04: **Planning and time management**

February 3, 2012

Announcements

- Observations/challenges from the literature search assignment
- You'll have my feedback no later than Fri Feb/13

The "Ph.D." perspective

There are four requirements for a successful career in science: knowledge, technical skill, communication, and originality or creativity. Many succeed with largely the first three. Those who are meticulous and skilled can make a considerable name by doing the critical experiments that test someone else's ideas or by measuring something more accurately than anyone else. But in such areas of science as biology, anthropology, medicine, and theoretical physics, more creativity is needed because phenomena are complex and multivariate.

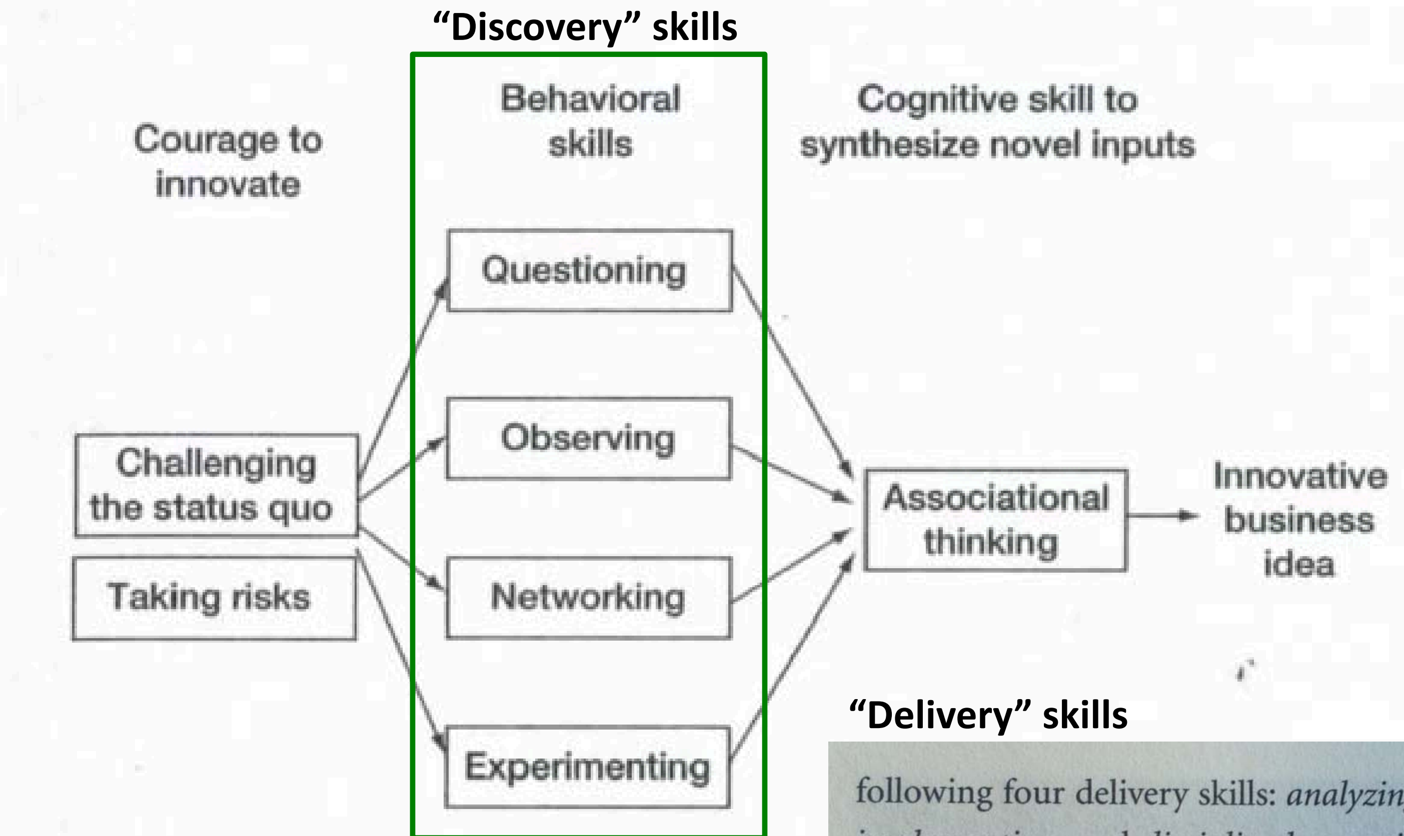
Most people can learn to be far more creative than they are. Our school system emphasizes single correct answers and provides few opportunities for exploratory learning, problem solving, or innovation. Suddenly, when one becomes a graduate student, however, it is expected that one is automatically an independent thinker and a creative problem solver.

Loehle, "A guide to increased creativity in research – inspiration or perspiration?"

The "MBA" perspective

FIGURE 1-1

The innovator's DNA model for generating innovative ideas



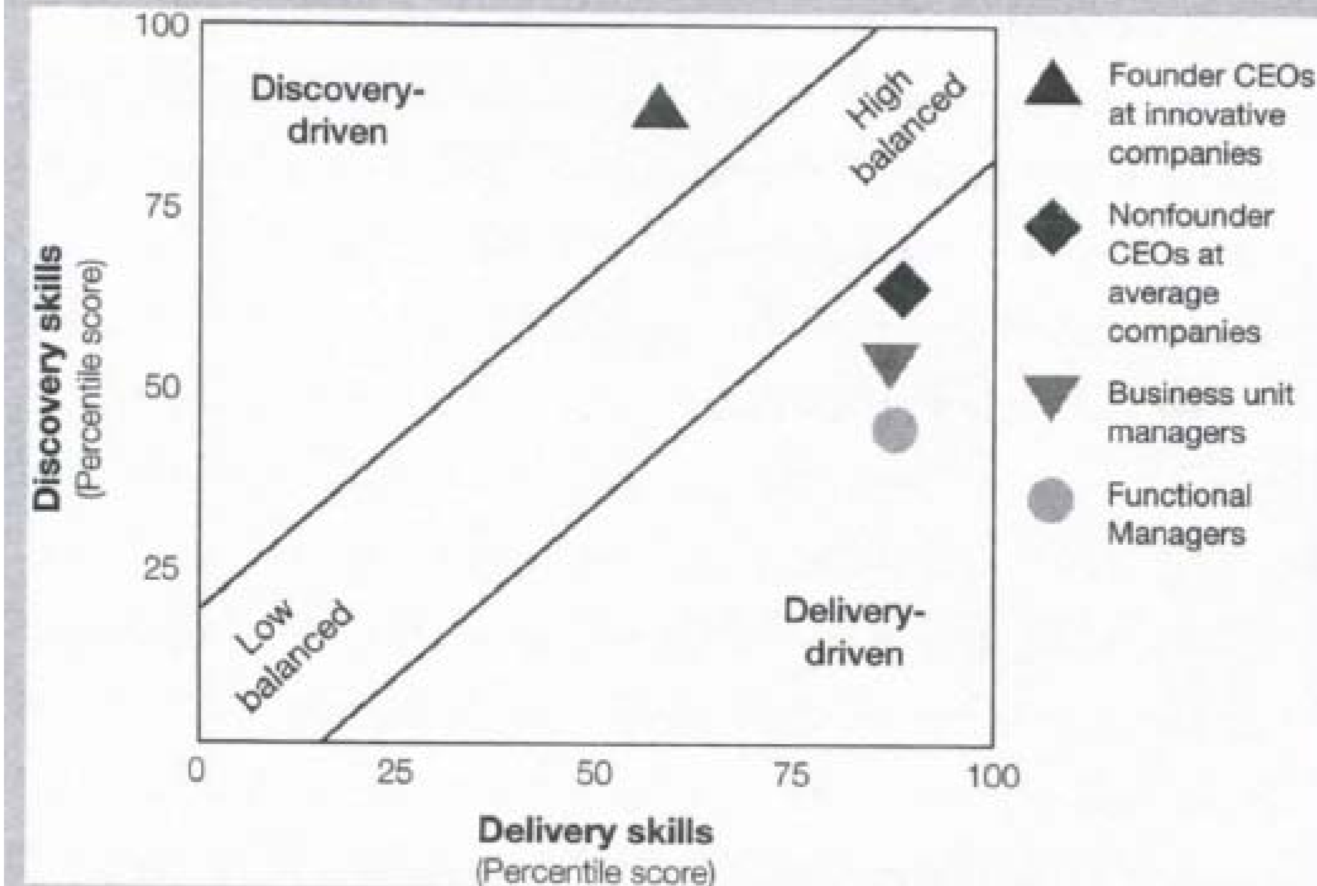
"Delivery" skills

following four delivery skills: *analyzing, planning, detail-oriented implementing,* and *disciplined executing.* (We'll say more about these skills later in the chapter and in chapter 8, but for now we need only note that they are critical for delivering results and translating an innovative idea into reality.)

Dyer, Gregersen, and Christensen, <u>The Innovator's DNA</u>

FIGURE 1-3

Discovery-delivery skills matrix



Discovery vs. delivery skills?

The practice of doing good research

methodical	a stepwise approach to answering the overarching research question; sequential
goal-oriented	having the end objective in mind
critical	rigorous in one's analysis; questioning
flexible	being able to take a new approach upon failure; adaptable
well-documented	organized and proper aggregation and explanation of information
ethical	

Evaluating good research

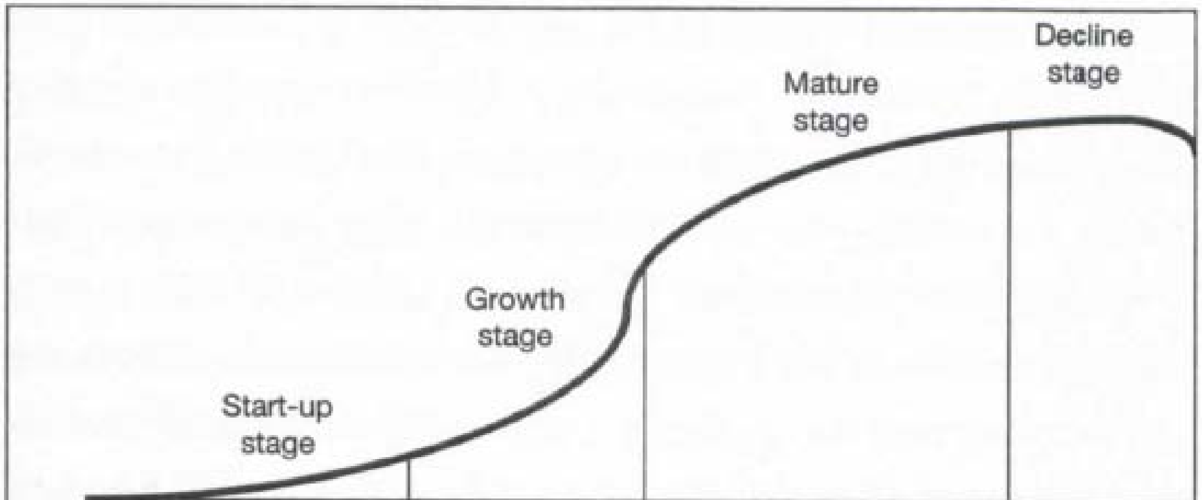
thorough	comprehensive presentation of your approach and solution/result
elegant	simple and concise
relevant	there must be a question to match the answer
repeatable	consistency
novel	creative, new solution

Attributes of a good researcher

zealous	curious and passionate; likes questioning everything
communicative	shares and receives information well
perseverent	able to overcome obstacles without losing motivation; not afraid of failure
versatile	able to apply knowledge from other fields; critical open-mindedness
balanced	self-aware of one's own limits; applied personal self-awareness
genius	creative, original, intellectual

FIGURE 1-4

The business and executive skill life cycles



Organization imperative	• Develop and launch new business idea	• Scale the new business idea • Build processes to execute consistently and systematically	• Exploit resources and capabilities generated during growth stage.	• Harvest, find, or develop other new business ideas
Organization primarily rewards	Discovery skills	Delivery skills	Delivery skills	Delivery skills still dominate but discovery skills increase in importance
Organization secondarily rewards	Delivery skills	Discovery skills	Discovery skills	

Dyer, Gregersen, and Christensen, <u>The Innovator's DNA</u>

Discovery and Delivery Skills Quiz: What's Your Profile?

To get a quick snapshot of your discovery-delivery skills profile, take the following self-assessment survey (1 = strongly disagree; 2 = somewhat disagree; 3 = neither agree nor disagree; 4 = somewhat agree; 5 = strongly agree). Remember to answer based on your actual behaviors, not what you would like to do.

1. Frequently, my ideas or perspectives diverge radically from others' perspectives.
2. I am very careful to avoid making any mistakes in my work.
3. I regularly ask questions that challenge the status quo.
4. I am extremely well organized at work.
5. New ideas often come to me when I am directly observing how people interact with products and services.
6. I must have everything finished "just right" when completing a work assignment.
7. I often find solutions to problems by drawing on solutions or ideas developed in other industries, fields, or disciplines.
8. I never jump into new projects and ventures and act quickly without carefully thinking through all of the issues.
9. I frequently experiment to create new ways of doing things.
10. I always follow through to complete a task, no matter what the obstacles.
11. I regularly talk with a diverse set of people (e.g., from different business functions, organizations, industries, geographies, etc.) to find and refine new ideas.

12. I excel at breaking down a goal or plan into the micro tasks required to achieve it.
13. I attend conferences (on my areas of expertise as well as unrelated areas) to meet new people and understand what issues are facing them.
14. I pay careful attention to details at work to ensure that nothing is overlooked.
15. I actively seek to identify emerging trends by reading books, articles, magazines, blogs, and so on.
16. I hold myself and others strictly accountable for getting results.
17. I frequently ask "what if" questions that provoke exploration of new possibilities and frontiers.
18. I consistently follow through on all commitments and finish what I've started.
19. I regularly observe the activities of customers, suppliers, or other organizations to get new ideas.
20. I consistently create detailed plans to get work done.

To score your survey:

Add your score on the odd-numbered items. You score very high on discovery skills if your total score is 45 or above, high on discovery if your score is 40–45, moderate to high on discovery if your score is between 35 and 40, moderate to low if you score 29–34; you score low on discovery if your score is 28 or less.

Add your score on the even-numbered items. You score very high on delivery skills if your total score is 45 or above, high on delivery if your score is 40–45, moderate to high on delivery if your score is between 35 and 40, moderate to low

(continued)

if you score 29–34; you score low on delivery if your score is 28 or less.

We have drawn this short survey from a more systematic seventy-item assessment (either a self-assessment or a 360-degree assessment) that we have developed to assess an individual's discovery skills and delivery skills. You can do this assessment through our Web site at http://www.InnovatorsDNA.com. Should you decide to complete an assessment, you will receive a *development guide* to walk you through your results and help you design a skill development plan. Your assessment will provide you with your DQ and percentile data for each discovery and delivery skill to compare your scores with the over five thousand executives and innovators in our dataset.

