitative GRE (T1)	163.8	22.8	.17*	–										
3. Research exper. (T1)	17.7	6.1	−.07	−.12**	**.82**									
4. Career commit. (T1)	3.6	.7	−.02	.07	.21*	**.73**								
5. Self-efficacy (T1)	7.9	1.7	−.01	.01	.33*	.29*	**.95**							
6. Psychosocial ment. (T2)	3.4	.8	−.07	−.10	.05	.05	.09	**.92**						
7. Career-related ment. (T2)	3.3	.8	.00	−.14**	.18*	.19*	.14**	.69*	**.80**					
8. Collaborative ment. (T2)	1.6	.7	−.18*	−.02	.22*	.09	.18*	.11	.26*	**.81**				
9. Productivity (accept.) (T2)	1.2	1.9	.00	−.11	.42*	.02	.24*	.11	.26*	.58*	–			
10. Productivity (submis.) (T3)	8.6	8.8	−.06	−.13	.31*	.09	.16**	.20*	.33*	.38*	.47*	–		
11. Career commit. (T3)	3.1	1.0	−.10	−.12	.22*	.51*	.26*	.06	.09	.05	.09	.27*	.90	
12. Self-efficacy (T3)	8.3	1.2	.00	−.05	.17**	.18*	.40*	.17**	.09	.04	.11	.26*	.44*	.93

Note. Coefficient alphas are shown on the diagonal in boldface where appropriate. *n*: T1 = 233; T2 = 161; T3 = 130.
*$p < .05$; **$p < .10$.

- 1: mentoring affects productivity
- 2: mentoring does not affect career *commitment*
- 3: mentoring probably affects self-efficacy (confirmed by regression analysis), publications and career commitment affect self-efficacy too

Paglis et al. *Research in Higher Education* 47(4) 451-476, 2006.

Strongest correlation between psychosocial mentoring and self-efficacy

TABLE 3. Regression Analysis Results

	Productivity (submissions)		Career commitment		Self-efficacy	
	(T3)	VIF	(T3)	VIF	(T3)	VIF
Verbal GRE (T1)	−.06	1.097	–	–	–	–
Quantitative GRE (T1)	−.10	1.095	–	–	–	–
Prior research experience (T1)	.19**	1.379	–	–	–	–
Ph.D. intention (T1)	.10	1.074	.02	1.048	.05	1.037
Self-efficacy (T1)	−.05	1.284	–	–	.39*	1.081
Career commitment (T1)	–	–	.50*	1.084	–	–
Productivity (acceptances) (T2)	–	–	–	–	.06	1.810
Psychosocial mentoring (T2)	−.01	2.137	.09	2.079	.22**	2.048
Career-related mentoring (T2)	.20	2.369	−.08	2.337	−.14	2.252
Collaborative mentoring (T2)	.30*	1.183	.04	1.141	−.05	1.849
F	4.18*		6.90*		4.10*	
R^2	.25		.25		.19	
df	8, 99		5, 105		6, 104	

Note. Cell entries are standardized regression coefficients. VIF = Variance Inflation Factor.
*$p < .05$; **$p < .10$.

Paglis et al. *Research in Higher Education* 47(4) 451-476, 2006.

An earlier 2-year (0,1,2) study

After 2 years of the PhD (the same student group):

- The three types of mentoring are **not** correlated to student productivity
- Having a targeted advisor increases productivity
- The "top prospects" initially receive more mentoring and are more productive:

titudes toward their work upon entering the program. This hypothesis was well supported providing the clearest empirical evidence to date that the mentoring functions are more likely to be available to the most capable newcomers. Incoming students who had higher verbal aptitude and stronger commitment to the program reported their advisers providing significantly higher levels of psychosocial and career mentoring functions at the end of their first year in their program. Similarly, entering students with more prior experience and a targeted adviser experienced more career mentoring. Thus, mentoring functions appear to

Green and Bauer. *Personnel Psychology* 48:537-560, 1995.

Regression of Time 3 Outcomes on Time 2 Supervisory Mentoring Controlling for Variables

Predictors	Publications	Submissions	Affective com.	Career com.
Verbal GRE	.10	.11	−.07	.01
Quantitative GRE	−.05	−.04	.02	.02
Prior experience	.25*	.19*	.09	−.01
Targeted adviser	.16+	.10	.02	.01
Affective commitment	−.04	−.04	.52*	.04
Career commitment	.01	−.21*	.02	.73*
Psychosocial	.00	.10	.15	.00
Career	.07	−.05	−.19+	−.06
Collaboration	.14	.14	−.09	−.05
Citizenship	na	na	na	.08
Undergraduate school	.10	.06	na	na
F value	2.92*	1.89*	7.51*	12.95*
R^2	.19	.14	.35	.51
df	(10, 121)	(10, 121)	(9, 128)	(10, 127)

Note: Cell entries are standardized coefficients. Unstandardized coefficients are not shown because they are essentially equivalent due to standardizing of the data by department. All statistical significance values are based on two-tailed tests.

*$p<.05$; +$p<.10$

So, early preparation pays off, but it takes longer to measure the effects of good mentorship (and perhaps to develop the relationship)

Green and Bauer. *Personnel Psychology* 48:537-560, 1995.

Long-term trends (for mathematicians)

nature Vol 465|3 June 2010|doi:10.1038/nature09040

LETTERS

The role of mentorship in protégé performance

R. Dean Malmgren[1,2], Julio M. Ottino[1,3] & Luís A. Nunes Amaral[1,3,4]

- In the first third of their careers, mentors with high fecundities (# of protégés that the mentor trains) train protégés that go on to have fecundities 29% higher than expected
- In the last third of their careers, mentors with high fecundities train protégés that go on to have fecundities 31% lower than expected
- Mentors with low fecundities train protégés that go on to have fecundities 37% higher than expected

Malmgren et al. *Nature* 45:622-627, 2010.

So, if success is having a lot of proteges,

- The study implies it's better to work with a young "rising star" advisor? …not an old one who has a large group?
- Otherwise, students in smaller research groups are more effectively mentores?

Malmgren et al. *Nature* 45:622-627, 2010.

- NAS members (=highly esteemed profs) have larger groups and publish more papers per protégé. So they're really good mentors and managers both?

