Talking about science:
a look at communication in academic settings

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2015 PlanetS professional development workshop

Where do I start?

What is the goal of the presentation?

What is the goal of the presentation?

conference talk

= get others to read your paper

= “sell” yourself and your work

What is the goal of the presentation?

group meeting

= update others on your progress

= get help with a sticky point

What is the goal of the presentation?

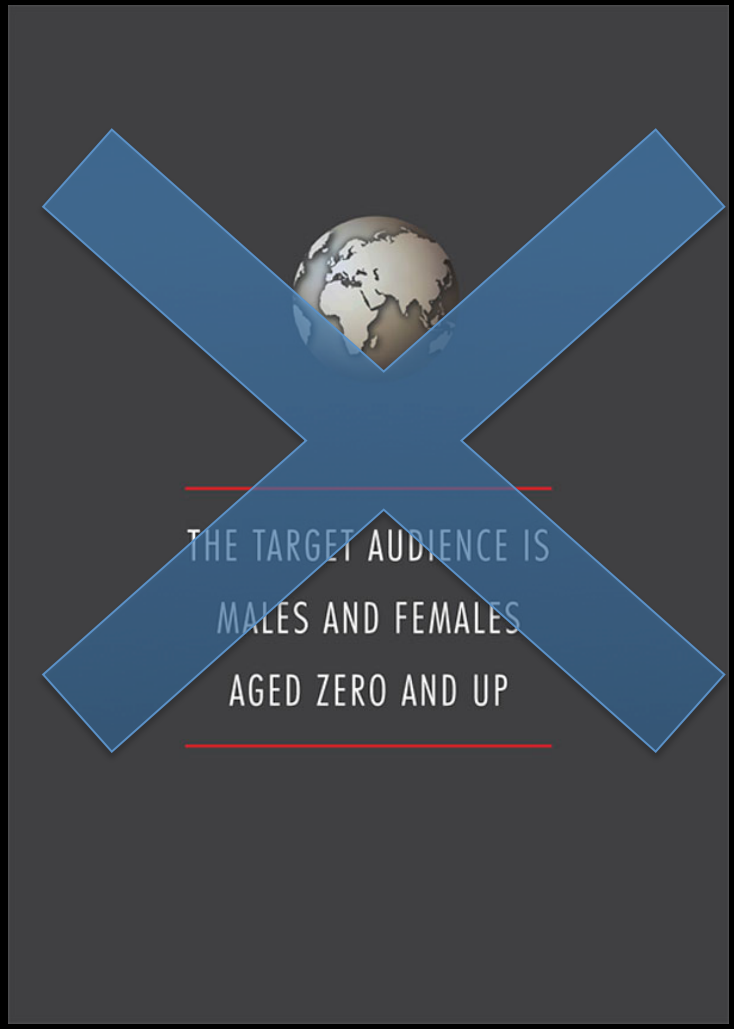
Exoplanet detection methods

Journal club
= keep up with literature
= explain/critique a paper

Who is your audience?

Who is your audience?

- experts
- non-experts
- peers
- potential employers



Start on paper to craft your story

The story you want to tell
- why?
- what?
- how?

Start on paper to craft your story

Powerpoint version of the story

The story you want to tell
- why?
- what?
- how?