Schedule (subject to change)

#	Date	Theme	Pre-class task (Thurs 2pm)	Assignment (Fri 2pm)
0	Jan/6	Course overview; recap of ME RFE/candidacy process		
1	Jan/13	Defining "research"; learning styles	Research words	
2	Jan/20	Searching and analyzing the literature	Research theme	
3	Jan/27	Creativity and impact; choosing a research topic		
4	Feb/3	Planning and time management		Literature search
5	Feb/10	Advisor-student relations; mentorship and collaboration		
6	Feb/17	Responsible conduct of research		
	Feb/24	No class		Background report
	Mar/2	No class (spring break)		
7	Mar/9	Formulating and writing a proposal	Proposal exercise	
8	Mar/16	Evaluating proposals	Proposal aims	
9	Mar/23	Graphics and visual aids		Proposal
10	Mar/30	Giving and evaluating presentations	Proposal peer-review	
11	Apr/6	Research administration and commercialization	Discussion topics	
12	Apr/13	Student presentations (extended session)		Presentation

Three things

- Write down
  - Three skills (one word each if possible) that you are good at
  - Three skills that you'd like to improve at
- Make a copy
- Submit one, keep one for yourself

Today's topics

- Defining hypotheses/questions
- Time management
  - principles
  - tools
  - methods

(2011 list – green ok, red improve)

diligence, hard work
creativity
communication/writing/presentation
identifying problems, asking questions
efficiency
focus

Related topics next week

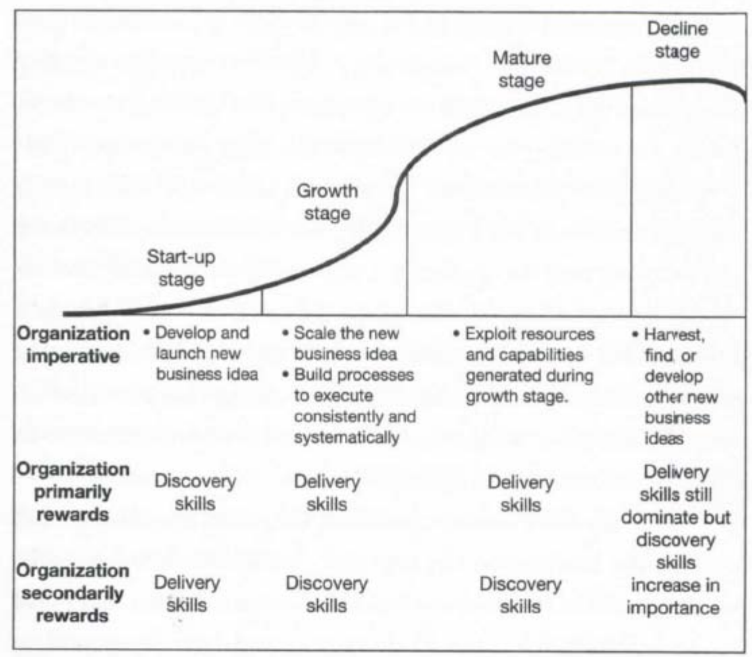
- Teamwork and collaboration
- Delegation
- Meetings
- Managing "up", i.e., working with your advisor

The scientific method

1. Define the topic area
2. Gather information and assess resources
3. **Form a hypothesis (question/problem)**
4. Design and conduct experiments; collect data
5. Analyze data
6. Interpret data and draw conclusions
7. Publish results
8. (Iterate or extend)

FIGURE 1-4

The business and executive skill life cycles



The importance of a good hypothesis

Hypothesis is the most important mental technique of the investigator, and its main function is to suggest new experiments or new observations. Indeed, most experiments and many observations are carried out with the deliberate object of testing an hypothesis. Another function is to help one see the significance of an object or event that otherwise would mean nothing. For instance, a mind prepared by the hypothesis of evolution would make many more significant observations on a field excursion than one not so prepared. Hypotheses should be used as tools to uncover new facts rather than as ends in themselves.

"a hypothesis is sometimes very fruitful without being correct"

"the vast majority of hypotheses prove to be wrong"

Beveridge, The Art of Scientific Investigation

Hypothesis vs. question

- Hypothesis:
  - "a supposition or proposed explanation made on the basis of limited evidence as a starting point for further investigation" (OED)
  - Example: …(anyone?)
- Question:
  - stating something that you want to find out by doing your research
  - Example: … (reformulating the example hypothesis)
- Here, we will use the terms interchangeably, although the formulation is different
- In your background report you will identify "questions" that have not been answered, while in your proposal you may pose more specific questions or a central hypothesis for your work.

What makes a "good" research questions?

- Identified as a "gap" in knowledge based on your literature survey
  - Important to others in your field
  - Can be placed in Pasteur's quadrant (last week)

- Clearly expressed in a sentence
- A specific outcome can be envisioned by an expert in your field

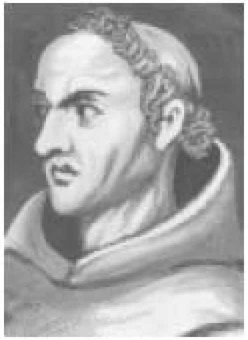
- Accessible based on knowledge/skills/resources you have or plan to acquire (you don't need to discuss these in the background report

Keep it simple

- "…unverified assumptions should be kept down to the bare minimum and the hypothesis with the fewest assumptions is to be preferred." (Occam's Razor)

William of Occam (1248-1347), English philosopher

"Entities must not be multiplies beyond what is necessary"



http://en.wikipedia.org/wiki/William_of_Ockham

doi:10.1038/nature10739

Nonlinear material behaviour of spider silk yields robust webs

Steven W. Cranford[1,2], Anna Tarakanova[1,2,3], Nicola M. Pugno[4] & Markus J. Buehler[1,2,5]

Natural materials are renowned for exquisite designs that optimize function, as illustrated by the elasticity of blood vessels, the toughness of bone and the protection offered by nacre[1–5]. Particularly intriguing are spider silks, with studies having explored properties ranging from their protein sequence[6] to the geometry of a web[7]. This material system[8], highly adapted to meet a spider's many needs, has superior mechanical properties[9–15]. In spite of much research into the molecular design underpinning the outstanding performance of silk fibres[1,6,10,13,16,17], and into the mechanical characteristics of web-like structures[18–21], it remains unknown how the mechanical characteristics of spider silk contribute to the integrity and performance of a spider web. Here we report web deformation experiments and simulations that identify the nonlinear response of silk threads to stress—involving softening at a yield point and substantial stiffening at large strain until failure—as being crucial to localize load-induced deformation and resulting in mechanically robust spider webs. Control simulations confirmed that a nonlinear stress response results in superior resistance to structural defects in the web compared to linear elastic or elastic–plastic (softening) material behaviour. We also show that under distributed loads, such as those exerted by wind, the stiff behaviour of silk under small deformation, before the yield point, is essential in maintaining the web's structural integrity. The superior performance of silk in webs is therefore not due merely to its exceptional ultimate strength and strain, but arises from the nonlinear response of silk threads to strain and their geometrical arrangement in a web.

Although spider silk is used by spiders for many purposes, from wrapping prey to lining retreats[22,23], here we focus on silk's structural role in aerial webs and on how silk's material properties relate to web function. The mechanical behaviour of silk, like that of other biological materials, is determined by the nature of its constituent molecules and their hierarchical assembly into fibres[13,16,17,24–26] (Supplementary Fig. 1). Spider webs themselves are characterized by a highly organized geometry that optimizes their function[7,8,18–20]. To explore the contribution of the material characteristics to web function, we developed a web model with spiral and radial threads based on the geometry commonly found in orb webs[1]. The silk material behaviour was parameterized from atomistic simulations of dragline silk from the species *Nephila clavipes* (model A)[16,17] (Fig. 1a, b) and validated against experiments[10] (Methods Summary). Properties of silk can vary across evolutionary lineages by over 100% (refs 9, 27 and 28; Supplementary Information section 1), so we avoided species-specific silk properties and instead used a representative model to reflect the characteristic nonlinear stress–strain (σ–ε) behaviour of silk found in a web. The mechanical performance of individual silk threads has been previously investigated[10,12,13], and is in agreement with our model in terms of tensile deformation behaviour.

It is rare to see a perfectly intact web—debris,
anchorage lead to loss of threads (see inset to Fig.
ture usually remains functional for a spider's use.
ability to tolerate defects by removing web section
applying a local load (Fig. 1c). Removal of up to
different locations relative to the load, had little i
response; in fact, the ultimate load capacity increa
the introduction of defects (Fig. 1c). We observ
failure is limited to the thread to which the force
of a spiral thread resulted in relatively isolated web
whereas loading of a radial thread (Fig. 1f) resulted
tion (about 20% more deflection and about 190%
dissipation; Fig. 1d). But in both cases, failure was
A comparative study of loading radial versus spi
strated that the web's structural performance is
properties of the stiffer and stronger radial dragline
required to break radial threads within the web a
higher), suggesting that the spiral threads play
(such as capturing prey).

In situ experiments on a garden spider (*Araneu*
(Fig. 1e, f) were in qualitative agreement with th
confirmed the prediction that failure is localized w
spiral or a radial thread. Complementing these fi
atomistic silk model[16,17] to connect the stress states
top row) with molecular deformation mechanis
(Fig. 1a). Under loading and immediately before
threads in the structure exhibited deformation stat
yield regime (regime II in Fig. 1a), where the prese
semi-amorphous regions permits entropic unfoldi
composite under relatively low stress[16,17,29]. Once
plete, the system stiffens as stress is transferred
β-sheet nanocrystals[17] (regimes III–IV in Fig. 1a
the thread where force is applied, because the applie
to rupture the nanocrystals.

Simulation and experiment both indicated that
universal characteristic of spider webs. It is unres
behaviour is unique to silk-like materials or a resul
tecture (that is, a property of the construction mat
tural design). We therefore systematically compa
webs constructed from three different types of
mechanical behaviour (Fig. 2a, left panels): in add
the atomistically derived stress–strain behaviou
(model A), we used idealized engineered fibres t
linear elastic behaviour (model A′) or elastic–pe
viour that involves severe softening (plastic yield)
cases, we loaded one of the radial threads and assu
stress (about 1,400 MPa) and strain (about 67%)
constant, so that any changes in deformation beha

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Natural materials are renowned for exquisite designs that optimize function, as illustrated by the elasticity of blood vessels, the toughness of bone and the protection offered by nacre[1–5]. Particularly intriguing are spider silks, with studies having explored properties ranging from their protein sequence[6] to the geometry of a web[7]. This material system[8], highly adapted to meet a spider's many needs, has superior mechanical properties[9–15]. In spite of much research into the molecular design underpinning the outstanding performance of silk fibres[1,6,10,13,16,17], and into the mechanical characteristics of web-like structures[18–21], it remains unknown how the mechanical characteristics of spider silk contribute to the integrity and performance of a spider web. Here we report web deformation experiments and simulations that identify the nonlinear response of silk threads to stress—involving softening at a yield point and substantial stiffening at large strain until failure—as being crucial to localize load-induced deformation and resulting in mechanically robust spider webs. Control simulations confirmed that a nonlinear stress response results in superior resistance to structural defects in the web compared to linear elastic or elastic–plastic (softening) material behaviour. We also show that under distributed loads, such as those exerted by wind, the stiff behaviour of silk under small deformation, before the yield point, is essential in maintaining the web's structural integrity. The superior performance of silk in webs is therefore not due merely to its exceptional ultimate strength and strain, but arises from the nonlinear response of silk threads to strain and their geometrical arrangement in a web.

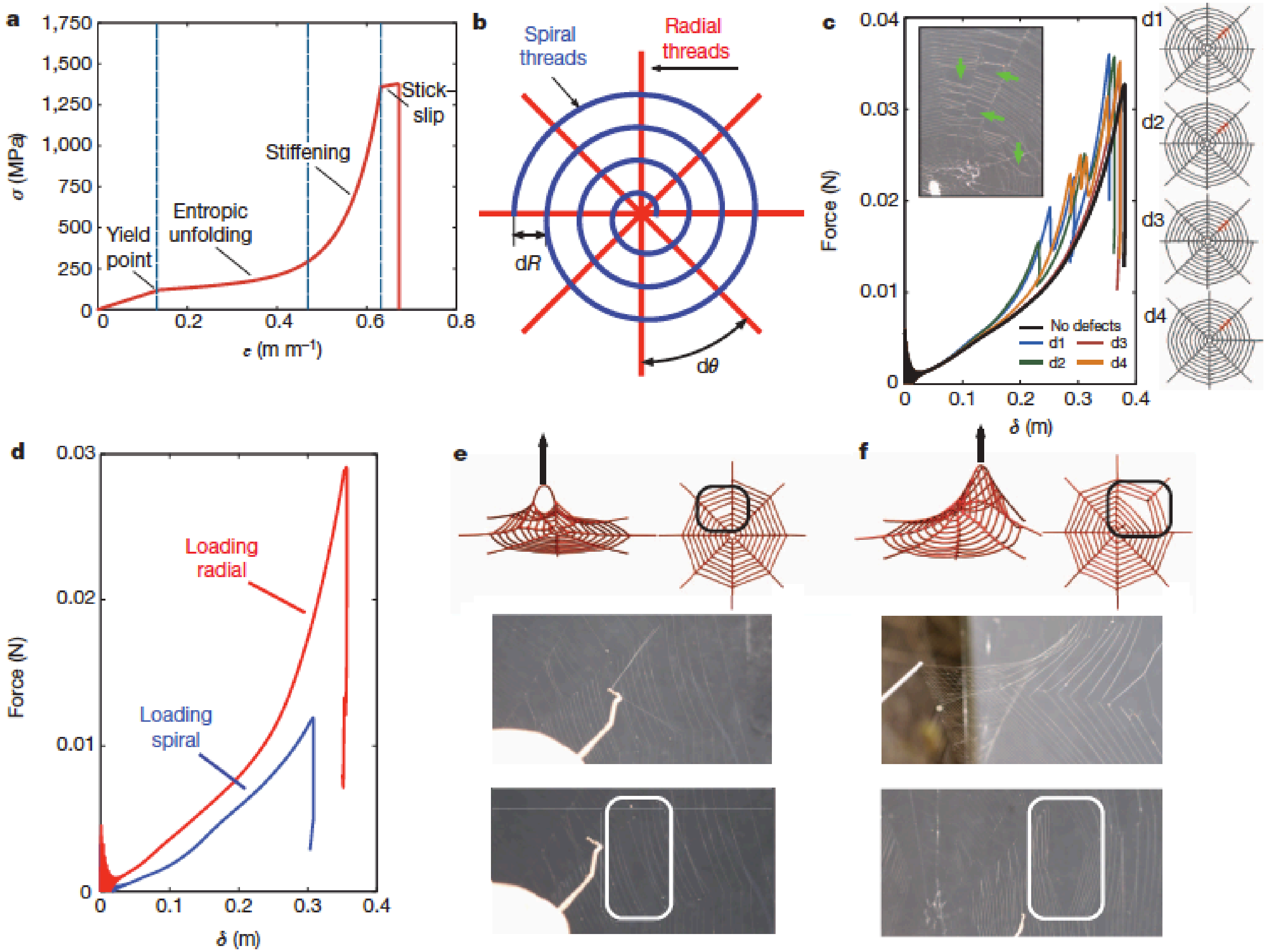

Figure 1 | Material behaviour of dragline spider silk, web model, and behaviour of webs under load. **a**, Derived stress–strain (σ–ε) behaviour of dragline silk, parameterized from atomistic simulations and validated against experiments[16,17]. There are four distinct regimes characteristic of silk[16,17]. I, stiff initial response governed by homogeneous stretching; II, entropic unfolding of semi-amorphous protein domains; III, stiffening regime as molecules align and load is transferred to the β-sheet crystals; and IV, stick–slip deformation of β-sheet crystals[16] until failure. **b**, Schematic of web model, approximated by a continuous spiral (defined by dR) supported by eight regular radial silk threads (defined by dθ), typical of orb webs[7]. **c**, Force–displacement curves for loading a defective web (results for model A; loaded region shown in red). Case studies include missing spiral segments (d1 to d3) and a missing radial thread (d4). The inset to **c** shows the *in situ* orb web as discovered, containing many defects (marked by green arrows). **d**, Force–displacement behaviour of web, comparing the loading of a single radial thread and a single spiral thread (model A). **e**, Loading of a spiral thread results in small web deformation. **f**, Loading applied at radial threads results in an increase in web deformation. In both cases (**e** and **f**) failure is isolated to the pulled thread in simulation and experiment, restricting damage to a small section of the web (indicated by white rectangles).