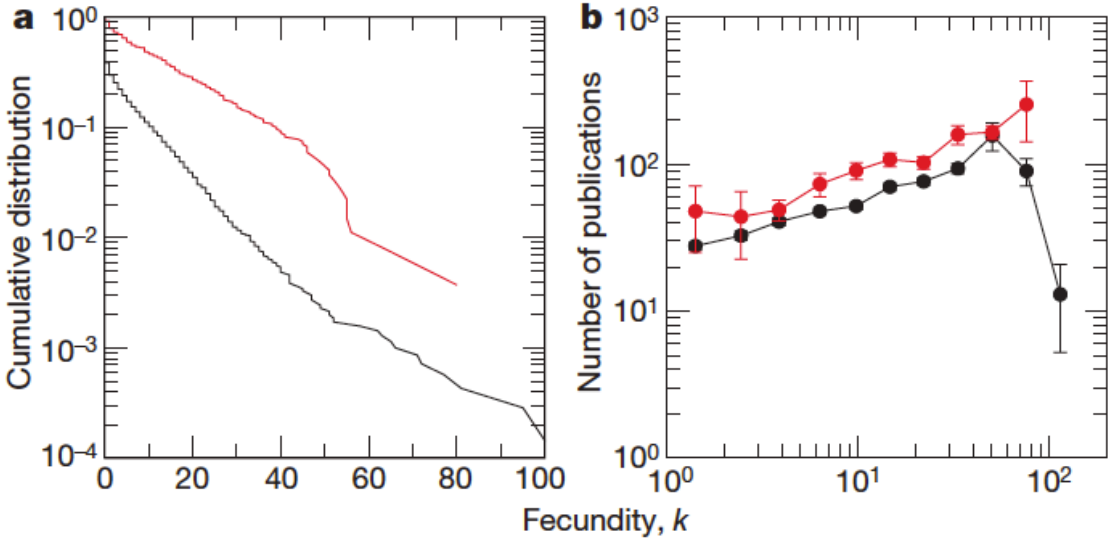
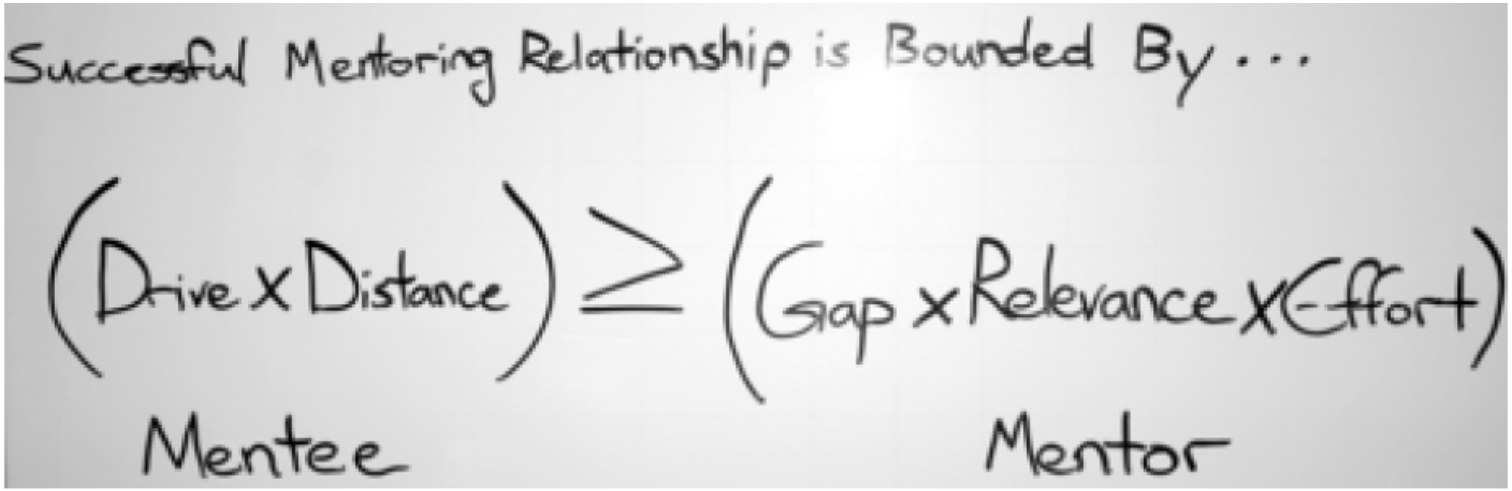


Figure 1 | Relationship between mentorship fecundity and other performance metrics. **a**, Cumulative distribution of the mentorship fecundity for NAS members (red) and non-NAS members (black). NAS members have an average fecundity of $\langle k \rangle_{\mathrm{NAS}} = 14$, which is far greater than the average fecundity of non-NAS members, $\langle k \rangle_{\text{non-NAS}} = 3.1$, indicating that fecundity is closely related to academic recognition. Not all mathematicians in the non-NAS group were eligible for NAS membership, owing to citizenship and other circumstances. This fact makes the result in the figure all the more striking. **b**, Average number of publications as a function of the mentorship fecundity, for NAS members (red) and non-NAS members (black). NAS members have nearly twice as many publications on average as non-NAS members for all fecundity levels. Error bars, 1 s.e.

Malmgren et al. *Nature* 45:622-627, 2010.

What are some attributes of a good advisor?

Successful mentoring requires effort from both the mentor and the mentee



The mentee side of the equation describes: *How badly does the mentee want to advance his/her career and how much ground do they feel they need to cover to get there?*

Drive = How motivated is the mentee?
Distance = Where is the mentee in terms of experience vs. where they need/want to be?

The mentor side asks: *Can I help and how much effort will it require?*

Gap = The amount of experience the mentor has compared with the mentee.
Relevance = The distance between the mentor's expertise and the mentee's goal.
Effort = How much work it will take to bridge any gaps of experience or relevance.

http://blogs.hbr.org/johnson/2011/10/get-the-mentoring-equation-rig.html

Thoughts about the equation

- Sometimes it's necessary for the mentor to advise the mentee on how to make the relationship most successful, especially if the mentor has limited time/attention.
- The mentor should take time to understand what the mentee is hoping to achieve/gain. I think this is sometimes neglected in academic research.

What Google did

Google's Quest to Build a Better Boss

By ADAM BRYANT
Published: March 12, 2011

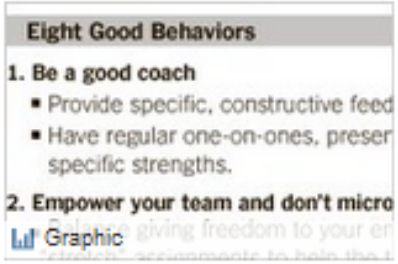
Mountain View, Calif.

Enlarge This Image

Peter DaSilva for The New York Times

Laszlo Bock of Google says its study found that a boss's technical expertise was less important than "being accessible."

Multimedia



Google's Rules

IN early 2009, statisticians inside the Googleplex here embarked on a plan code-named Project Oxygen.

Their mission was to devise something far more important to the future of Google Inc. than its next search algorithm or app.

They wanted to build better bosses.

So, as only a data-mining giant like Google can do, it began analyzing performance reviews, feedback surveys and nominations for top-manager awards. They correlated phrases, words, praise and complaints.

Later that year, the "people analytics" teams at the company produced what might be called the Eight Habits of Highly Effective Google Managers.

RECOMMEND
TWITTER
LINKEDIN
SIGN IN TO E-MAIL
PRINT
REPRINTS
SHARE

http://www.nytimes.com/2011/03/13/business/13hire.html?_r=1&pagewanted=all

What Google found (ranked)

Eight Good Behaviors

1. **Be a good coach**
   - Provide specific, constructive feedback, balancing the negative and the positive.
   - Have regular one-on-ones, presenting solutions to problems tailored to your employees' specific strengths.
2. **Empower your team and don't micromanage**
   - Balance giving freedom to your employees, while still being available for advice. Make "stretch" assignments to help the team tackle big problems.
3. **Express interest in team members' success and personal well-being**
   - Get to know your employees as people, with lives outside of work.
   - Make new members of your team feel welcome and help ease their transition.
4. **Don't be a sissy: Be productive and results-oriented**
   - Focus on what employees want the team to achieve and how they can help achieve it.
   - Help the team prioritize work and use seniority to remove roadblocks.
5. **Be a good communicator and listen to your team**
   - Communication is two-way: you both listen and share information.
   - Hold all-hands meetings and be straightforward about the messages and goals of the team. Help the team connect the dots.
   - Encourage open dialogue and listen to the issues and concerns of your employees.
6. **Help your employees with career development**
7. **Have a clear vision and strategy for the team**
   - Even in the midst of turmoil, keep the team focused on goals and strategy.
   - Involve the team in setting and evolving the team's vision and making progress toward it.
8. **Have key technical skills so you can help advise the team**
   - Roll up your sleeves and conduct work side by side with the team, when needed.
   - Understand the specific challenges of the work.

Team members should help set team goals

Why is this 8th?

Technical skills are #8 – well, if you can communicate and understand, you learn along the way. This is what the most innovative/effective advisors do, though technical savvy is required. Their "pattern recognition" skills also get better.