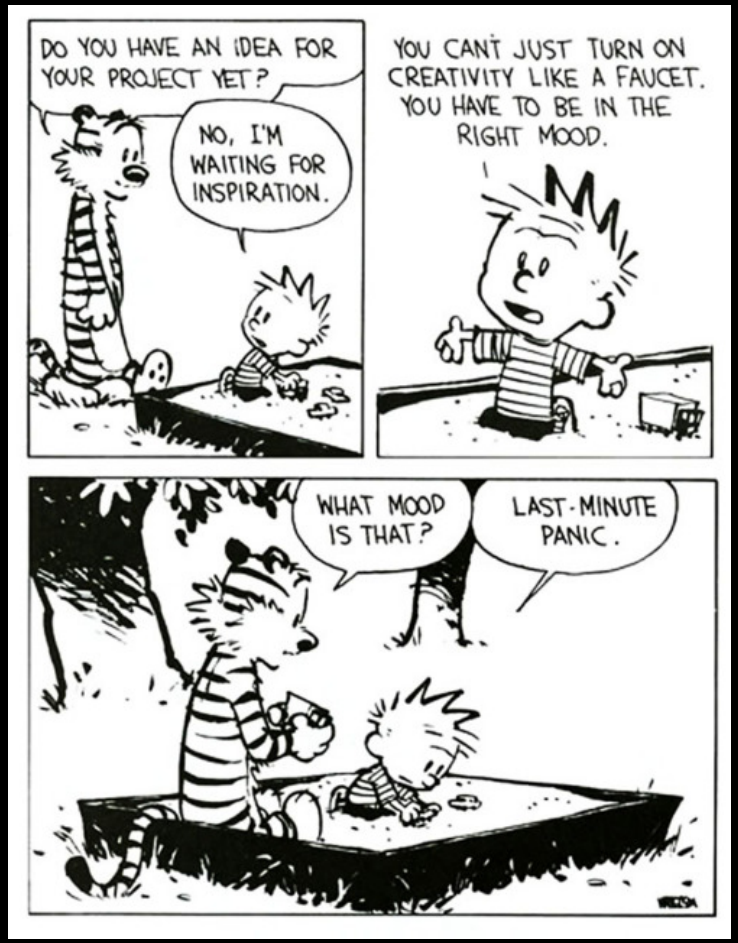
words and images

When emotions are triggered, memory of event is improved

- Passion

When emotions are triggered, memory of event is improved

- Passion
- Humor



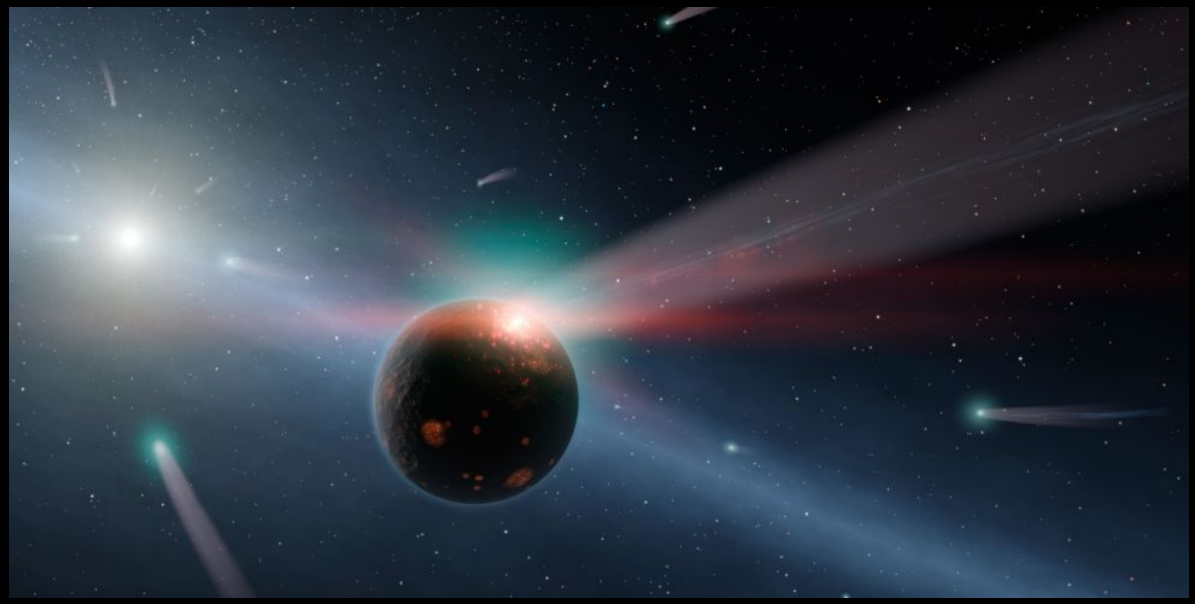
When emotions are triggered, memory of event is improved