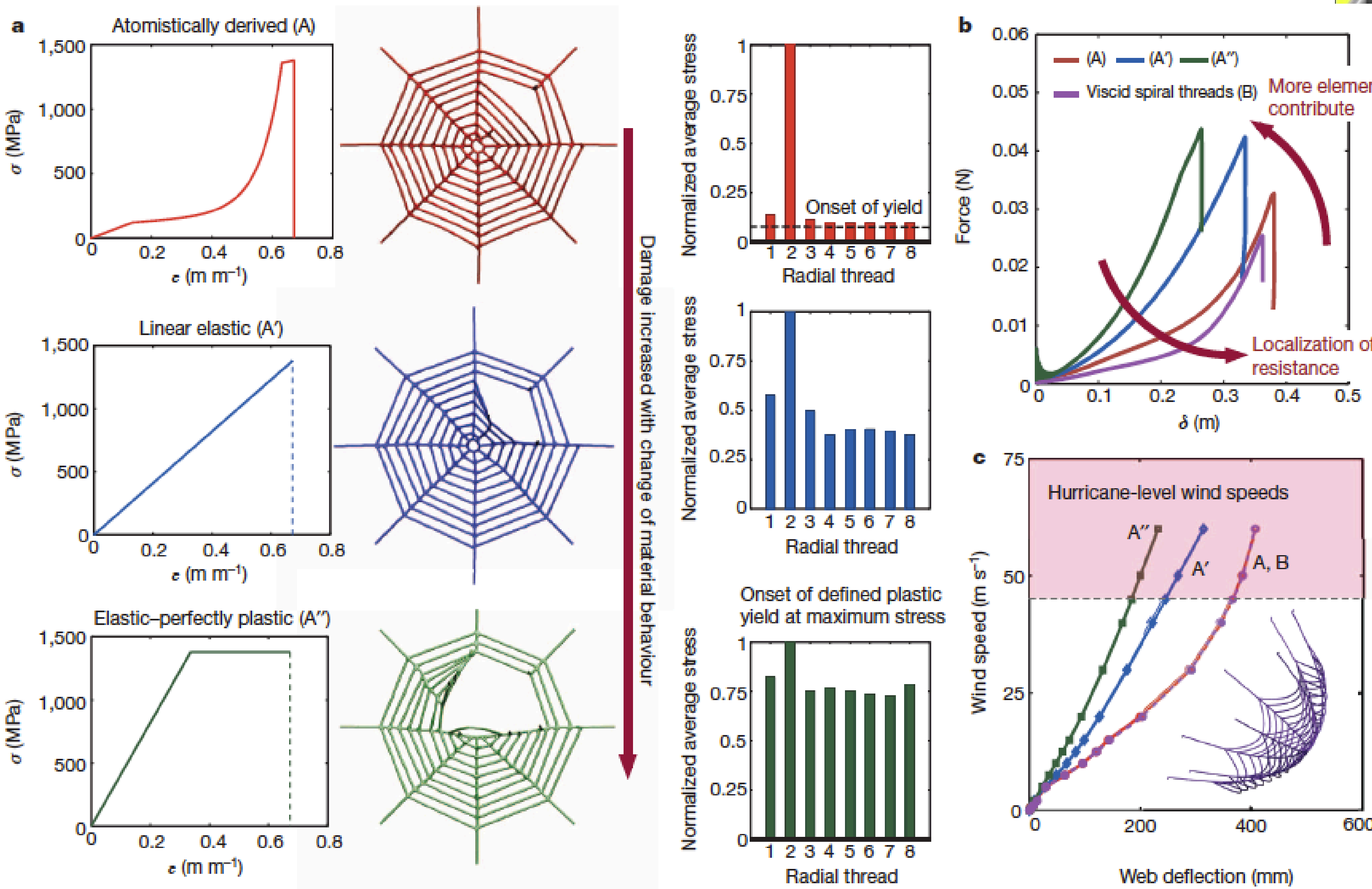

Figure 2 | Web response for varied silk behaviour under targeted (local) and distributed (global) loading. **a**, Comparison of failure for derived dragline silk, linear elastic and elastic–perfectly plastic behaviours (left, models A, A′ and A′′). Comparison of failure (centre) confirms localized stresses and minimized damage for the natural nonlinear stiffening silk behaviour. The average stress of each radial thread (bar plots, right) reflects the nonlinear deformation states in the silk. When load is applied locally to a radial thread, other radial threads not subject to applied force reach a stress corresponding to the onset of yielding (that is, regime II in Fig. 1a). The elastic–perfectly plastic behaviour leads to an almost homogeneous distribution of stress. **b**, Force–displacement curves for varying material behaviours (models A, A′ and A′′ and model B). **c**, Web behaviour under distributed (global) wind loading. The plot shows a comparison of the wind-deflection behaviour (models A, A′, A′′ and B). The initial high stiffness of natural dragline silk enhances the structural integrity of the web under such loading. Failure of all webs occurs at wind speeds in excess of 60 m s^{-1}.

Background report assignment

Due on ctools at 2p Friday, February 24

a. Guided by your literature search, identify the following:
   1. Two or three important (unanswered) questions related to your research topic.
   2. Two or three leading researchers in your field who are working (or have worked) toward answering these questions.
   3. A series of important techniques/achievements/discoveries (e.g., the seminal findings) related to the questions above. The leaders you identify may have made these achievements.

b. Based on the analysis from (a) write a report that:
   1. Introduces your research theme and its significance (1-2 paragraphs).
   2. Defines the questions you identified in (a). These can be listed so they are easy to identify.
   3. Reviews the contributions of the leaders, the seminal findings outlined in (a), and any other knowledge that you think is important to identify the frontier for your topic. There is no specific format for this; however, you should divide your text into subsections according to the key points you make, and make sure your information is presented in a logical order.
   4. Describes future directions, e.g., getting at what you hope to do in your research. Both fundamental (i.e., new scientific knowledge) and practical (i.e., commercial applications, impact on society) significance should be addressed. You don't need to give a detailed description of your research (we'll do that in the proposal).

Your report should be addressed to a general technical audience. Imagine giving it to someone who just joined your research group and wants to learn about your topic. Moreover, the reader should be convinced that it's worth doing research on your topic, and should have a clear idea of the **frontier** for your research. And, keep in mind to address both breadth and depth (like the "T" principle discussed in class).

The report must be no longer than 5 pages and should include at least 10 references. The page limit includes figures, but does not include the bibliography. Make sure the bibliography uses a consistent reference format of your choice, which includes the full title of all journal articles that you cite. Margins must be 1" (left/right/top/bottom), and the text should be single-spaced, 11- or 12-point font.

A few more thoughts about research methodology and planning

Break a big problem into smaller ones

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

Always do control experiments

- "Controls are needed to eliminate alternate explanations of experimental results"

- **Negative control** – where the theory expects no phenomenon. Make sure there is no effect when there should be no effect, like giving a "placebo" to a group of test subjects for a new drug.
- **Positive control** – to show that the conditions of the experiment can bring about a positive outcome, even if the hypothesis is incorrect. For example, if you are testing a flu vaccine, expose a group of subjects to the flu to make sure the vaccine has a chance to work.

http://en.wikipedia.org/wiki/Scientific_control

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PLoS one

Propagation of Respiratory Aerosols by the Vuvuzela

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Abstract

Vuvuzelas, the plastic blowing horns used by sports fans, recently achieved international recognition during the FIFA World Cup soccer tournament in South Africa. We hypothesised that vuvuzelas might facilitate the generation and dissemination of respiratory aerosols. To investigate the quantity and size of aerosols emitted when the instrument is played, eight healthy volunteers were asked to blow a vuvuzela. For each individual the concentration of particles in expelled air was measured using a six channel laser particle counter and the duration of blowing and velocity of air leaving the vuvuzela were recorded. To allow comparison with other activities undertaken at sports events each individual was also asked to shout and the measurements were repeated while using a paper cone to confine the exhaled air. Triplicate measurements were taken for each individual. The mean peak particle counts were 658×10^3 per litre for the vuvuzela and 3.7×10^3 per litre for shouting, representing a mean $\log_{10}$ difference of 2.20 (95% CI: 2.03,2.36; $p<0.001$). The majority (>97%) of particles captured from either the vuvuzela or shouting were between 0.5 and 5 microns in diameter. Mean peak airflows recorded for the vuvuzela and shouting were 6.1 and 1.8 litres per second respectively. We conclude that plastic blowing horns (vuvuzelas) have the capacity to propel extremely large numbers of aerosols into the atmosphere of a size able to penetrate the lower lung. Some respiratory pathogens are spread via contaminated aerosols emitted by infected persons. Further investigation is required to assess the potential of the vuvuzela to contribute to the transmission of aerosol borne diseases. We recommend, as a precautionary measure, that people with respiratory infections should be advised not to blow their vuvuzela in enclosed spaces and where there is a risk of infecting others.

Citation: Lai K-M, Bottomley C, McNerney R (2011) Propagation of Respiratory Aerosols by the Vuvuzela. PLoS ONE 6(5): e20086. doi:10.1371/journal.pone.0020086

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Competing Interests: The authors have declared that no competing interests exist.

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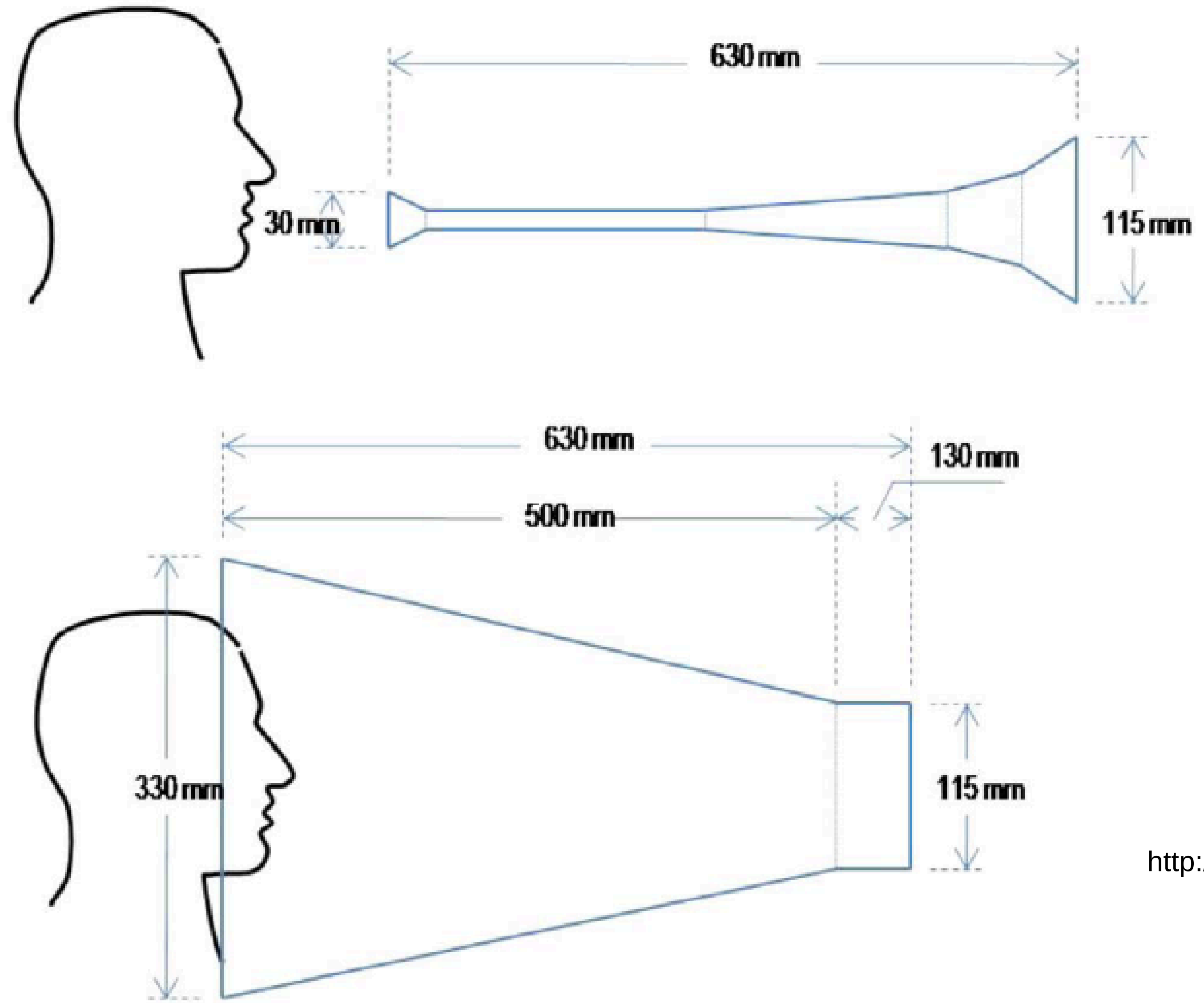
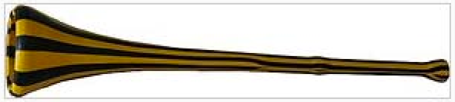




A black and yellow striped vuvuzela

A 2010 FIFA World Cup crowd blowing vuvuzelas

http://en.wikipedia.org/wiki/Vuvuzela

Figure 1. Experimental setup of vuvuzela and shouting experiments. An anemometer or particle counter were positioned at the bell of the vuvuzela to measure the velocity of air leaving the device and to capture and count aerosolized particles. Study participants also shouted into a cone tapered to the same diameter as the vuvuzela bell and measurements were repeated.
doi:10.1371/journal.pone.0020086.g001