Google's take on how managers can do better

Three Pitfalls of Managers

1. **Have trouble making a transition to the team**
   - Sometimes, fantastic individual contributors are promoted to managers without the necessary skills to lead people.
   - People hired from outside the organization don't always understand the unique aspects of managing at Google.
2. **Lack a consistent approach to performance management and career development**
   - Don't help employees understand how these work at Google and doesn't coach them on their options to develop and stretch.
   - Not proactive, waits for the employee to come to them.
3. **Spend too little time managing and communicating**

Source: Google

More questions

- How much time does/should an advisor commit to one Ph.D. student?
- What do you think advisors (in general) need to do better?
- Anything else you want to know about how advisors think about their students?

Balancing individual and team performance

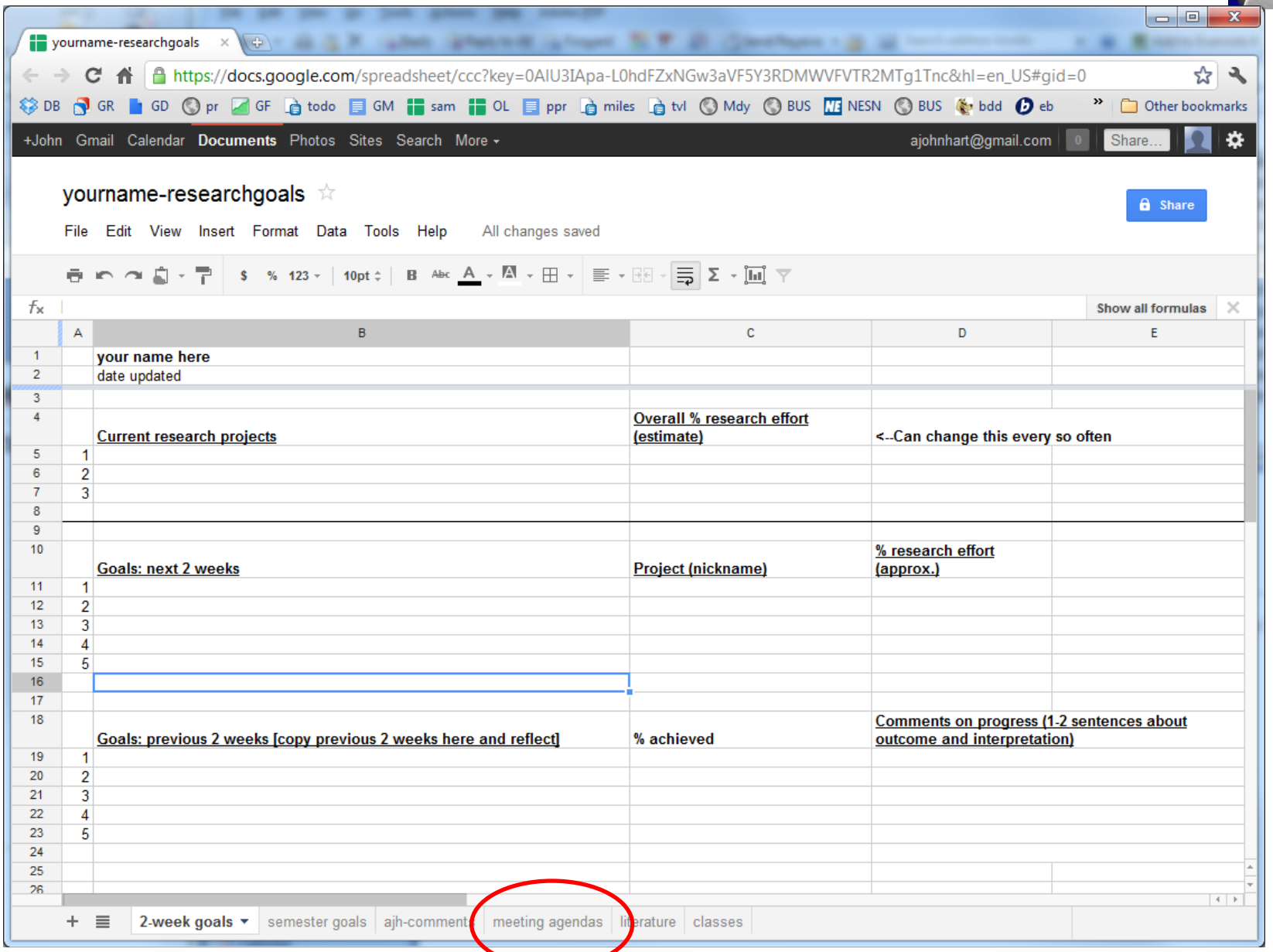
- Levels of interaction
  - Group meetings (everyone)
  - Subgroup meetings (advisor and students with common theme)
  - Individual meetings (advisor and student)
  - Ad-hoc interactions (students get together on their own)

- Thoughts on
  - Design of individual meetings
  - Design of group meetings
  - How an advisor can/should facilitate good teamwork and collaboration

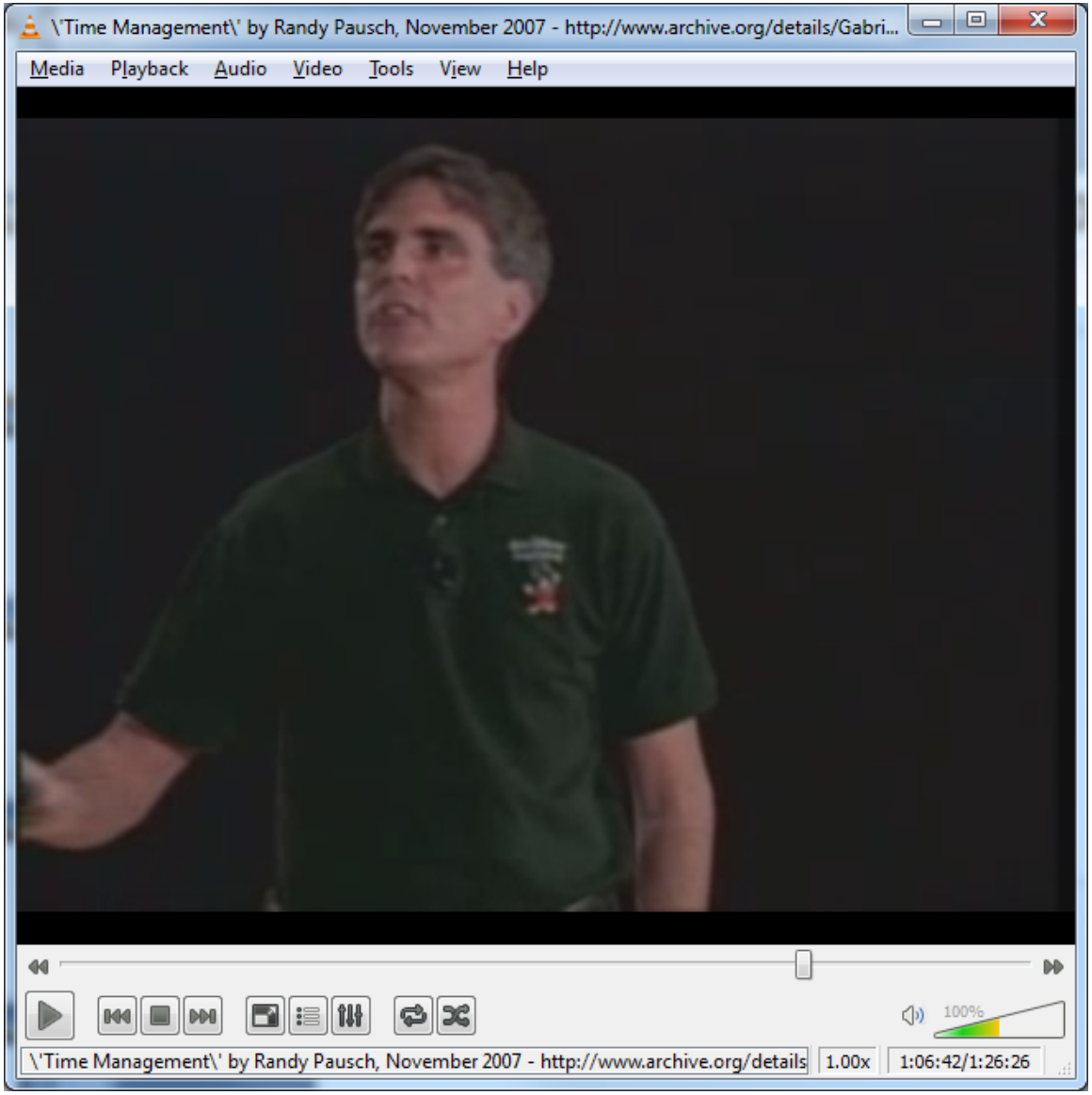
Attributes of good meetings

- Clear agenda, with everyone planning ahead as necessary
- Open discussion, with appropriate constructive criticism
- Leader truncates discussion and suggests follow-up when something is going off track, is unimportant to the agenda, or is evolving into a mini-meeting
- Action items are decided and communicated after the meeting