- Passion
- Humor
- Anecdotes

When emotions are triggered, memory of event is improved

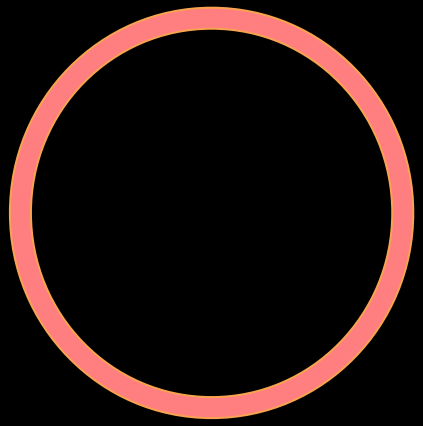
- Passion
- Humor
- Anecdotes

- Beautiful or inspiring images



Use images in place of words, when possible

CIRCLE



10%
recall 72 hours later

65%
recall 72 hours later

fonts

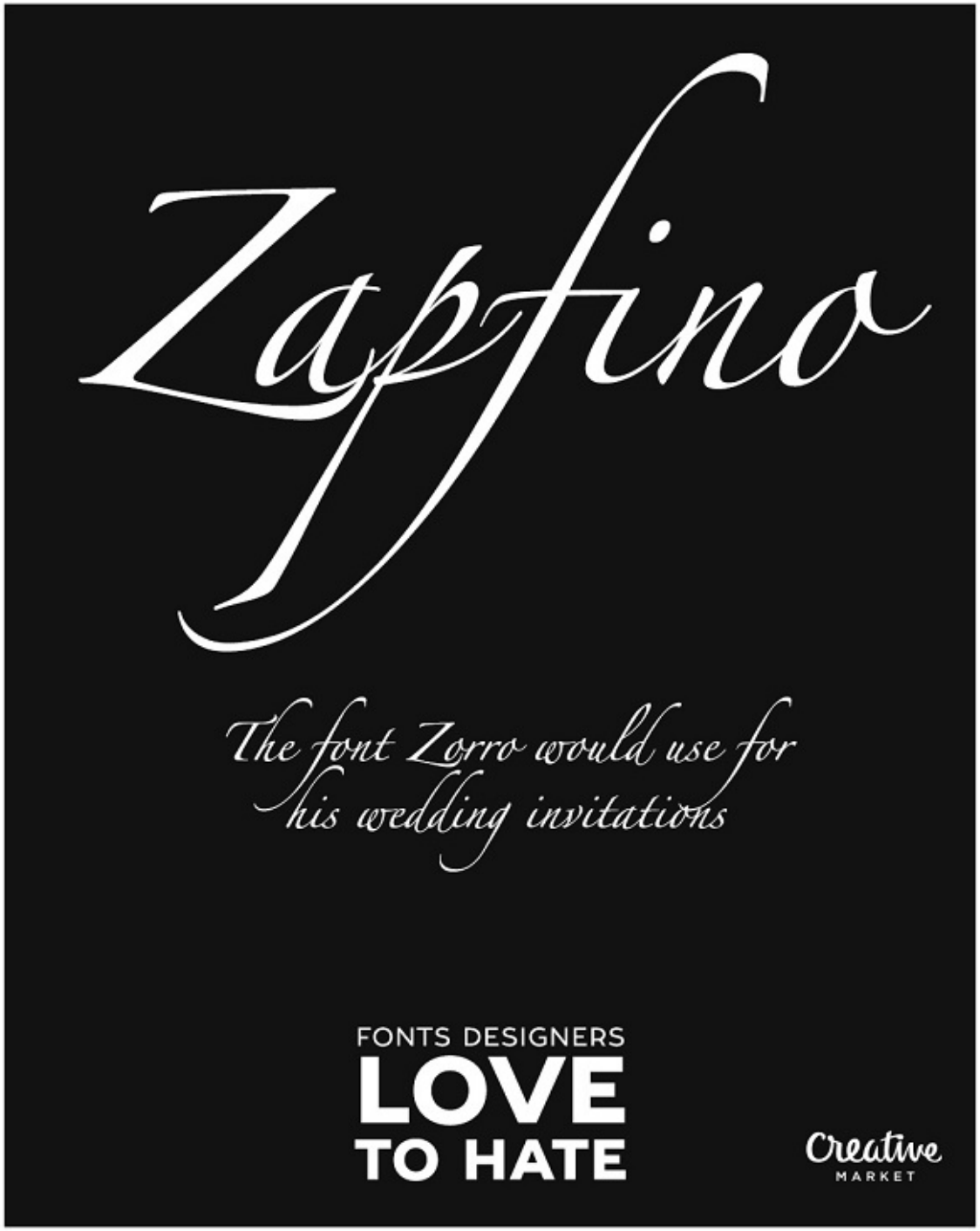
TRAJAN

THE FONT USED ON EVERY MOVIE POSTER, REGARDLESS OF GENRE OR TIME PERIOD.