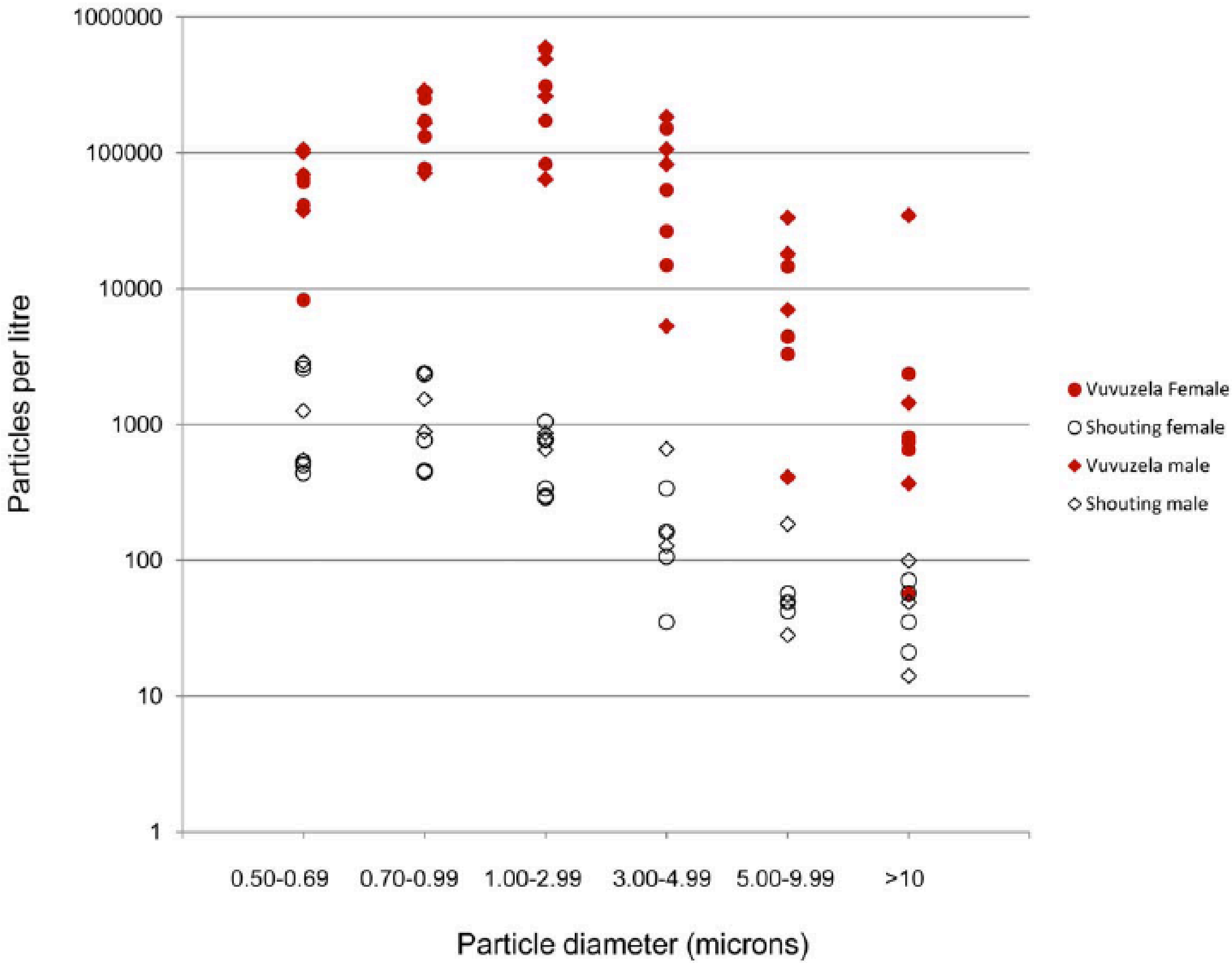


Figure 2. Concentration of airborne particles exiting the vuvuzela or shouting cone by their diameter. Peak concentration of particles captured at the exit of the vuvuzela and shouting cone when used by eight volunteers, four female and four male. Data points are means of triplicate experiments.

doi:10.1371/journal.pone.0020086.g002

Always be critical and be willing to reconsider

- Examine your ideas critically before fixing your hypothesis
  - "it must be submitted to most careful scrutiny before being accepted even as a tentative hypothesis, for once an opinion has been formed it is even more difficult to think of alternatives."

- Be ready to modify (or even abandon) your hypothesis if it is shown to be inconsistent with the facts (results)
  - "…with as few regrets as possible."
  - "The scientist who has a fertile mind and is rich in ideas does not find it so difficult to abandon one found to be unsatisfactory as does the man who has few."
  - BUT be persistent: "There is a great difference between (a) stubborn adherence to an idea which is not tenable in face of contrary evidence, and (b) persevering with an hypothesis which is very difficult to demonstrate but against which there is no direct evidence."

Beveridge, The Art of Scientific Investigation

But, don't be afraid of uncertainty

There is nothing reprehensible about making a mistake, provided it is detected in time and corrected. The scientist who is excessively cautious is not likely to make either errors or discoveries. Whitehead has expressed this aptly: "panic of error is the death of progress." Humphrey Davy said: "The most important of my discoveries have been suggested to me by my failures." The trained thinker shows to great advantage over the untrained person in his reaction to finding his idea to be wrong. The former profits from his mistakes as much as from his successes. Dewey says:

> "What merely annoys and discourages a person not accustomed to thinking . . . is a stimulus and guide to the trained enquirer. . . . It either brings to light a new problem or helps to define and clarify the problem."[29]

The productive research worker is usually one who is not afraid to venture and risk going astray, but who makes a rigorous test for error before reporting his findings. This is so not only

Have a flexible path in mind

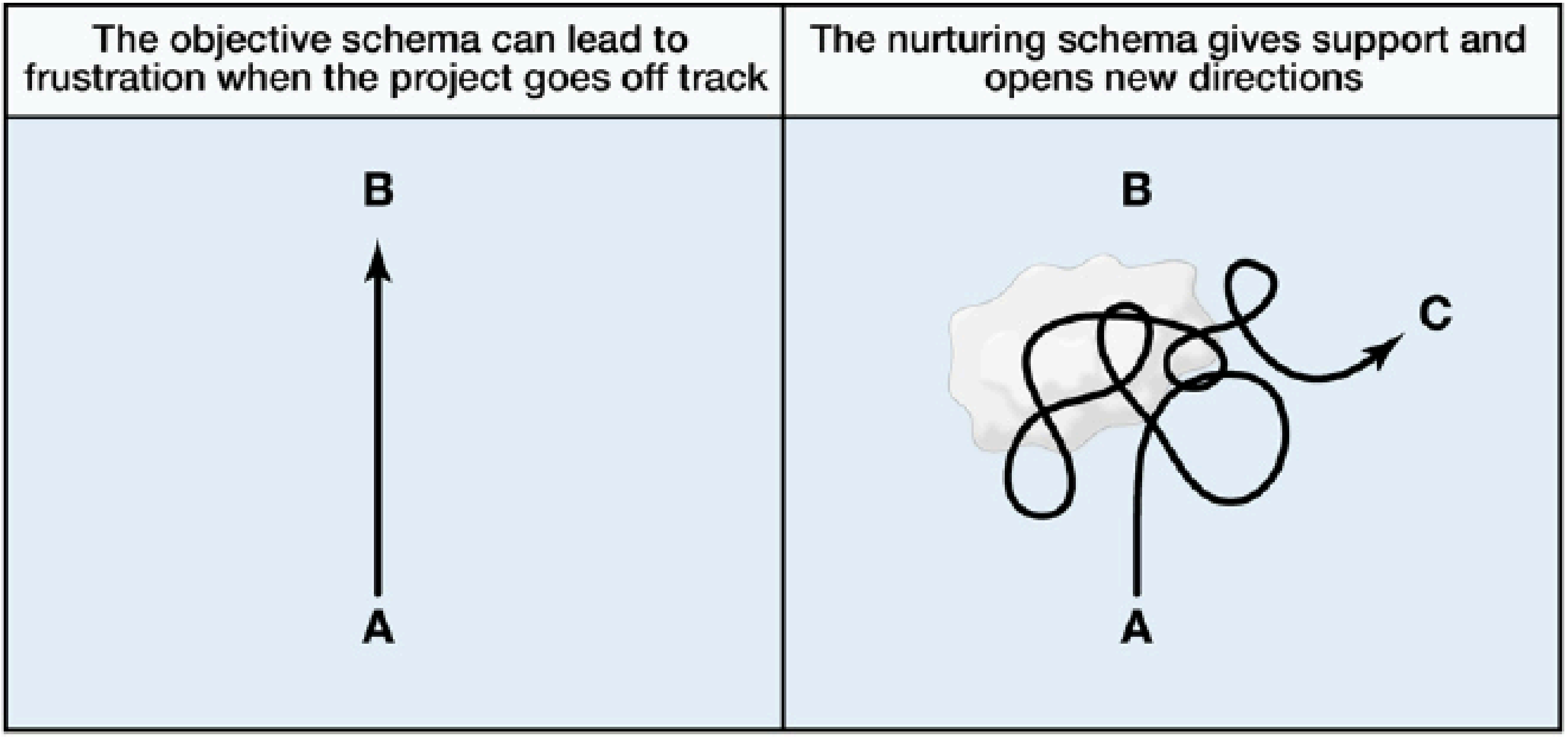


Figure 2. The Objective and Nurturing Schemas of Research

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"

Alon, *Molecular Cell* 35, 2009.

What we don't want

http://www.youtube.com/watch?v=Fl4L4M8m4d0

3,344,628 views as of Jan 2012

How do you manage your time?

What are your most annoying tasks?

What tasks would you like to manage better?

Who needs a personal productivity coach?

Why need a time management strategy?

- We will always have more demands on our time; thus, we need to keep track of things at multiple levels
- Bad time management = **stress**

- Time management is an important **life** skill, way beyond research
- Efficient doesn't imply impolite; it's very much the opposite.

Why it's difficult to manage academic time

- Lots of choices (academic "freedom")
- Lots of open-ended tasks (i.e., research)
- Universities (especially big ones) are sometimes bureaucratic, e.g., some simple administrative actions involve several levels of communication/approval
- We need to balance short-term and long-term interests, and we need "thinking time" which may not be urgent but is VERY important
- We're learning as we go…

Being Bob Langer

Running one of the biggest academic labs in America gives Robert Langer almost 100 people to help and advise; his BlackBerry gives him the rest of the world. **Helen Pearson** joins the throng.

At 16.26 in the afternoon on an icy Tuesday in January, Robert Langer is in his office at the Massachusetts Institute of Technology (MIT) with a Harvard University freshman called Lulu Rebecca Tsao. Langer met Tsao last year in Finland when he and her stepfather were collecting awards from the Millennium Prize Foundation. Now she is in Cambridge, she has come to ask his advice on which projects to do, and Langer offers to show her around the lab. A quick tour would be great, she says.

It will have to be quick. In my hand there is a three-page printout of the day's schedule provided by Bethany Day, the assistant who keeps Langer's diary. He has four minutes until what would be the fourteenth meeting since breakfast — if he had had breakfast. And his research lab is not a thing to tour in four minutes: try four hours. It is the biggest in the chemical-engineering department, and probably the biggest in MIT. It may well be one of the biggest academic labs in the world under a single principal investigator. Its 1,300 square metres take up most of this floor of MIT's building E25 and some of a floor above. But Langer doesn't mention any of that. He leads us from room to room pointing out postdocs and pausing at embryonic stem-cell cultures.

At the doors, he peers over the top of his glasses at a list of key codes that Day has helpfully printed out while he carefully punches numbers into the locks.

Langer has a lab of more than 80 people, has authored in excess of 1,000 papers and holds more than 300 patents with almost as many pending. Those patents have been licensed or sublicensed by more than 200 companies, about two dozen of which Langer took a key role in founding. His 73-page CV (in small font, single spaced) starts with a 1970 chemical engineering degree at Cornell University in Ithaca, New York, and ends with patents pending in biodegradable shape-memory polymers. I have come to spend the day with him to get a sense of how it is possible for such a monster of productivity to do what he does — and why he does it.

"If people feel good about themselves, they will solve problems."
— Robert Langer

In answer to the latter question, he says that he has only ever wanted to help people, make them happy and do good in the world. "If people feel good about themselves, they will solve problems." When I first heard this, the previous evening, I thought it sounded trite. By the time he, Tsao and I are touring the lab, I've come to think it pretty unvarnished truth.

TUE, JAN 13 06:15

Langer is up and pulling on his shorts. When his father died from heart disease aged 61, Langer, then 28, gave up eating meat and started exercising, something he now does for two hours or more each day. Now 60, he uses the time in his home gym to work and read, sometimes scrawling notes on the gym-machine console. This morning, he reads *The Boston Globe*, starts skimming through the nearly 200 grant proposals he is reviewing for the Bill & Melinda Gates Foundation's Grand Challenges in Global Health and listens to country music — his favourite. He skips breakfast but for a few sips of Diet Coke.

These first hours, I must admit, are hearsay. I had suggested that our day together run from waking to sleeping but Langer — in consultation with his wife — understandably declined.

TUE, JAN 13 08:45

Langer picks me up at the hotel near his office in his beige Mercedes-Benz E350. It's only a few blocks to his office, but the trip is long enough

H. PEARSON

to pass two or three of the biotechnology companies he has started. Langer traded up from a clapped-out Ford Pinto to a Mercedes Baby Benz when he received his first consulting fee in the 1980s. He gets a new one every five years.

TUE, JAN 13 09:37

I am not the only media person around today. A film crew is setting up in Langer's office; he puts on a jacket (his black jeans and brown shoes are out of shot) and starts answering questions about his achievements. It's an educational video for the website of the Charles Stark Draper Prize, a US$500,000 award sometimes called a Nobel prize for engineering. Langer won it in 2002. The woman organizing the shoot told me that some of the other winners were impossible to pin down, but Langer was happy to oblige.

Langer recently read *Outliers*, a book in which Malcolm Gladwell makes the case that exceptional people get where they are partly because of the exceptional circumstances in which they find themselves, rather than through exceptional ability or sheer hard work. Langer concurs. There is a personal aspect, he says, "a combination of stubbornness, risk taking, perhaps being reasonably smart and wanting to do good". But there is also just the chance of wh engineer ke he tried to f medical scho Harvard Uni job isolating growth. It w was like a kid sheer numb that might y and imagina inhibitor Fol *ence* 193, 70 a porous po which such (R. Langer ar 1976). The i both biologi them absur founding th delivery and

TUE, JAN 13

Phil Hilts, w Journalism some advice ogy to invit He is possib for some ad

access to his network and his experience, and he obliges. In *The Audacity of Hope*, Barack Obama recounts asking Langer's advice on stem-cell research in 2006. Langer replied that more stem-cell lines would be useful, but "the real problem we're seeing is significant cutbacks in federal grants".