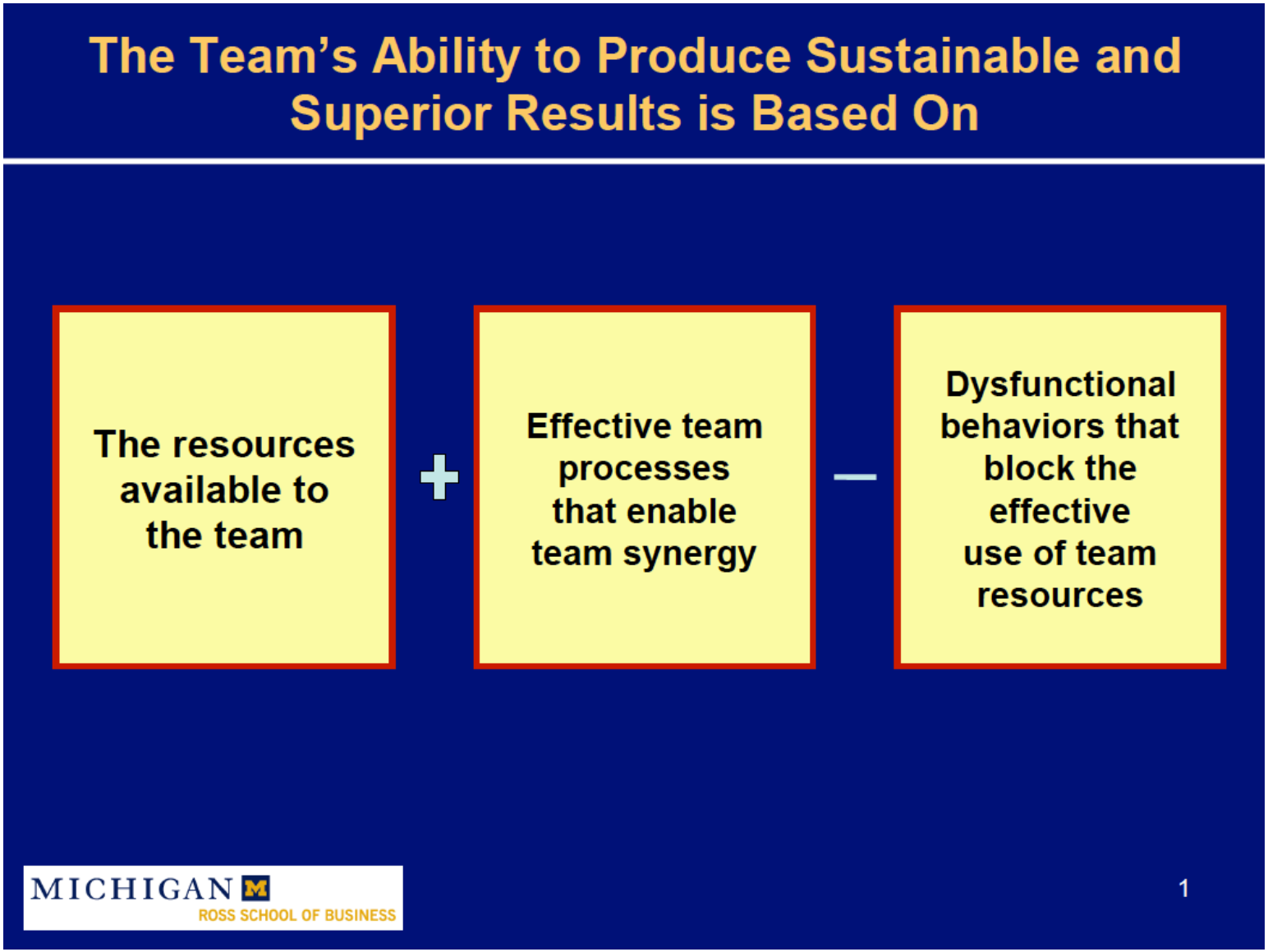
The goalsheet



Delegation et al., (Pausch 106:30-)



Success in research is a collective effort



What makes a successful collaboration?

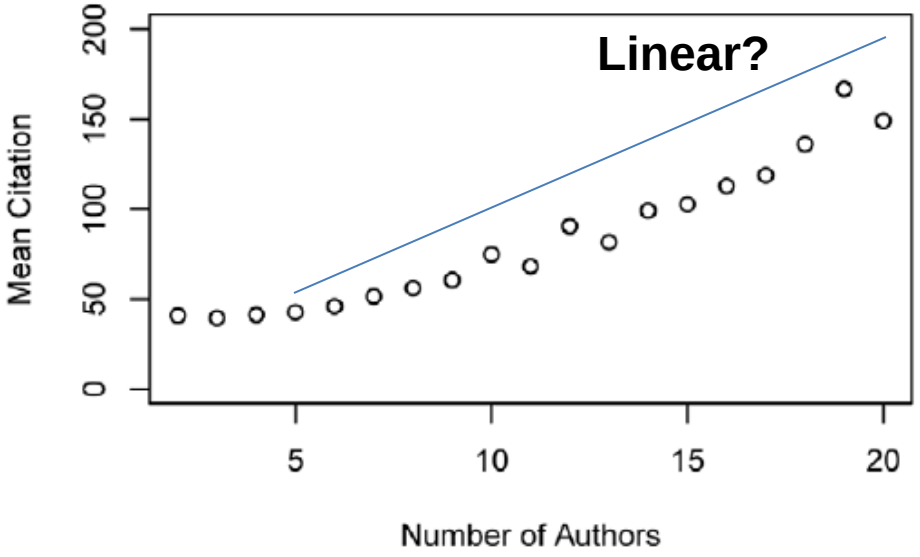
- …(discuss)

Does Collocation Inform the Impact of Collaboration?

Kyungjoon Lee[1], John S. Brownstein[2], Richard G. Mills[3], Isaac S. Kohane[1,2]*

1 Center for Biomedical Informatics, Harvard Medical School, Boston, Massachusetts, United States of America, **2** Children's Hospital Informatics Program at the Harvard-MIT Division of Health Sciences and Technology, Boston, Massachusetts, United States of America, **3** Operations and Business Affairs, Harvard Medical School, Boston, Massachusetts, United States of America

- Analysis of publications from Harvard Medical School, 1993-2003
- Publications sorted by # of authors and # of citations