FONTS DESIGNERS

LOVE TO HATE

Creative MARKET


Zapfino
The font Zorro would use for his wedding invitations
FONTS DESIGNERS
LOVE
TO HATE
Creative
MARKET

COMIC SANS
Ruining PowerPoint presentations since 1994.
FONTS DESIGNERS
LOVE
TO HATE
Creative
MARKET

Sans serif font

- Use sans serif instead of (with) serif
  - Calibri, Arial, Corbel, Century Gothic, Helvetica
- 18 - 36pt type
- Use one or two fonts only

colors

Keep colors simple and high contrast

- White on black
- Light on black
- White on dark

- If used, colors should add or reinforce meaning
  - Short wavelength
  - Long wavelength

Color mistakes

- Colors should add meaning, not be used without purpose
- Low contrast (black and dark purple)
- Don’t mix complementary colors
- Don’t mix red and green – about 12% of people have colorblindness

Color mistakes

- Be very careful using background images. They may be beautiful, but can distract from information.

language

For non-experts in the audience, keep it simple

- Avoid too much technical language
- Use examples and metaphors
- Minimize, and explain all acronyms
  - E.g., CHaracterizing ExoPlanets Satellite (CHEOPS)

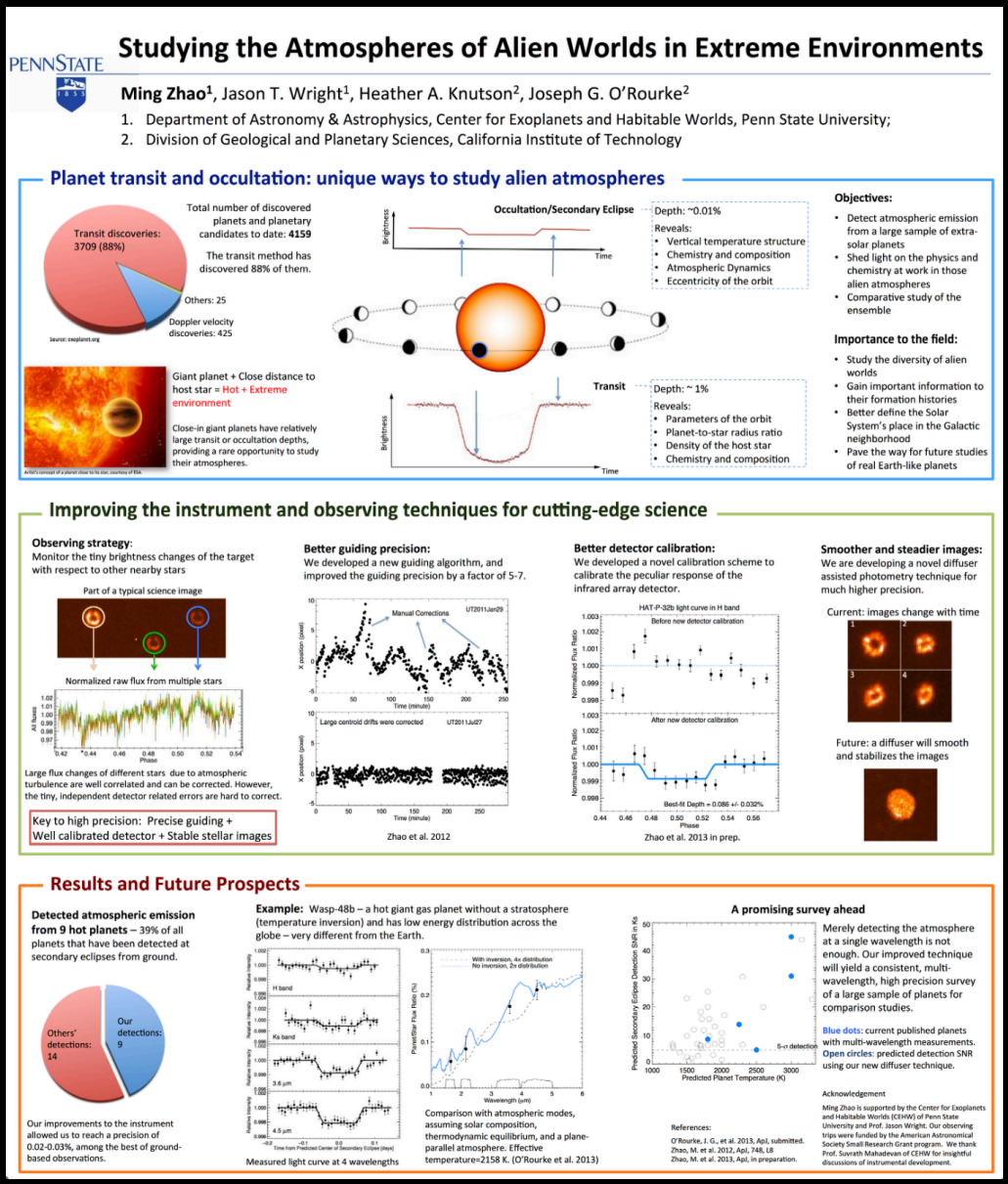
Keep slides simple

It shouldn't look like a poster

Pick one or two graphs, spectra, tables or images per slide

Limit text

If you are not going to explain it, take it out



Studying the Atmospheres of Alien Worlds in Extreme Environments

Ming Zhao[1], Jason T. Wright[1], Heather A. Knutson[2], Joseph G. O'Rourke[2]

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2. Division of Geological and Planetary Sciences, California Institute of Technology

Planet transit and occultation: unique ways to study alien atmospheres

Transit discoveries: 3709 (88%)

Total number of discovered planets and planetary candidates to date: **4159**

The transit method has discovered 88% of them.

Others: 25

Doppler velocity discoveries: 425

Source: exoplanet.org

Giant planet + Close distance to host star = Hot + Extreme environment

Close-in giant planets have relatively large transit or occultation depths, providing a rare opportunity to study their atmospheres.