TUE, JAN 13 11:13

On the way to and from the bathroom, Langer deals with seven or eight e-mails, including editorial advice on a paper being considered for *Proceedings of the National Academy of Sciences*. A passion for his BlackBerry is another link to Obama. At every moment he is not talking to someone directly, he slumps into a characteristic stoop over the device. His computer, by contrast, has not even been switched on so far today. All its processing power would make little difference to the speed at which Langer — a one-finger typist — sends messages. Not that much difference could be made. There is rarely more than a few minutes between sending Langer an e-mail and receiving a BlackBerry reply.

"Langer is the Tiger Woods, the Michael Jordan of engineering."
— Susann Luperfoy

TUE, JAN 13 11:45

down the requirements for starting a biotech company to a set of clear bullet points. (Do you have a platform technology, a seminal paper and a blocking patent? If not you may be in trouble). Then he recounts six of his own success stories. "Dazzling," says my neighbour at the table as Langer rounds up his talk.

As we walk back to his office, a small Mars rover appears to be making its way through the snow. "These kinds of things happen at MIT," he says.

TUE, JAN 13 13:35

Langer is embracing Smadar Cohen, once his postdoc and now a professor at Ben Gurion University in Tel Aviv, Israel. He says that nothing makes him prouder than his 180–200 former students and postdocs now heading academic labs of their own. Cohen is involved in a new biotech 'incubator' for promising academic research projects called Pharmedica, based in Haifa, Israel. She and Yoram Rubin, the chief executive, have flown here largely for 30 minutes of Langer's time; their questions are how to raise money and which field to specialize in.

Langer tells them that their incubator needs to be closer to having a product if they want to

Robert Langer's papers make covers — as does he.

stay in his lab. One is Dan Anderson, who has come to the office to talk about further expansion. "We need to hire more people and figure out how to get them," he says. The reason they need to expand is that the Juvenile Diabetes Research Foundation, which has awarded the lab a large grant to develop biocompatible polymers for encasing pancreatic islet cells, has recommended they get an immunologist on board. They talk about hiring a joint-postdoc with another lab, but then Langer says, "it's probably easier to have our own". He picks his book of National Academy Fellows off the shelf and turns to immunology. "I knew quite a few of these people. Frank Austen. Fred Alt. Irv Weissman, he's really interested in tissue engineering."

TUE, JAN 13 14:32

Charles Jennings wants to consult Langer about an IP issue. As head of the neurotechnology programme at MIT's McGovern Institute for Brain Research, it has fallen to Jennings to hammer out an IP agreement for discoveries made by researchers at the institute — somewhat like a prenuptial agreement for future income. In general, MIT policy is that income from IP is split three ways between the inventors, their department and MIT. Jennings has drafted an agreement to sort out how this would work at the McGovern Institute, which often involves collaboration across several departments. Langer is concerned that MIT's Department of Brain and Cognitive Sciences (BCS) might not like it. They agree it would be bad, as Langer says, if three years from now "the head of BCS says how did you guys pull this off? We got nothing and you get 100%."

TUE, JAN 13 15:00

A smell of perfume fills the air. Rob Robillard and three well-made-up young women (Jamie, Amber and Michelle) file into the office. As well as starting a bevy of companies that make biomedical devices, drugs or delivery systems, Langer also helped found Andora, which is now called Living Proof. The company, also based in Cambridge, uses chemical engineering to design hair and beauty products. Robillard is the chief executive.

Its first product, No Frizz, seals the gaps in the hair shaft so that water cannot enter, thus attempting to live up to its name. The three young women will be training beauty consultants across the United States when it is officially launched there in February (and on the QVC shopping channel). "It's spreading through the MIT campus," says Robillard. Through starting this company, Langer now has his (frizzy) hair cut for free by a top hair stylist.

TUE, JAN 13 15:30

Langer parcels out wisdom and contacts in 15- and 30-minute slots. To the undergraduate student wanting advice on courses: "The most important thing you can learn is fundamentals." If you want a placement in a company, "we can arrange that", he says. He gives Tsao the lab tour. A button has come undone, unnoticed, on his shirt. Langer told me earlier that he does wonder whether he needs to be better at saying no to things. But "I don't like to hurt people's feelings", he says.

"The most important thing you can learn is fundamentals."
— Robert Langer

TUE, JAN 13 16:38

We are slightly late to meet Rodriguez, whose appointment was rescheduled. She missed her original slot because she was trapped in an elevator for 45 minutes. She looks close to tears, but not because of the elevator; she's having difficulty deciding whether to accept a job offer from Merck, or whether to go to graduate school. Langer tells her there is no wrong choice. "What do you feel in your heart you want to do?" he says. "I think I'm gonna work," she says eventually, looking unconvinced.

TUE, JAN 13 17:10

Langer walks upstairs to a conference room filled with a throng that, in most other labs, would be an all-hands meeting. But this is just the undergraduates who work here; he has organized a pizza and soda session in an attempt to make himself accessible. As they introduce themselves (he doesn't know all their names), their varied projects outline the sheer scope of the lab's activities: stem-cell regeneration; contact lenses that release drugs; lipid parcels that deliver small RNAs; biomaterials for insulin delivery; DNA vaccines.

What is your favourite discovery, they ask. (His 1976 *Nature* paper.) Where do you like to travel best? (Paris. Maui. Where the food is good.) Are you still intimidated by talks? (No.) Where do you find your inspiration? (TV shows, music, reading, no single mechanism.) How do you balance everything? (Exercise a lot.) If you did it all over again, what would you do differently? (He wouldn't change anything.) Will America still be a power in future research? (Yes.) What was your worst mistake? (Even mistakes teach you to be better.) He answers them all, between three pieces of pizza.

TUE, JAN 13 18:50

Langer's computer is still sitting unused as we leave the office. He drops me back at the hotel — I'm exhausted. On his way home he stops for an ice cream — coffee chip frozen yoghurt with hot fudge sauce. He spends an hour on the exercise bike. Sometimes he reads *People* magazine or watches the Boston teams play. Tonight he reads CVs, revises a paper for *Angewandte Chemie* and prepares his talk for the World Economic Forum in Davos, Switzerland, later in the month. He listens to his daughter — one of three teenagers — practise the presentation for her Friday chemistry class on smart polymers. "She did it all herself," he says. "She has four citations and an interview with me. I don't do her homework. I explained some of the chemistry." Then he does another hour on the cross-trainer and treadmill. No dinner speech today, and his own bed to look forward to: comparatively relaxed.

TUE, JAN 13 23:10

While packing for tomorrow's trip to Tampa, Florida, for the Armed Forces Institute of Regenerative Medicine, Langer panics: where are his passport and phone? They're in his coat.

TUE, JAN 13 23:50

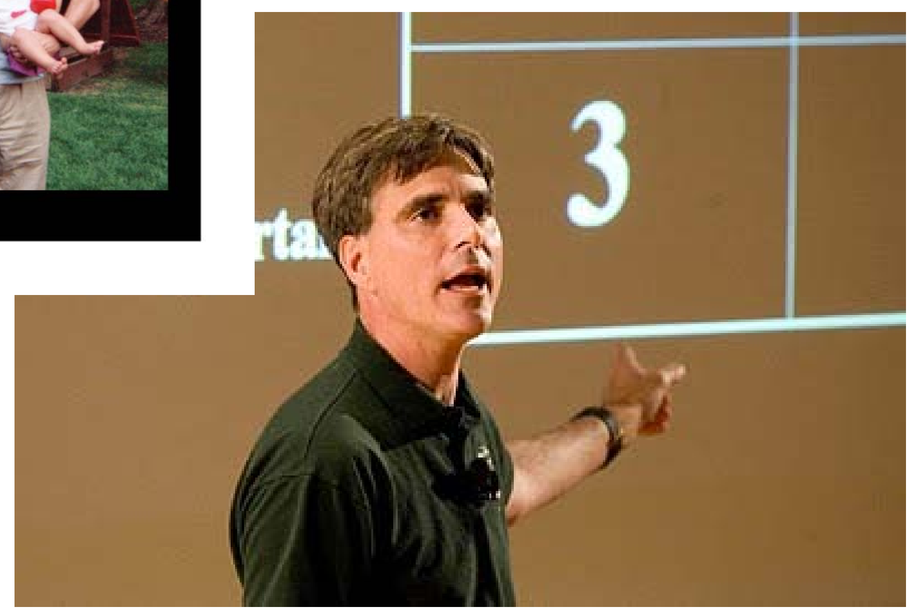
Langer's BlackBerry is charging in the bathroom. He is in bed. I can't tell you what he dreams of. But if I had to guess it would be about happy, helped people. ■

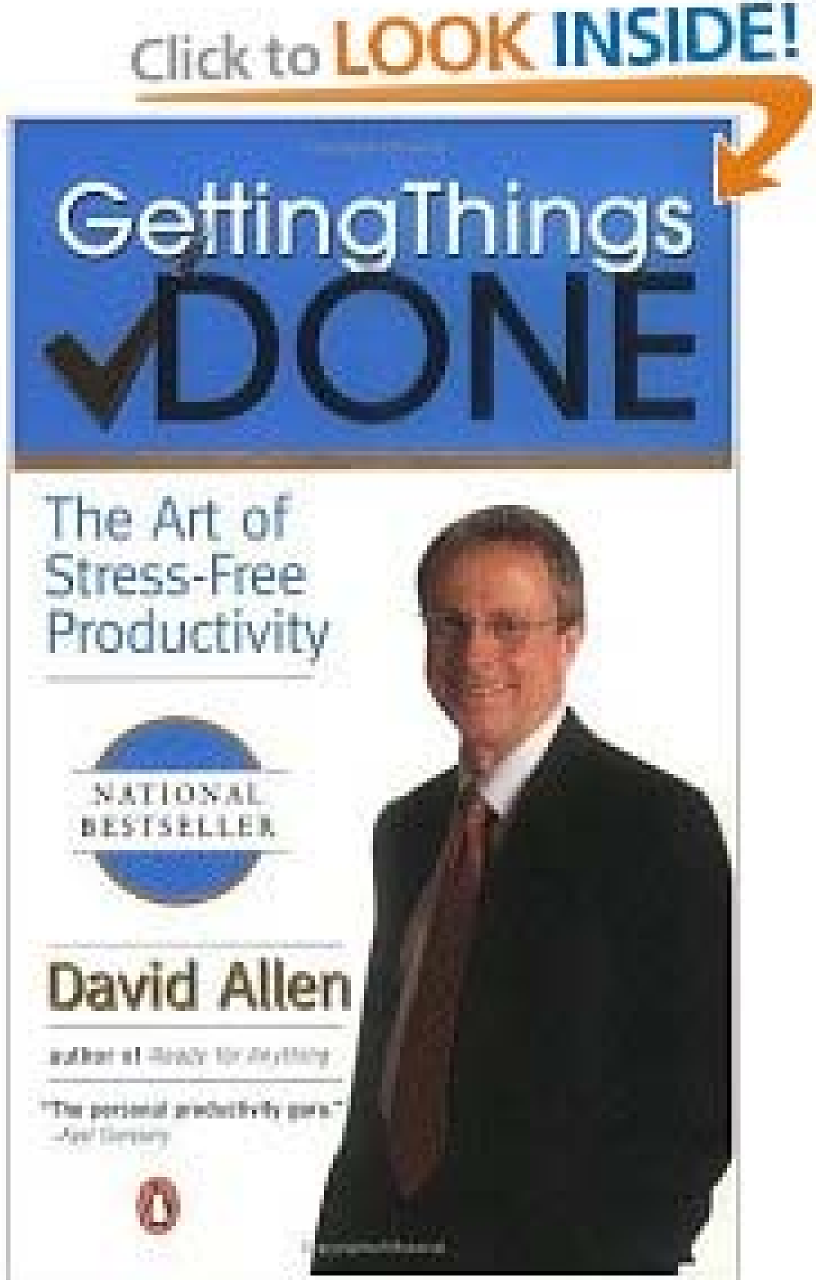
Helen Pearson is *Nature*'s biology features editor.

BOSTON GLOBE/LANDOV; WILEY-VCH VERLAG; SCIENCE/AAAS

Inspiration and resource

http://www.cs.virginia.edu/~robins/Randy/




Click to LOOK INSIDE!
Getting Things DONE
The Art of Stress-Free Productivity
NATIONAL BESTSELLER
David Allen

“Most of the stress people experience comes from inappropriately managed commitments they make or accept.

Even those who are not consciously stressed out will invariably experience greater relaxation, better focus, and increased productive energy when they learn more effectively to control the ‘open loops’ of their lives”

-David Allen

How can we always be focused?

The **extended will**:

"…external tools and techniques that help the parts of ourselves that actually want to work"

"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

you

goal

Allen's approach to managing actions

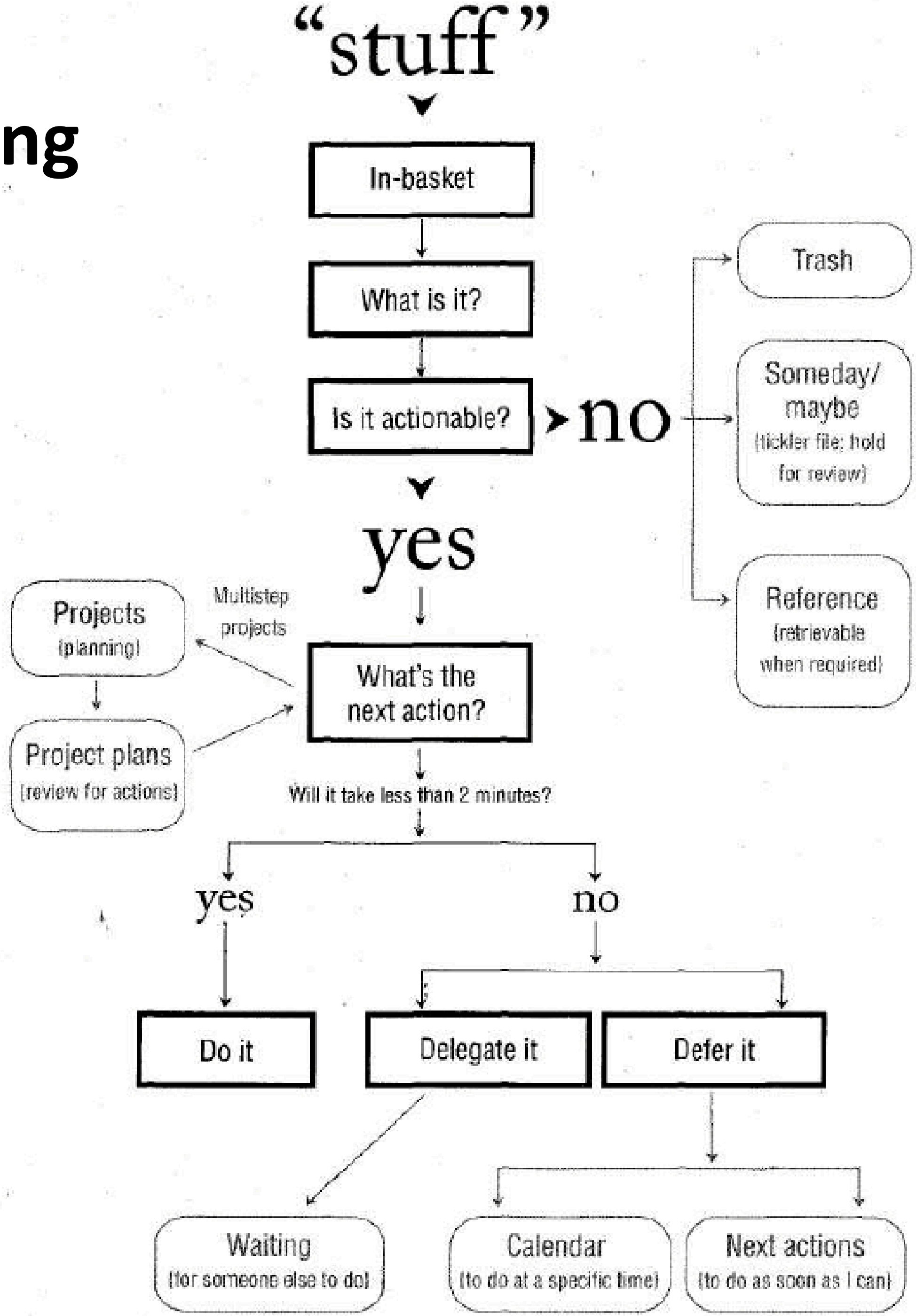
1. Collect things that command your attention
2. Process what they mean and decide what to do about them
3. Organize the results (=actions you decided)
4. Review (daily, weekly)
5. **DO**