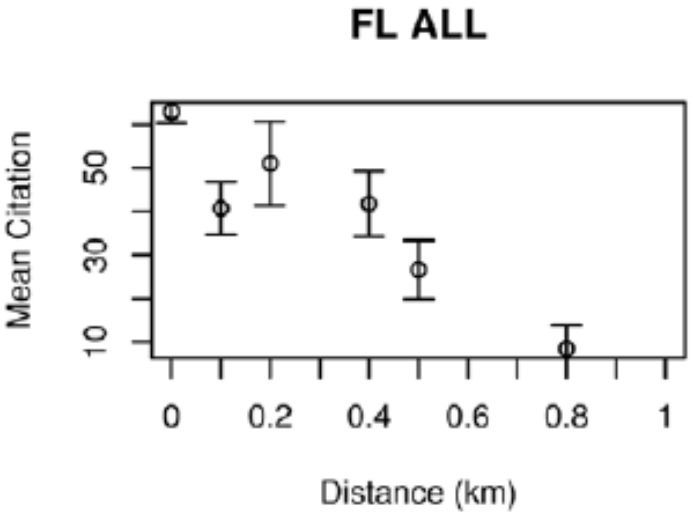


Figure 1. Number of coauthors and mean citations. Citation of an article has strong positive correlation with the number of coauthors. This trend becomes obvious for articles with more than 5 authors. Because of this, to see the relationship between author distance and citation, articles with different number of coauthors need to be analysed separately. We separated articles with 4 or less authors and 5 or more authors.

doi:10.1371/journal.pone.0014279.g001

- First-last author distance was important
- Middle-middle author distance (less clear contributions was not important)

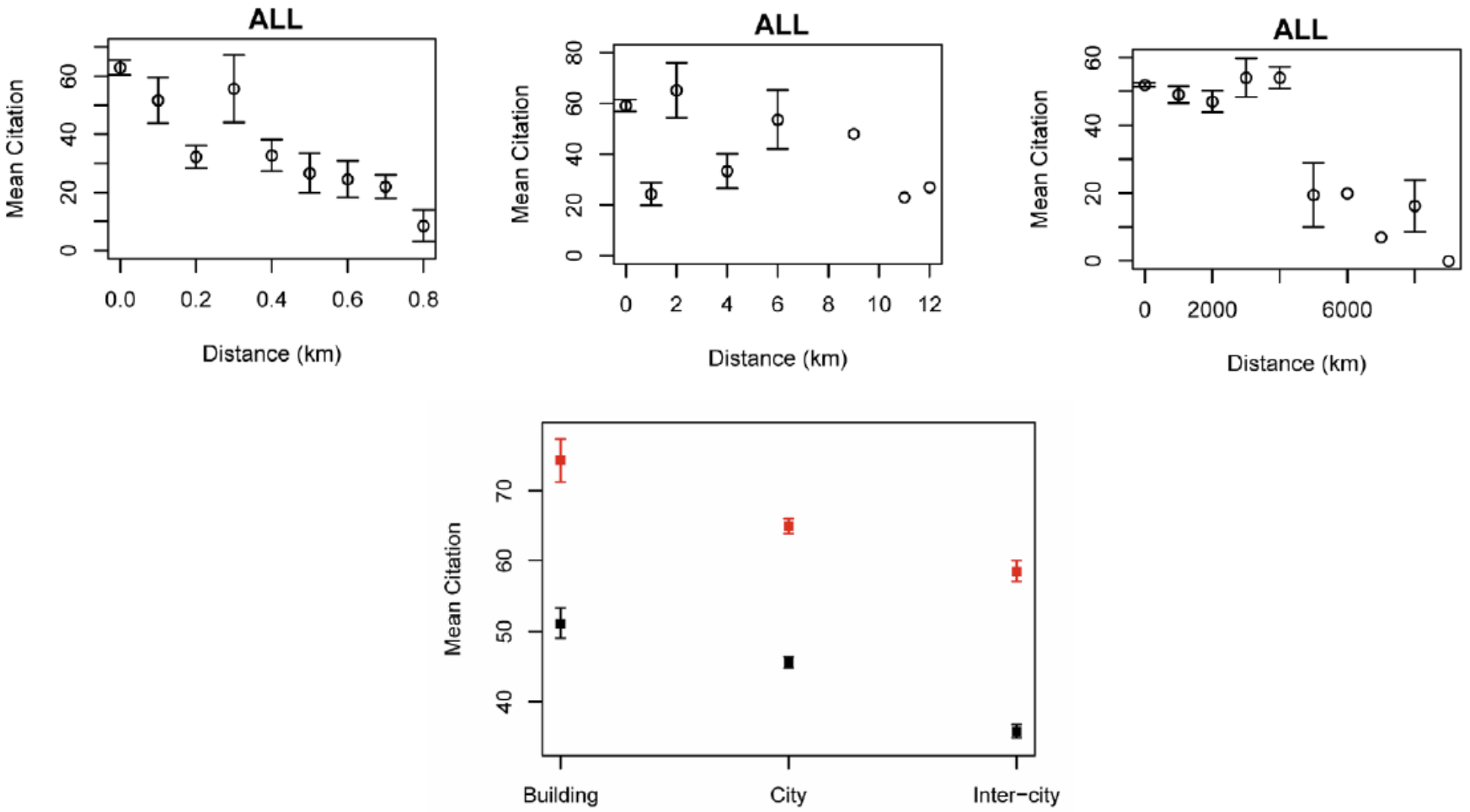


Figure 7. Mean citation for first-last authors in the same building, same city, or different city. Scatter plot showing relationship between first author-last author distance and publication citation impact (±2 SEM). Three inter-author distances were selected for illustration: same building, same city or different cities. Results are plotted for publications with four or fewer authors (black), and with five or more authors (red).
doi:10.1371/journal.pone.0014279.g007