Artist's concept of a planet close to its star, courtesy of ESA

Occultation/Secondary Eclipse

Brightness

Time

Depth: ~0.01%

Reveals:
- Vertical temperature structure
- Chemistry and composition
- Atmospheric Dynamics
- Eccentricity of the orbit

Transit

Brightness

Time

Depth: ~ 1%

Reveals:
- Parameters of the orbit
- Planet-to-star radius ratio
- Density of the host star
- Chemistry and composition

Objectives:
- Detect atmospheric emission from a large sample of extra-solar planets
- Shed light on the physics and chemistry at work in those alien atmospheres
- Comparative study of the ensemble

Importance to the field:
- Study the diversity of alien worlds
- Gain important information to their formation histories
- Better define the Solar System's place in the Galactic neighborhood
- Pave the way for future studies of real Earth-like planets

Improving the instrument and observing techniques for cutting-edge science

Observing strategy:
Monitor the tiny brightness changes of the target with respect to other nearby stars

Part of a typical science image

Normalized raw flux from multiple stars

All Stars

Phase

Large flux changes of different stars due to atmospheric turbulence are well correlated and can be corrected. However, the tiny, independent detector related errors are hard to correct.

Key to high precision: Precise guiding + Well calibrated detector + Stable stellar images

Better guiding precision:
We developed a novel guiding algorithm, and improved the guiding precision by a factor of 5-7.

Manual Corrections UT2011Jan29

X position (pixel)

Time (minute)

Large centroid drifts were corrected UT2011Jul27

Zhao et al. 2012

Better detector calibration:
We developed a novel calibration scheme to calibrate the peculiar response of the infrared array detector.

HAT-P-32b light curve in H band

Before new detector calibration

After new detector calibration

Normalized Flux Ratio

Best-fit Depth = 0.086 +/- 0.032%

Phase

Zhao et al. 2013 in prep.

Smoother and steadier images:
We are developing a novel diffuser assisted photometry technique for much higher precision.