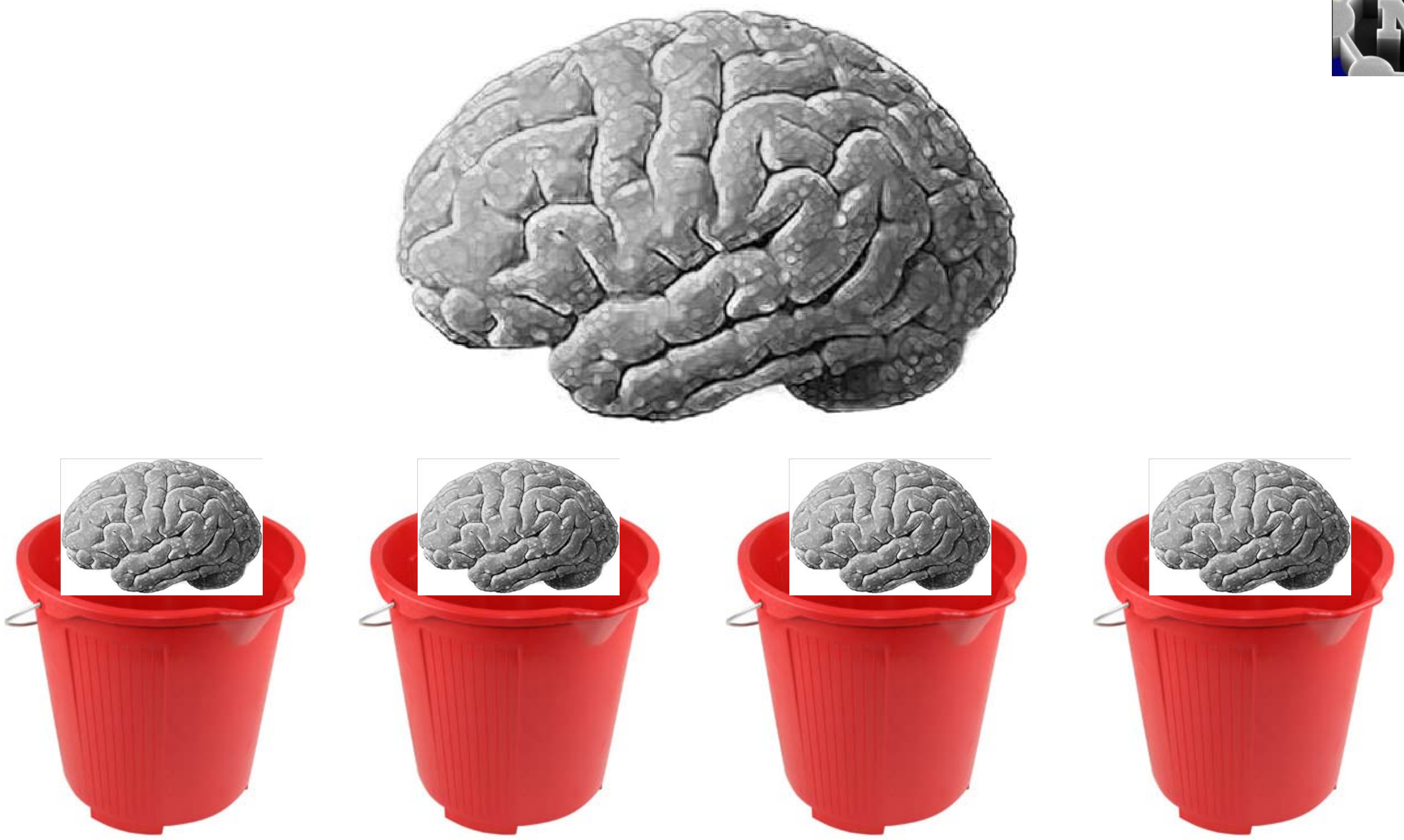
1-4 are "horizontal" and 5 is "vertical"

Start by listing all your projects/commitments, and related actions

This is a continuous and iterative process!

Processing and organizing



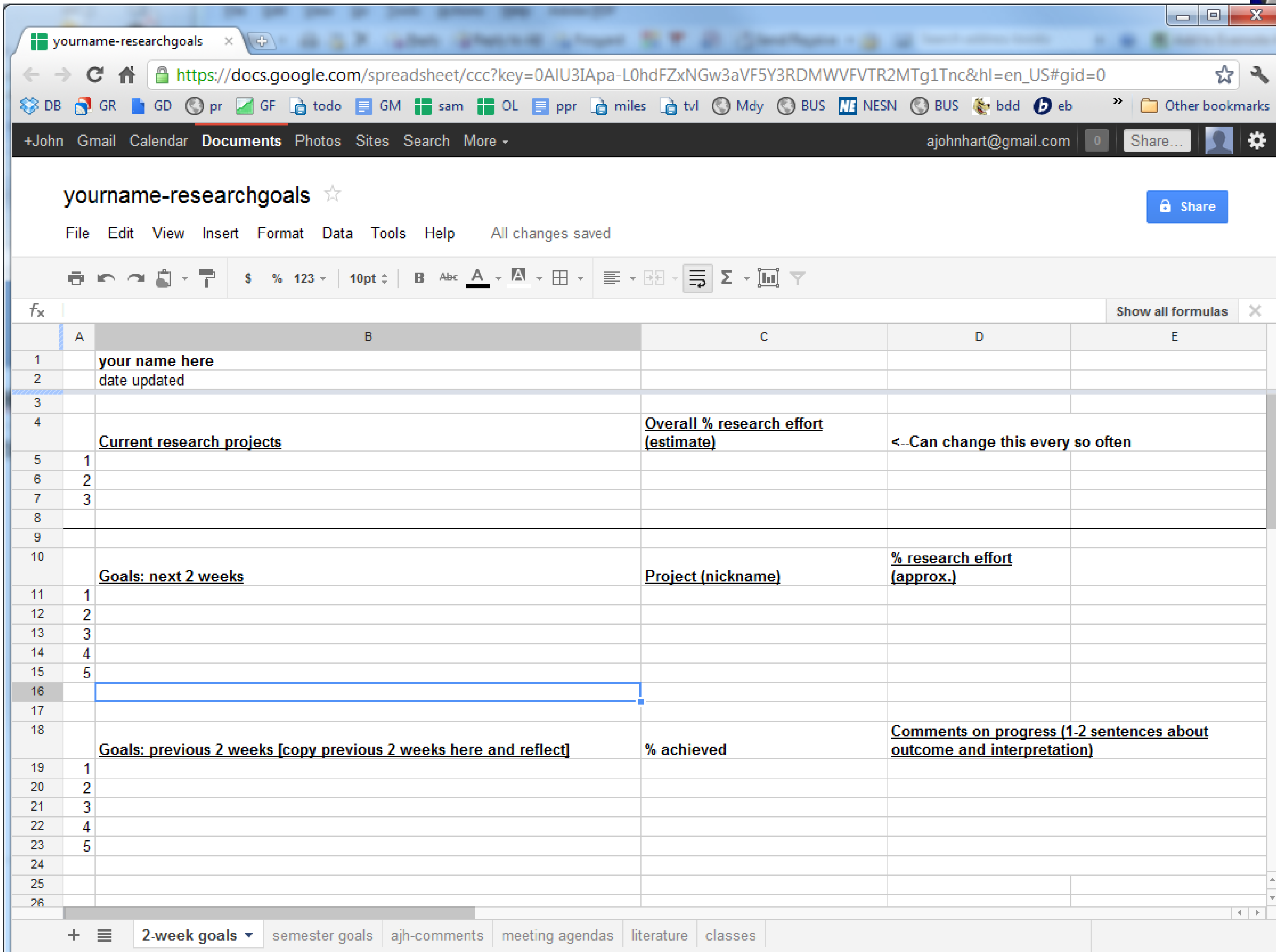


“It’s a waste of time and energy to keep thinking about something that you make no progress on”

-David Allen

How do I prioritize and prevent some things from slipping through the cracks?

The goalsheet



	A	B	C	D	E
1		**your name here**			
2		date updated			
3					
4		**Current research projects**	**Overall % research effort (estimate)**	**<--Can change this every so often**	
5	1				
6	2				
7	3				
8					
9					
10		**Goals: next 2 weeks**	**Project (nickname)**	**% research effort (approx.)**	
11	1				
12	2				
13	3				
14	4				
15	5				
16					
17					
18		**Goals: previous 2 weeks [copy previous 2 weeks here and reflect]**	**% achieved**	**Comments on progress (1-2 sentences about outcome and interpretation)**	
19	1				
20	2				
21	3				
22	4				
23	5				
24					
25					
26					

Always review short- and long-term plans

Always think horizontal and vertical

T

Like a deep sea diver riding a jetski

The "80/20" rule

- A very small number of things create a very large part of the total value in your work
  - [A very small number of experiments create the vast majority of results that will be in your thesis!]

- So, how do I prioritize so I maximize the time spent on tasks that generate value?

The four quadrants [Pausch 28:20-31:00]

	Urgent	Not urgent
Important		
Not Important		

Adapted from Covey's "7 Habits"

The four quadrants

	Urgent	Not urgent
Important	1	2
Not Important	3	4

- But sometimes we need a little of #3/#4

Adapted from Covey's "7 Habits"

How do I decide what to do?

1. Context
2. Time available
3. Energy available
4. Priority

Allocating your time

“Remember, that time is money.

He that can earn ten shillings a day by his labor, and goes abroad, or sits idle, one half of that day, though he spends but six pence during his diversion or idleness, ought not to reckon that the only expense; he has really spent, or rather thrown away, five shillings besides.”

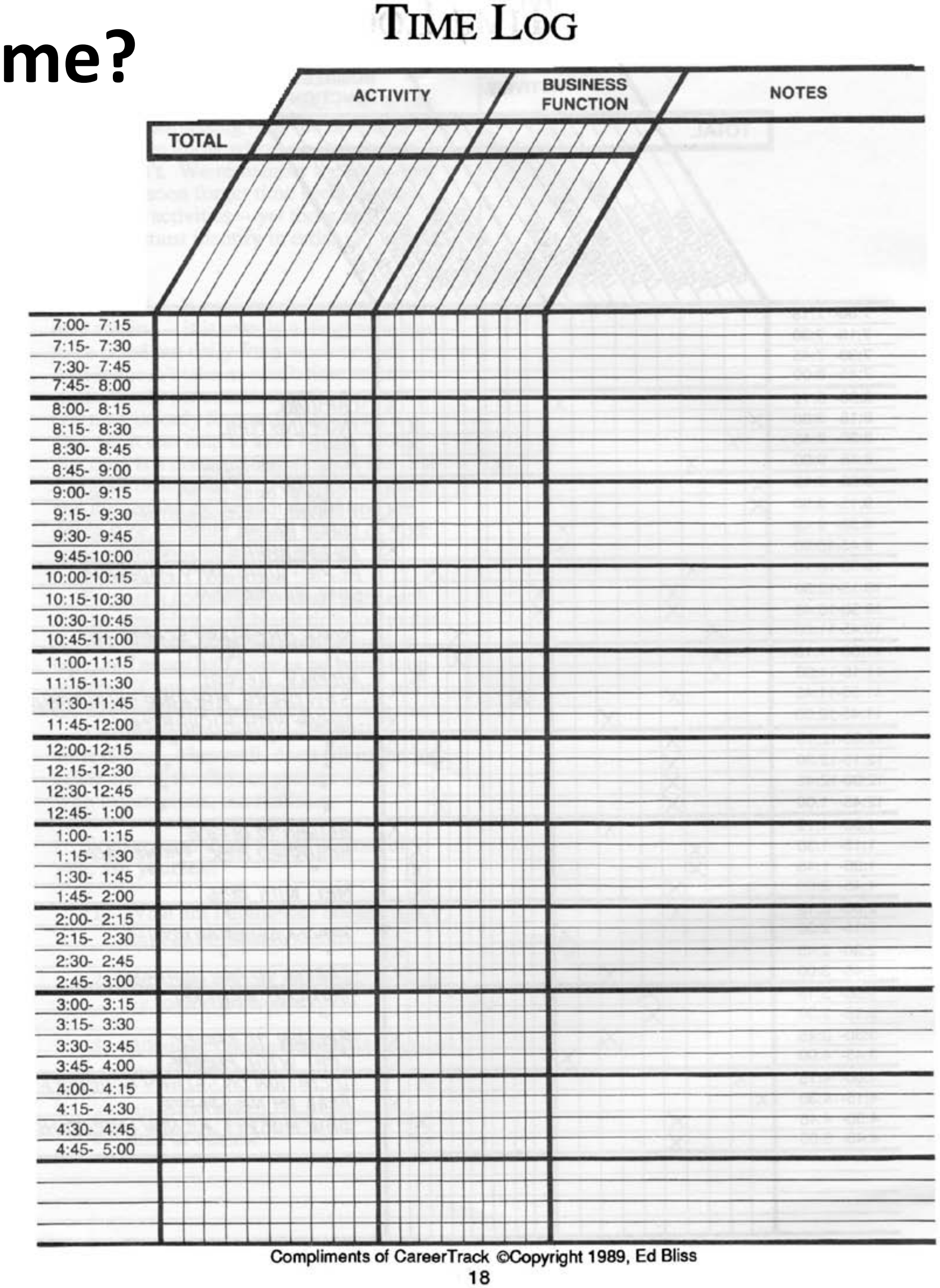
-Benjamin Franklin, 1748

What is the value of your time?

$$$

How do I spend my time? [Pausch 56:30-59:15]