How’d they do it? They tracked down all the authors in 3D

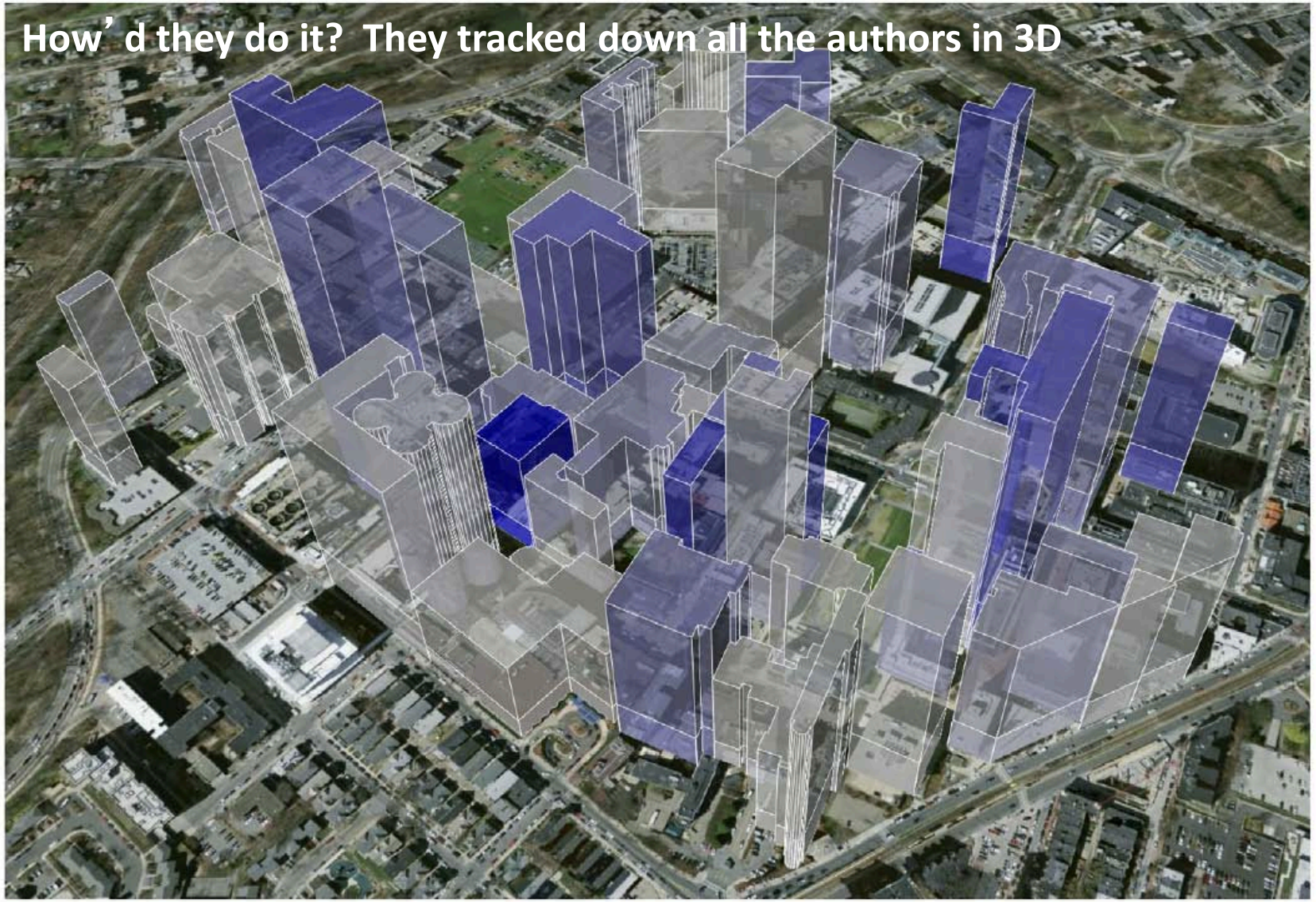


Figure 8. 3-D representation of the relationship between intra-building collaboration and mean citation impact on the Longwood campus of Harvard Medical School. The height of each building reflects the mean number of citations of publications originating in that building, and the color gradient reflects the proportion of publications originating from that building in which both first and last authors work in the building (from grey = low to blue = high). An interactive version of this map could be found at http://collaboration.harvard.edu.
doi:10.1371/journal.pone.0014279.g008

Teaching (and mentoring) helps research

Graduate Students' Teaching Experiences Improve Their Methodological Research Skills

David F. Feldon,[1*] James Peugh,[2] Briana E. Timmerman,[3] Michelle A. Maher,[4,5] Melissa Hurst,[4] Denise Strickland,[4] Joanna A. Gilmore,[6] Cindy Stiegelmeyer[7]

Science, technology, engineering, and mathematics (STEM) graduate students are often encouraged to maximize their engagement with supervised research and minimize teaching obligations. However, the process of teaching students engaged in inquiry provides practice in the application of important research skills. Using a performance rubric, we compared the quality of methodological skills demonstrated in written research proposals for two groups of early career graduate students (those with both teaching and research responsibilities and those with only research responsibilities) at the beginning and end of an academic year. After statistically controlling for preexisting differences between groups, students who both taught and conducted research demonstrate significantly greater improvement in their abilities to generate testable hypotheses and design valid experiments. These results indicate that teaching experience can contribute substantially to the improvement of essential research skills.

www.sciencemag.org SCIENCE VOL 333 19 AUGUST 2011

We compared the quality of 95 early-career (enrolled in the first three years) graduate students' written research proposals solicited at two time points using a previously validated rubric (*20*) described in the supporting online material (SOM) text. Some participants worked as research assistants with no teaching responsibilities, whereas others held split appointments with both research and teaching responsibilities as either teaching assistants in undergraduate courses or as GK-12 (*21*) participants partnering with middle school teachers of STEM content (*22*). We predicted that

Feldon et al., *Science* 333:1037-1039, 2011.

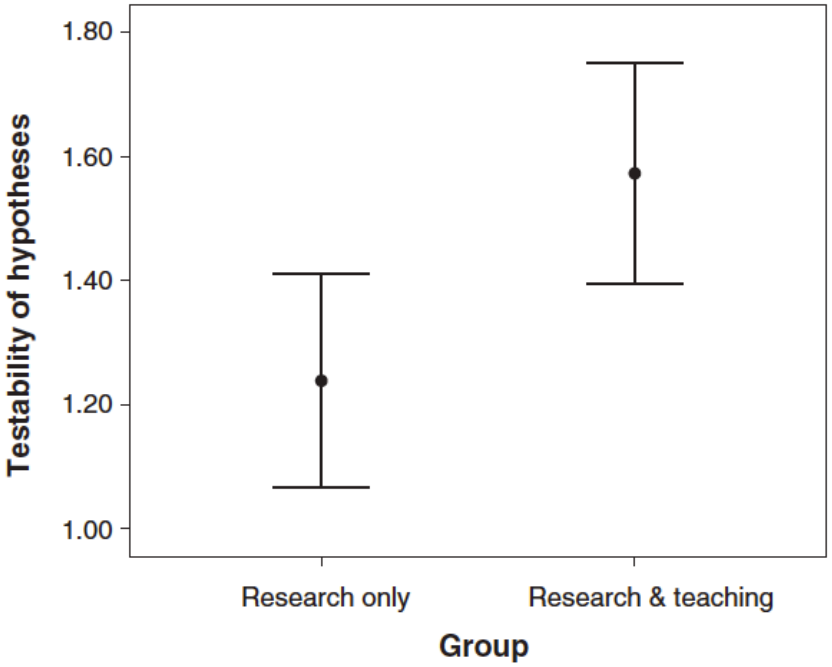
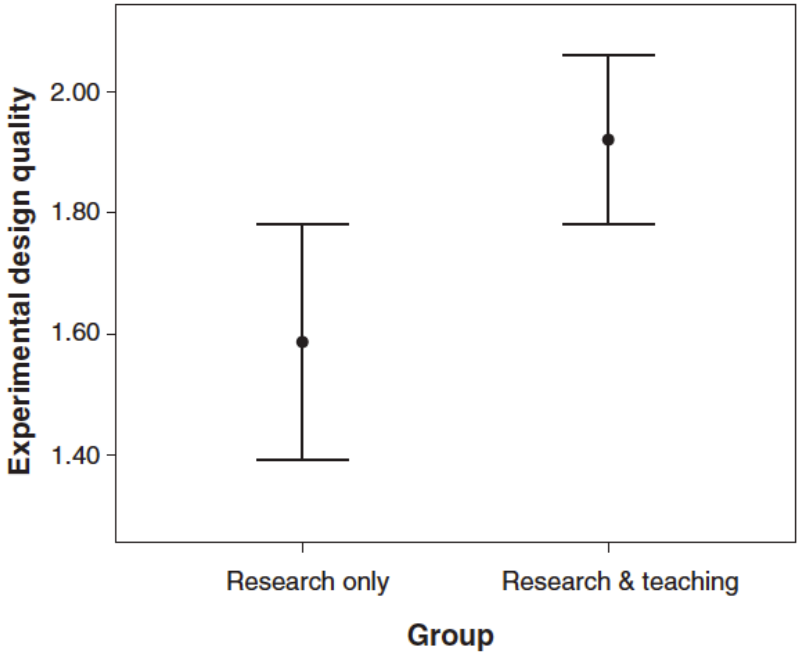


Fig. 1. Effect of both research and teaching experiences compared with research experiences alone for STEM graduate students' improvement in writing testable hypotheses. After statistically controlling for pre-existing differences in the quantity of prior research experience, scientific reasoning ability, and earned scores on the written research proposal at the first time point, the quality of the hypotheses proposed were significantly higher in the teaching-and-research condition (Cohen's $d = 0.58$). Error bars represent 95% CIs around the adjusted means.

Fig. 2. Effect of both research and teaching experiences compared with research experiences alone for STEM graduate students' improvement in experimental design. After statistically controlling for pre-existing differences in the quantity of prior research experience, scientific reasoning ability, and earned scores on the written research proposal at the first time point, the quality of the experimental designs proposed were significantly higher in the teaching-and-research condition (Cohen's $d = 0.63$). Error bars represent 95% CIs around the adjusted means.



Feldon et al., *Science* 333:1037-1039, 2011.

Additionally, when learners are required to articulate their reasoning processes substantial evidence indicates that they develop more elaborate and effective schemas for problem-solving that facilitate performance on both typical and new problems (*8*, *9*). Therefore, when instructors explain their own research processes to guide their students (*10*) they are further reinforcing their own learning. Research assistantships do not necessarily require extensive self-explanation (*11*).