Current: images change with time

Future: a diffuser will smooth and stabilizes the images

Results and Future Prospects

Detected atmospheric emission from 9 hot planets – 39% of all planets that have been detected at secondary eclipses from ground.

Others' detections: 14

Our detections: 9

Our improvements to the instrument allowed us to reach a precision of 0.02-0.03%, among the best of ground-based observations.

Example: Wasp-48b – a hot giant gas planet without a stratosphere (temperature inversion) and has low energy distribution across the globe – very different from the Earth.

H band

Ks band

3.6 μm

4.5 μm

Relative Intensity

Time from Predicted Center of Secondary Eclipse (days)

Measured light curve at 4 wavelengths

With inversion, 4π distribution

No inversion, 2π distribution

Planet/Star Flux Ratio (%)

Wavelength (μm)

Comparison with atmospheric modes, assuming solar composition, thermodynamic equilibrium, and a plane-parallel atmosphere. Effective temperature=2158 K. (O'Rourke et al. 2013)

A promising survey ahead

Predicted Secondary Eclipse Detection SNR in Ks

5-σ detection

Predicted Planet Temperature (K)

Merely detecting the atmosphere at a single wavelength is not enough. Our improved technique will yield a consistent, multi-wavelength, high precision survey of a large sample of planets for comparison studies.

Blue dots: current published planets with multi-wavelength measurements.
Open circles: predicted detection SNR using our new diffuser technique.

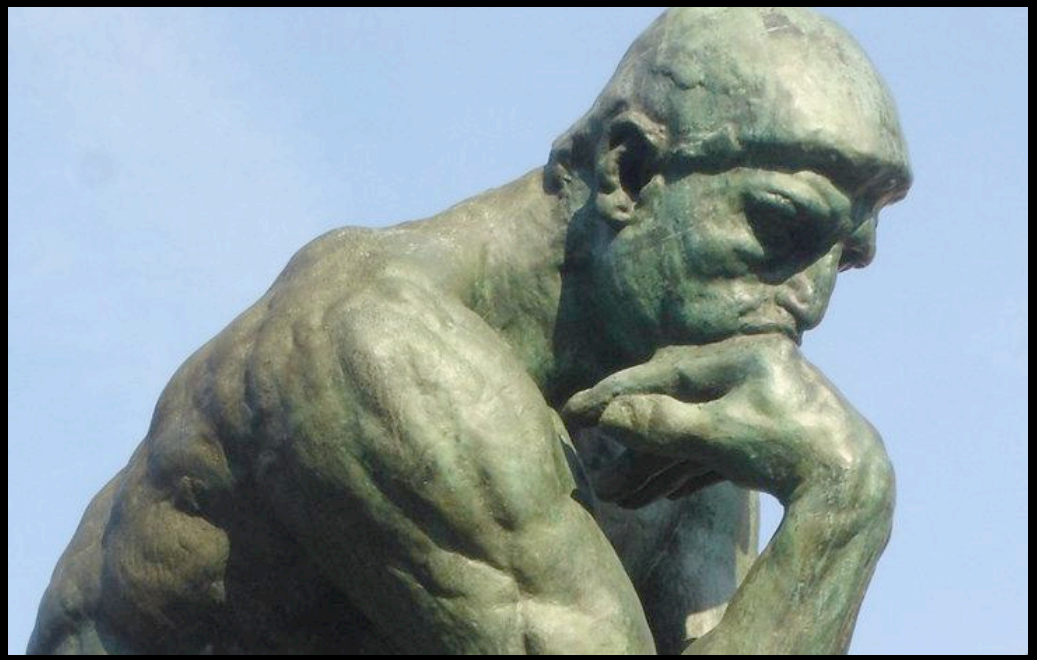
References:

O'Rourke, J. G., et al. 2013, ApJ, submitted.
Zhao, M. et al. 2012, ApJ, 748, L8
Zhao, M. et al. 2013, ApJ, in preparation.

Acknowledgement

Ming Zhao is supported by the Center for Exoplanets and Habitable Worlds (CEHW) of Penn State University and Prof. Jason Wright. Our observing trips were funded by the American Astronomical Society Small Research Grant program. We thank Prof. Suvrath Mahadevan of CEHW for insightful discussions of instrumental development.