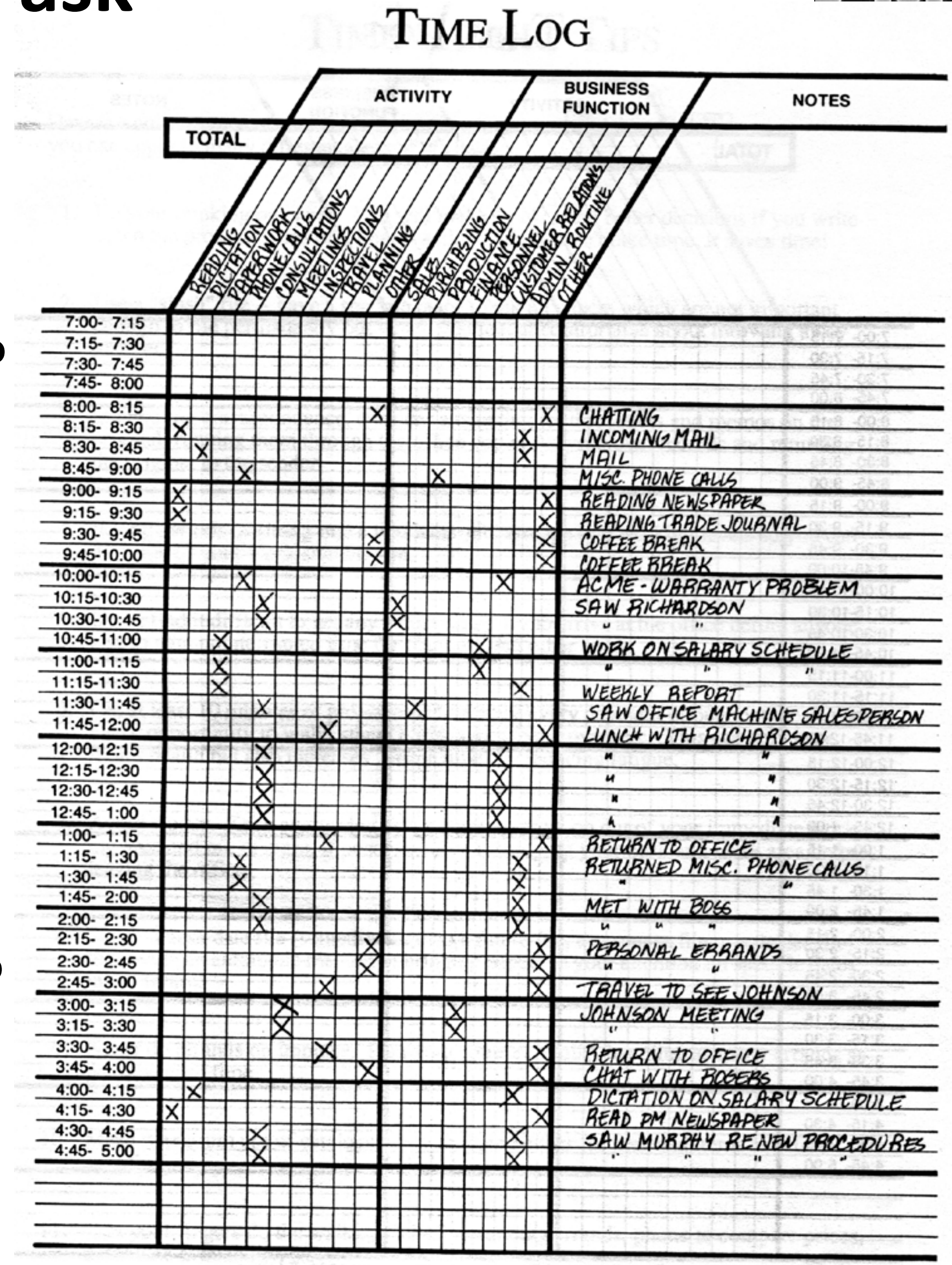
- Monitor yourself in 15 minute increments for up to 2 weeks
- Update it during the day, not at the end
- Has anyone done this?



Fred Brooks’ time clocks

Review your journal and ask

- Am I considering the urgent-important quadrant?
- What doesn't need to be done?
- What can I do more efficiently?
- What could I do more effectively with help?
- How am I wasting others' time?

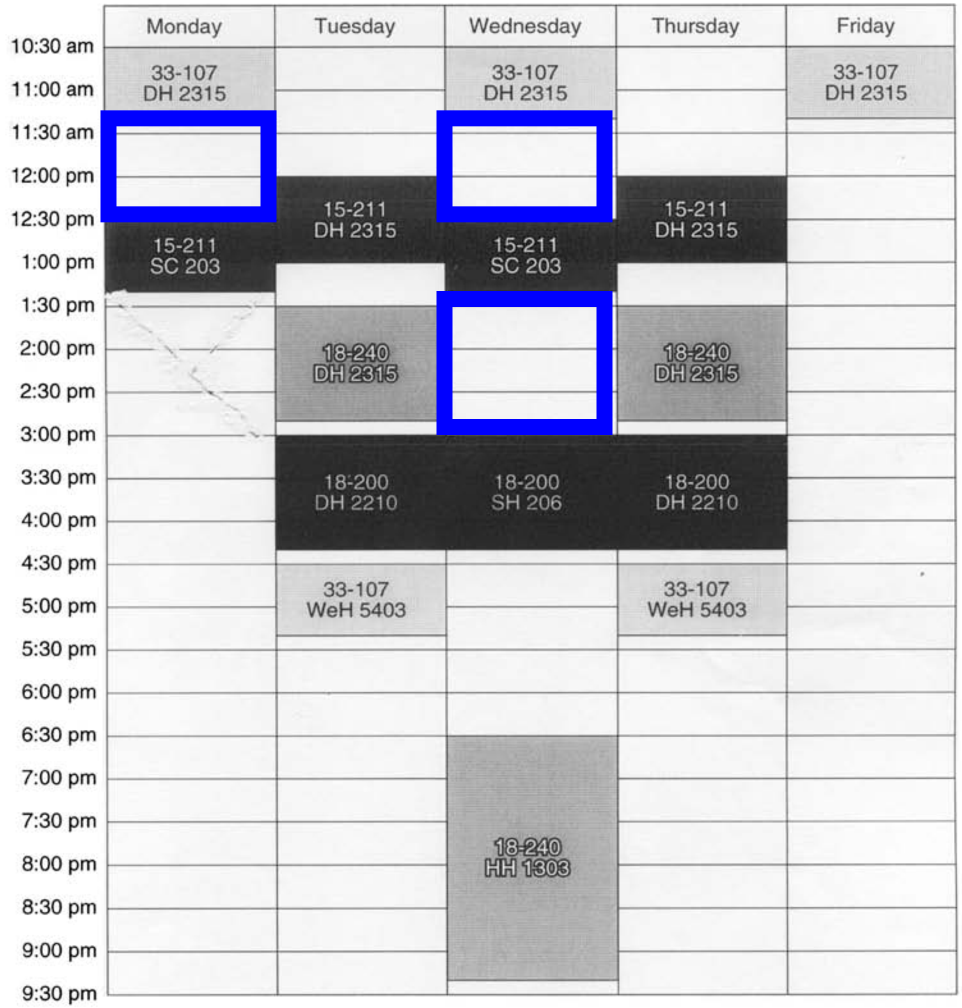


Know when you're good at what

- Find your creative time (and place), and defend it! This is a good time to do difficult experiments, write, or have important meetings.

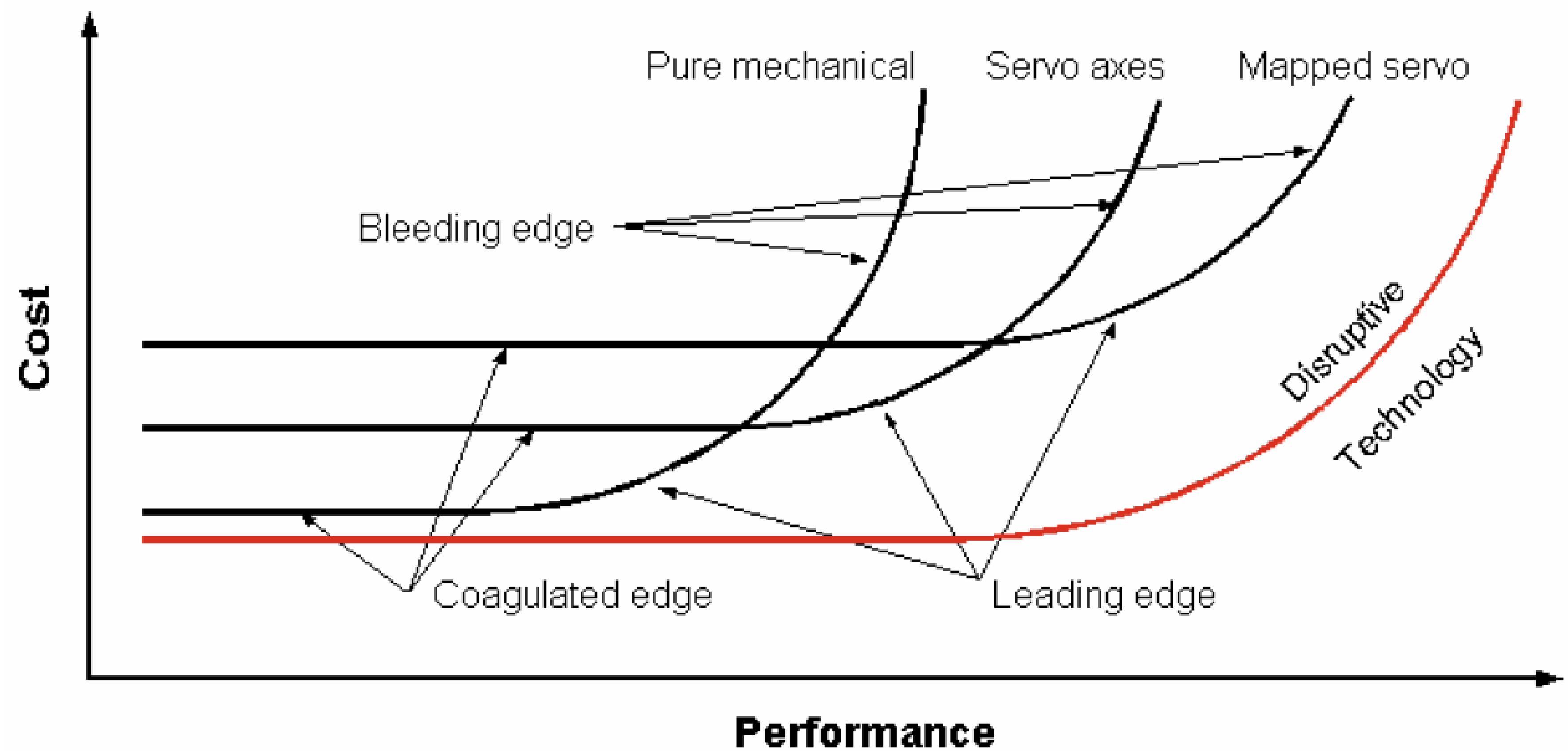
- Find your dead time and schedule mundane things then, like boring meetings or cleaning your lab bench!

Schedule your gap times



Course	Sec	Units	Professor	Course Name
15-211	E	12.0	Blum, Goldstein	Fundamental Structs of Computer Science I
18-200	C	12.0	Hoburg	Mathimatical Foundations of EE
18-240	B	12.0	Thomas	Fundamentals of Computer Engineering
33-107	G	12.0	Meyer, Feenstra	Physics for Engineering Students II
80-210	A	9.0	Scheines	Introduction to Logic

Know when/where to stop



→ Stay on the leading edge!


Do not burden yourself
with trivial matters.
10
DELL
DELL

Eliminate simple things that waste time

- Interruptions

- Messy desk/lab

- No calendar → missing appointments

- Being unprepared/late for meetings

- Being too tired thus unable to concentrate

→ Research [Pauch] says that these waste 2 hours a day!

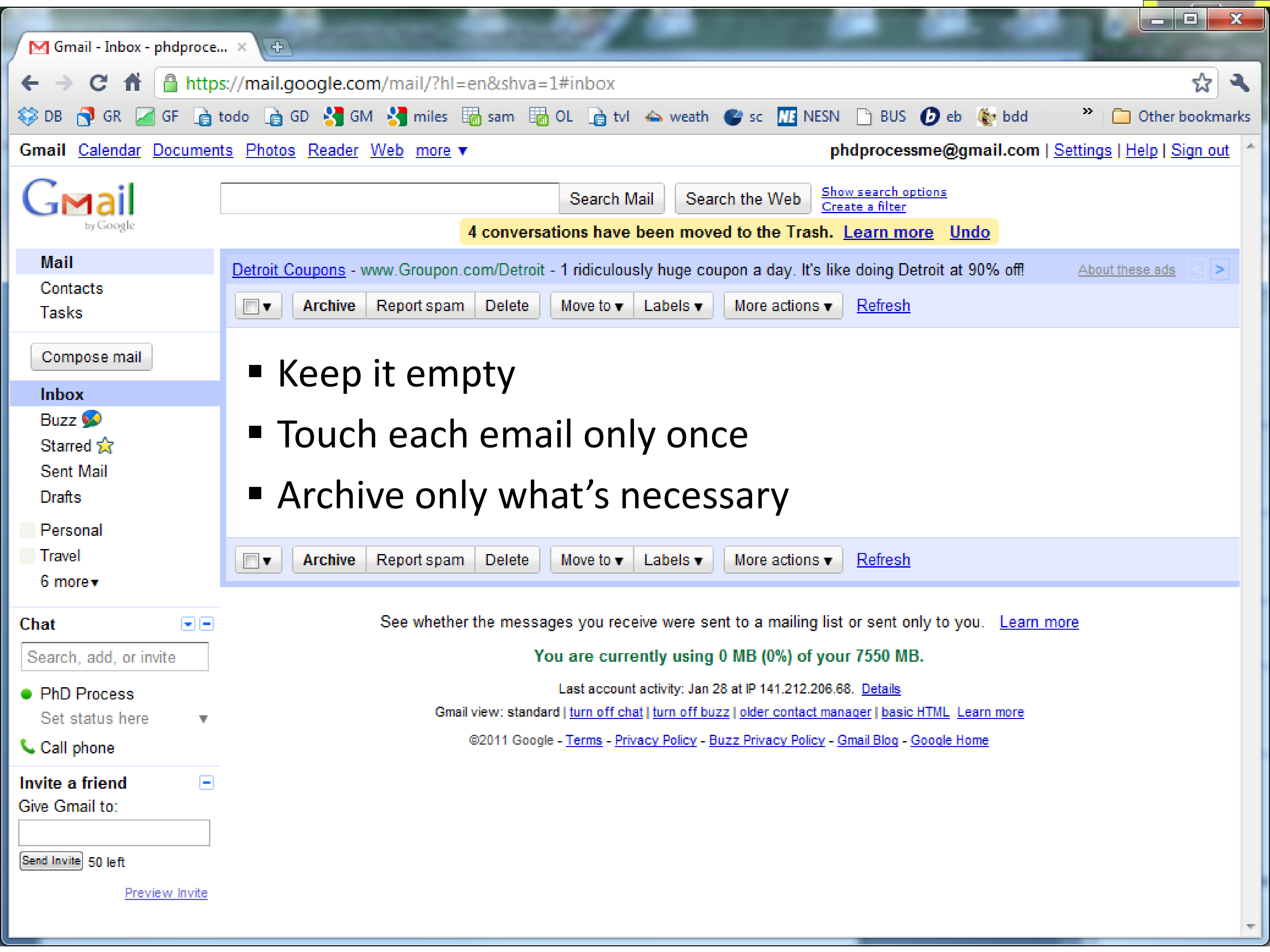
GET ORGANIZED!