Feldon et al., *Science* 333:1037-1039, 2011.

Advice for mentoring undergraduates

- Make sure the project has specific objectives and is well-suited to their skills and interests.
- Allow some independence:
  - Less work for you
  - More satisfaction (self-efficacy) for them
- Consistent progress is essential

- It's always a good experience, but think about the overall time tradeoff.

ENG580 "Teaching Engineering"

- Taught every fall by Dr. Susan Montgomery in ChemE
- Also see CRLT "preparing future faculty" May 2012 http://www.crlt.umich.edu/gsis/teaching_seminar.php
- "Tomorrow's Professor" http://cgi.stanford.edu/~dept-ctl/tomprof/postings.php

Teaching Engineering Fall 2010
Chemical Engineering 580 /Engineering 580

Instructor:	Susan Montgomery, PhD, PE, Lecturer, Chemical Engineering 3094 Dow, 936-1890, smontgom@umich.edu
Class Hours:	MW 1:00-2:30 2305 G.G. Brown, followed by office hours until 3 pm, 3094 Dow
Required Readings:	Wankat, Phillip C. and Frank S. Oreovicz (1993). *Teaching Engineering*. New York: McGraw-Hill - out of print but available through: https://engineering.purdue.edu/ChE/AboutUs/Publications/TeachingEng/index.html plus readings from Ctools class web page, available at https://ctools.umich.edu
Recommended for your own benefit	Tomorrow's Professor blog tomprofblog.mit.edu Ambrose, Susan et al (2010), *How Learning Works*, Jossey-Bass Svinicki and McKeachie, (2010), *McKeachie's Teaching Tips* (11th ed). Belmont, CA, Wadsworth: Cengage Learning
Goals:	The goals of the course are to: Help you prepare for the teaching responsibilities of a faculty position Acquaint you with learning theories Give you a chance to discuss teaching issues Give you practice preparing materials for a course you might teach someday
Objectives:	In preparing to apply for a faculty position, you will develop: Teaching Philosophy and Teaching Statement By the end of this course you should be able to, among others: Understand your learning style along different dimensions Describe Myers-Briggs Indicators and Soloman and VARK Learning Styles Describe and compare Piaget's and Perry's theories of cognitive development Describe and compare Kolb's learning cycle and Maslow's theory of needs Classify course activities using Bloom's Taxonomy Meet the needs of a diverse group of students In addition, in preparation for a course you might teach, you will: Prepare educational objectives using higher levels of Bloom's taxonomy Choose a textbook or other supporting materials Prepare a detailed syllabus Prepare and present a brief lecture Prepare an open-ended project and/or design activity and grading criteria Critique and select appropriate educational software Prepare an hourly exam and corresponding grading scheme.

Be proactive and manage the relationship

- Ask for time/help when you need it
  - Know what you want to accomplish when you meet your advisor
  - Express your objectives clearly and always suggest next steps
  - Identify what times and meeting styles are best for you and your advisor

- Understand what's on your advisor's mind, and how he/she is setting goals and feeling both pressures and rewards (from above or below)
- Help with research proposals
- Go to conferences (identify what YOU want to know)

- It's all about clarifying and managing expectations (both ways)
- Communicate !!!

Homework

- For group discussion in class, draft the questions that will guide your background report (you don't need to submit these)
- Bring 3 copies of 1 page with
  - Your research summary
  - The questions

Extra slides

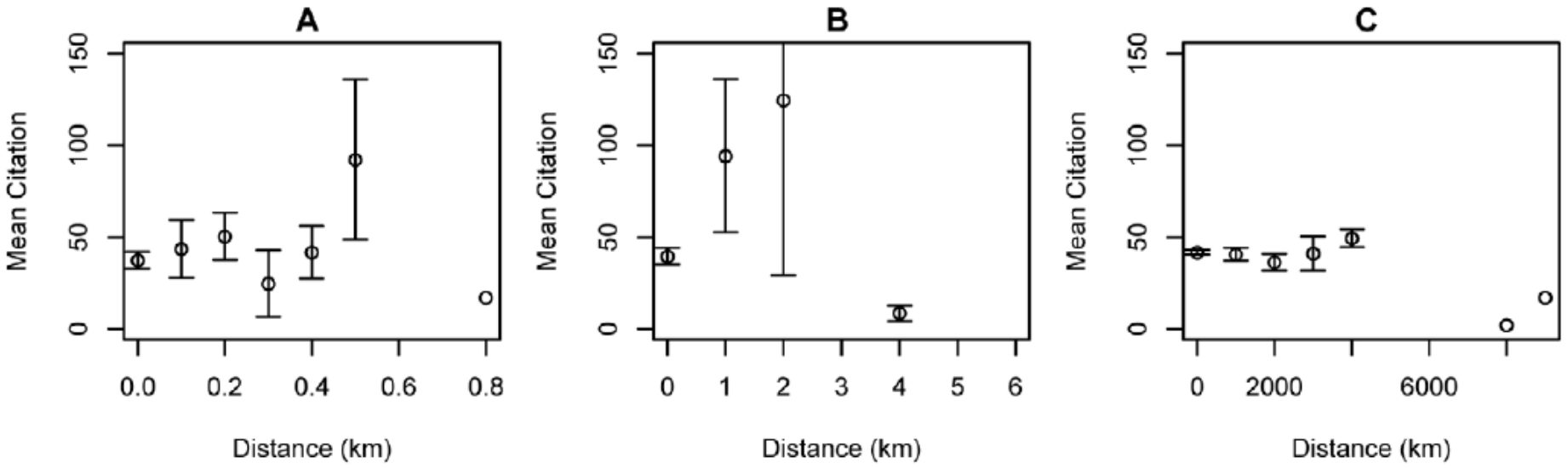
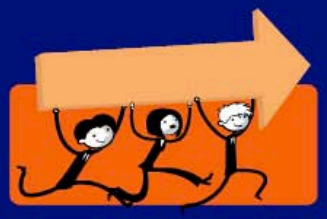


Figure 6. Distance and mean citation for middle-middle author relationship in articles with less than 5 coauthors in three resolutions (100 m, 1 km, and 1000 km). There is no obvious trend.
doi:10.1371/journal.pone.0014279.g006

The advisor as a team leader

Team Leaders Create a Context for High Performance

1. GOAL
Creating a clear, engaging goal



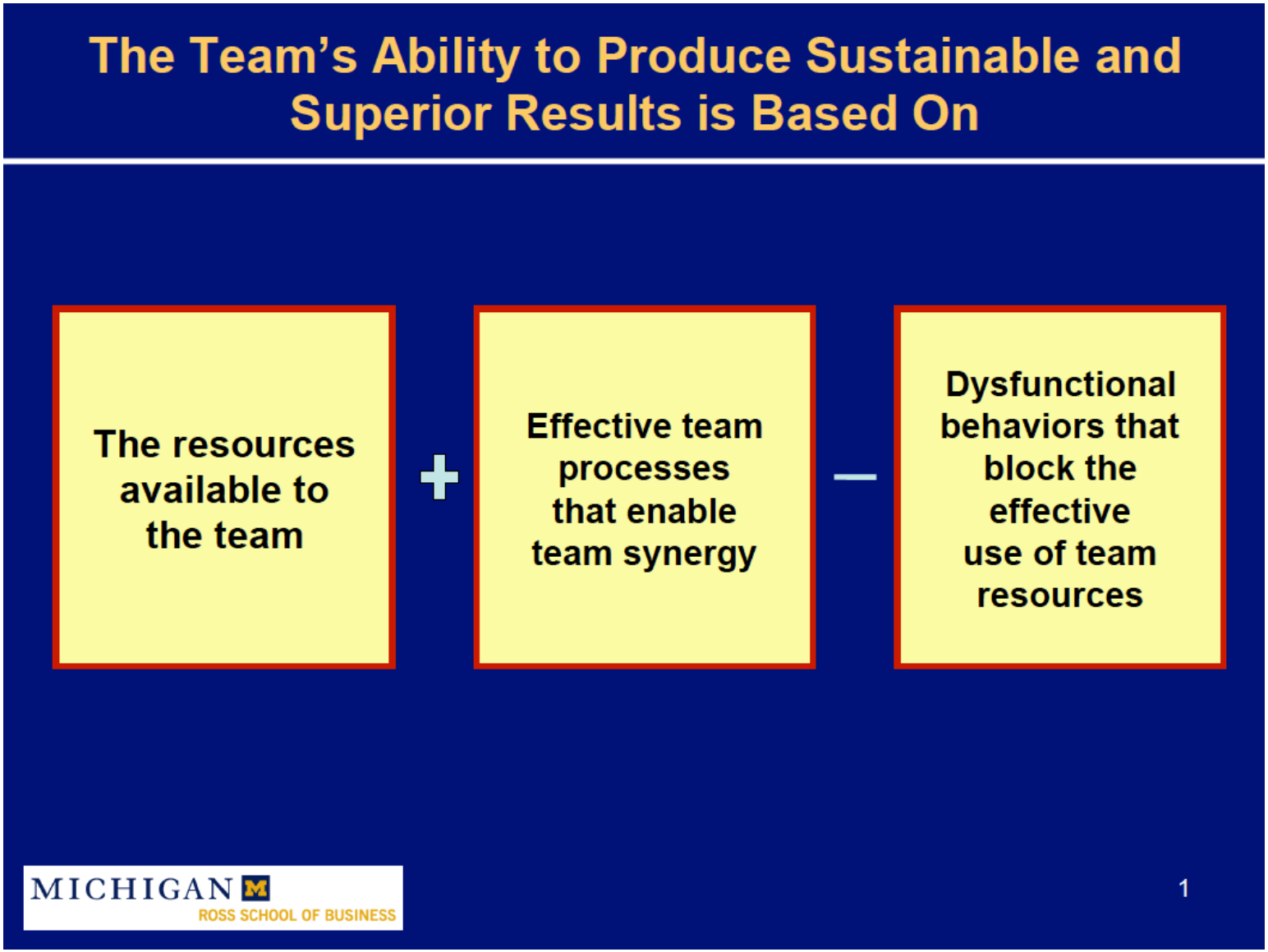
2. DESIGN
Providing a coordinated team process

3. COACHING
Helping the team and each team member succeed

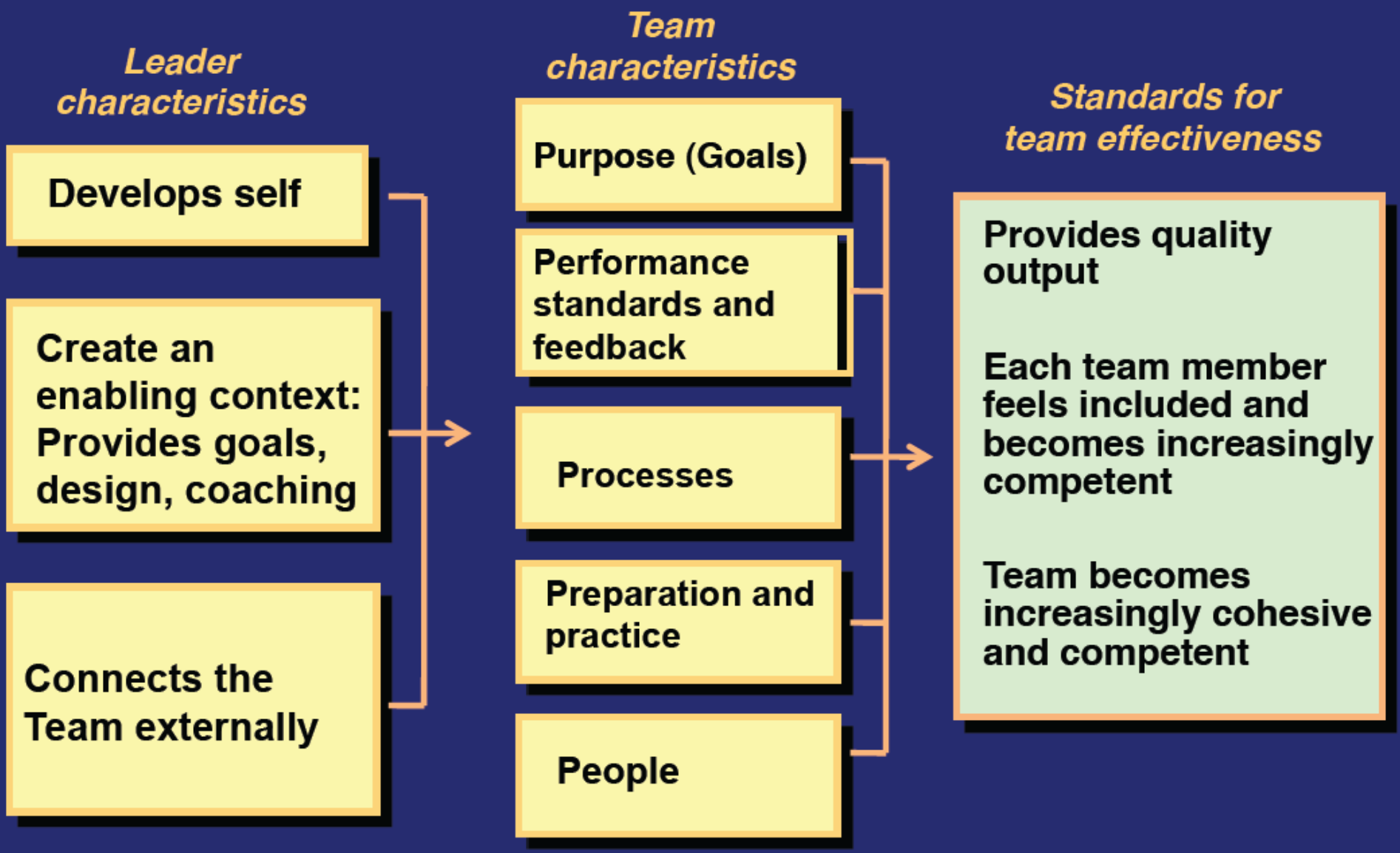
MICHIGAN ROSS SCHOOL OF BUSINESS

Richard Hackman 1

Success is a collective effort



Characteristics of High Performing Teams



Help Team Get Off to a Good Start Recommend 6:1 Positivity ratio

- ✓ Positive emotions predict success in students, relationships, and teams
- ✓ Positive emotions include support, encouragement, and appreciation; negative emotions include disapproval, sarcasm, cynicism, disgust, contempt
- ✓ Positive emotions create multiple benefits:
  - widens scope of attention
  - broadens behavioral repertoires
  - increases intuition, creativity, and resilience to adversity

SMART Goals

- **S**pecific and special (meaningful to team members)
- **M**easurable
- **A**ligned with vision/strategy and **A**ctionable
- **R**ealistic (achievable) and challenging
- **T**ime bound

Team Smart Goal Example

Vague Goal: We will develop more relationships with people and teams outside our team.

SMART Goal: At our December 15th meeting, the team will (1) target 3 divisions from whom we need support and (2) develop a plan of action for building a mutually supportive relationship with these divisions. The team will assess progress on the development of these relationships at our scheduled team meeting on January 15 by identifying how many relationships we have actually made and what benefits we have gained (and given) from each of these relationships.

Advantages of SMART Goals

1. Clarifies direction
2. Helps turn ideas into reality
3. Helps prioritize tasks/time (helps team know what to say “no” to)
4. Helps team members clarify their roles/contributions
5. Helps provide feedback on whether team is moving toward goals