Avoid interruptions (grrrrrrr)

- Say each interruption takes 7 minutes, and you need 5 minutes to recover (= full focus): 5 interruptions = 1h gone!

- Reduce the frequency and length of interruptions, e.g.,
  - Put ideas into bins for later
  - Make best use of phone and email
  - Don't check email continuously
  - Ignore your mobile phone!
  - Busy status on chat
  - Limit web surfing…

- On the contrary, if it's really quick:
  - do it now but put yourself in a position to reduce the number of interruptions


Gmail - Inbox - phdproce...
https://mail.google.com/mail/?hl=en&shva=1#inbox
DB GR GF todo GD GM miles sam OL tvl weath sc NESN BUS eb bdd
Other bookmarks
Gmail Calendar Documents Photos Reader Web more ▾
phdprocessme@gmail.com | Settings | Help | Sign out
Search Mail
Search the Web
Show search options
Create a filter
4 conversations have been moved to the Trash. Learn more Undo
Mail
Contacts
Tasks
Compose mail
Inbox
Buzz
Starred
Sent Mail
Drafts
Personal
Travel
6 more ▾
Detroit Coupons - www.Groupon.com/Detroit - 1 ridiculously huge coupon a day. It's like doing Detroit at 90% off!
About these ads
Archive
Report spam
Delete
Move to ▾
Labels ▾
More actions ▾
Refresh
▪ Keep it empty
▪ Touch each email only once
▪ Archive only what's necessary
See whether the messages you receive were sent to a mailing list or sent only to you. Learn more
You are currently using 0 MB (0%) of your 7550 MB.
Last account activity: Jan 28 at IP 141.212.206.68. Details
Gmail view: standard | turn off chat | turn off buzz | older contact manager | basic HTML Learn more
©2011 Google - Terms - Privacy Policy - Buzz Privacy Policy - Gmail Blog - Google Home
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Search, add, or invite
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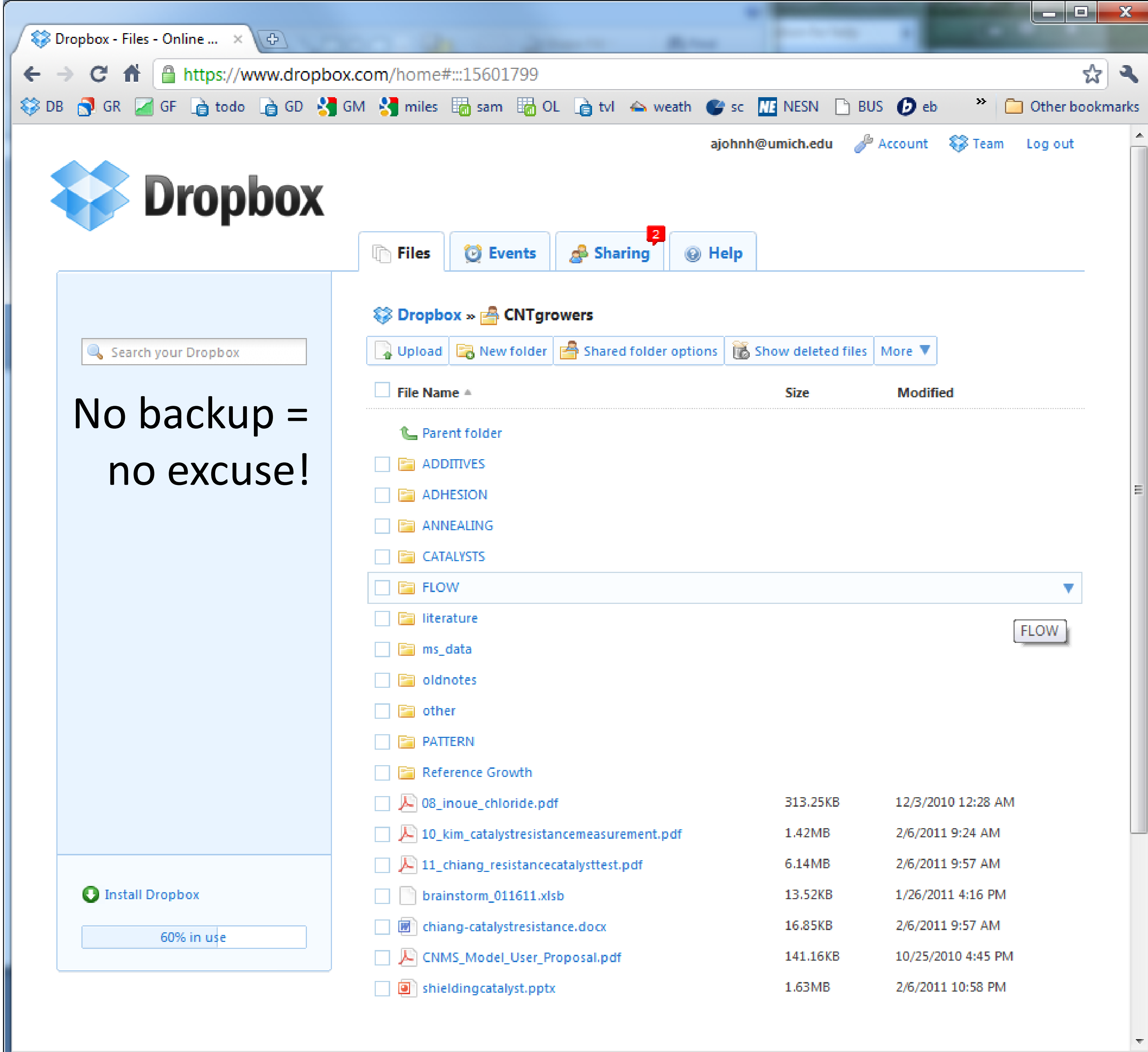
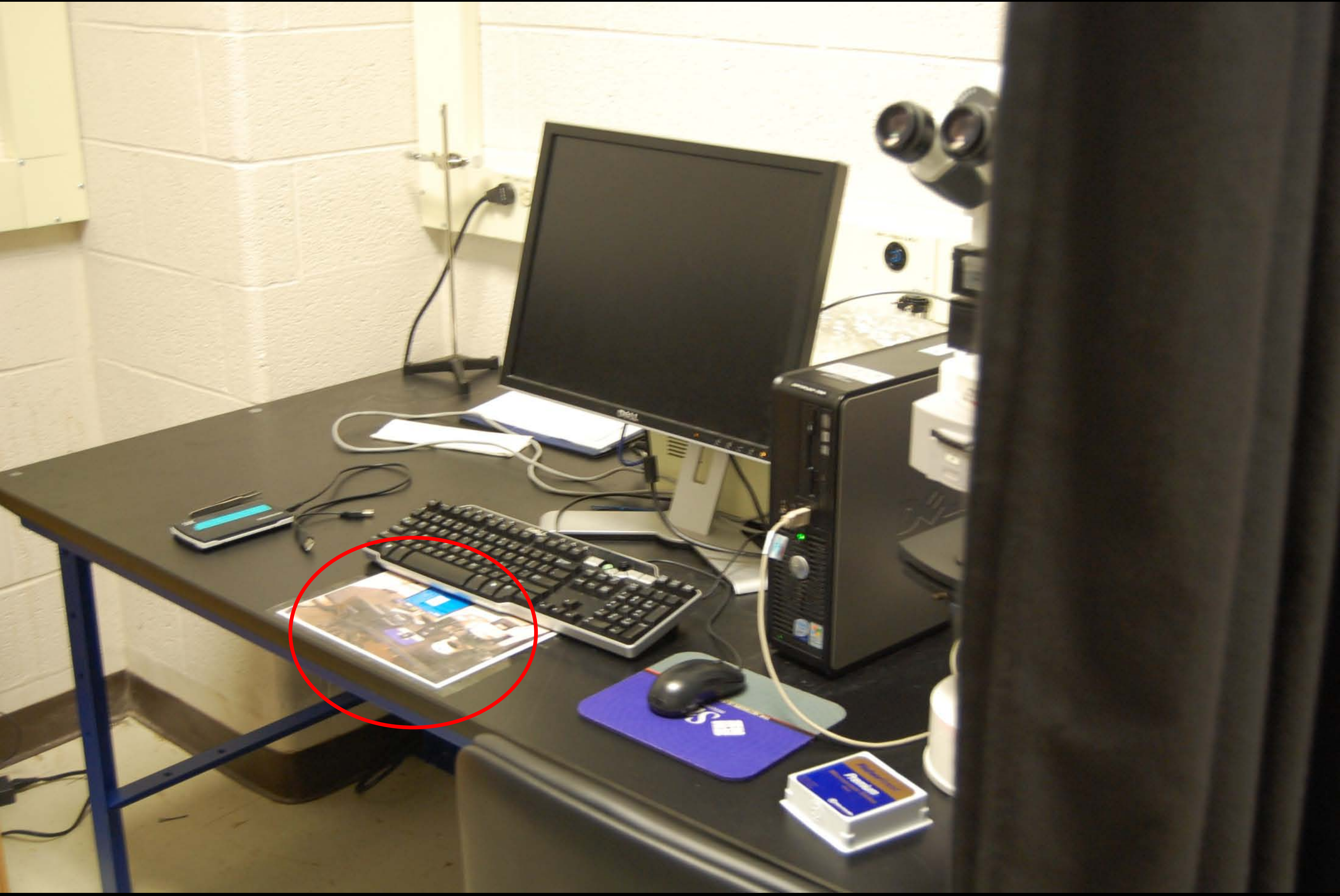


No backup =
no excuse!

How does your environment encourage/discourage wasted time?



Last: procrastination

"**Procrastination** is the thief of time."

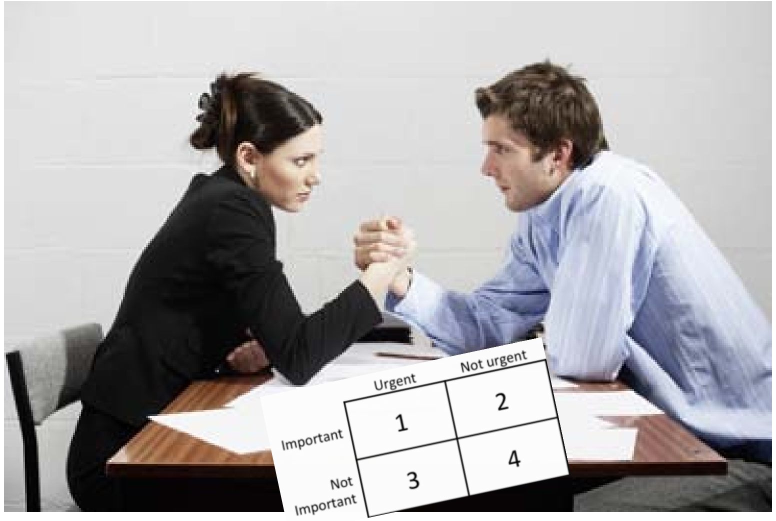
-Edward Young, 1742
(6y before Ben Franklin)

"Procrastination most often arises from a sense that there is too much to do, and hence no single aspect of the to-do worth doing. . . . Underneath this rather antic form of action-as-inaction is the much more unsettling question whether anything is worth doing at all."

-Mark Kingwell

An internal struggle?

"…the person who makes plans and the person who fails to carry them out are not really the same person: they're different parts of what the game theorist Thomas Schelling called "**the divided self**." Schelling proposes that we think of ourselves not as unified selves but as different beings, jostling, contending, and bargaining for control."



http://www.newyorker.com/arts/critics/books/2010/10/11/101011crbo_books_surowiecki#ixzz1DbjBVZVa

Consider the "cones of annoyance" …how soon before its deadline does a task start to bother you? The shape of the function changes if you know you're going to procrastinate!

“Academics, who work for long periods in a self-directed fashion, may be especially prone to putting things off.”

-James Surowiecki, 2010

- Research Proposal Submission Process
  - Introduction
  - **College of Engineering Proposal Deadline and Administrative Shell Policy (Effective 1 January 2012)**
  - Cost Sharing Policies
  - Research Administration Resources
  - Quick Links
- Research Funding Resources and Information
- Research Faculty Appointments and Promotions
- Research Overview
- People
- Foundation Relations

College of Engineering Proposal Deadline and Administrative Shell Policy (Effective 1 January 2012)

CoE Proposal Deadline Policy Preamble

The CoE is reputed to be the most frequent abuser of DRDA proposal deadline policy. This practice of late delivery occasionally leads to failure to submit to sponsor and almost always leads to a rushed process with concomitant defects and aggravation of the DRDA staff. The customer service orientation of DRDA usually accommodates offenders of the policy so it has been difficult to enforce it.

To address this continuing problem, we have negotiated a relaxed deadline for delivery of a proposal to DRDA with the intent of enforcing it by returning proposals that miss the deadline. The proposed policy is described below.

CoE Deadline Policy (effective January 1, 2012)

DRDA has graciously agreed to pilot a new 2-day deadline policy for CoE proposals. The finalized proposal must arrive at DRDA 2 business days before the sponsor deadline date. DRDA will not begin the review process until the proposal is finalized within the eRPM and sponsor on-line systems.

Under this pilot program, the ePAF including the CoE Admin Shell (defined below) must be received in the CoE’s research office 4 business days prior to the sponsor deadline date. (Please note: the ePAF will not route to the CoE research office until all other departments and schools/colleges have signed off.)

Proposals arriving after the CoE deadline will not be approved

In rare cases where the PI team will be unable to meet this deadline, an exemption request must be made to the Associate Dean for Research. This exemption request must be made no later than one day prior to the CoE deadline date. Exemption requests after the deadline date will not be considered.

Battling procrastination

- Set a deadline for yourself (and stick to it!)
  - Doing things just in time is much better than a last minute frenzy
- Step out of your comfort zones
- Identify why you aren't enthusiastic about something
- Don't fear embarrassment or failure
- Ask for help when you' re not sure what to do next

IMPORTANT: Be accountable

- Set stretch goals (deadlines for yourself) and more realistic deadlines when others are depending on you
- Never break a promise → if you won't be finished on time, try to renegotiate the deadline ahead of time
- Be open and clear about your priorities (e.g., "I can't do X right away because I need to do Y")
- Don't take on too many responsibilities: if you don't have time to do it right, you don't have time to do it wrong

Homework

- Reading for lecture 5 (on ctools)
  - Rackham graduate student mentoring guide

- Other references (in same folder)
  - Malmgren et al., "The role of mentorship in protégé performance"
  - Green and Bauer, "Supervisory mentoring by advisors: relationships with doctoral student potential, productivity, and commitment"

- ? 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