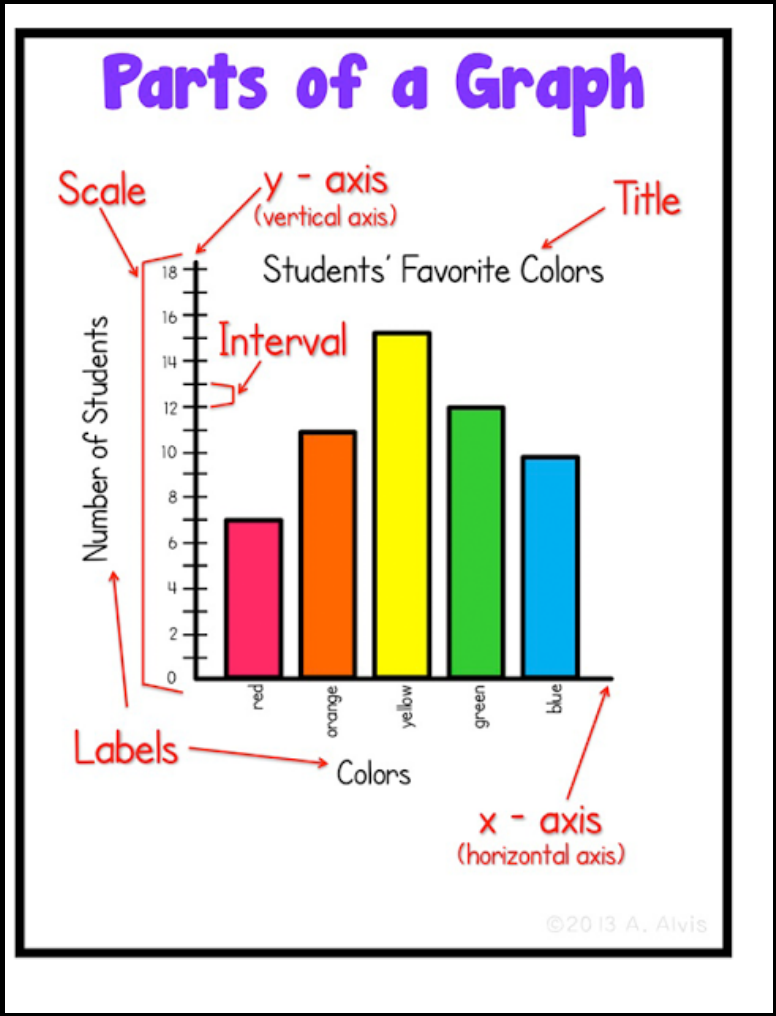
Title your slides with the take-away point



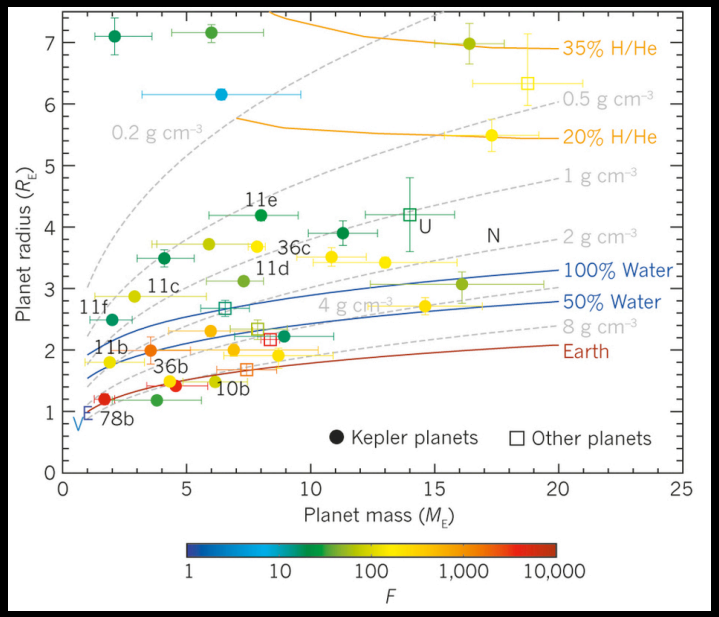
- It helps the audience re-connect with the talk

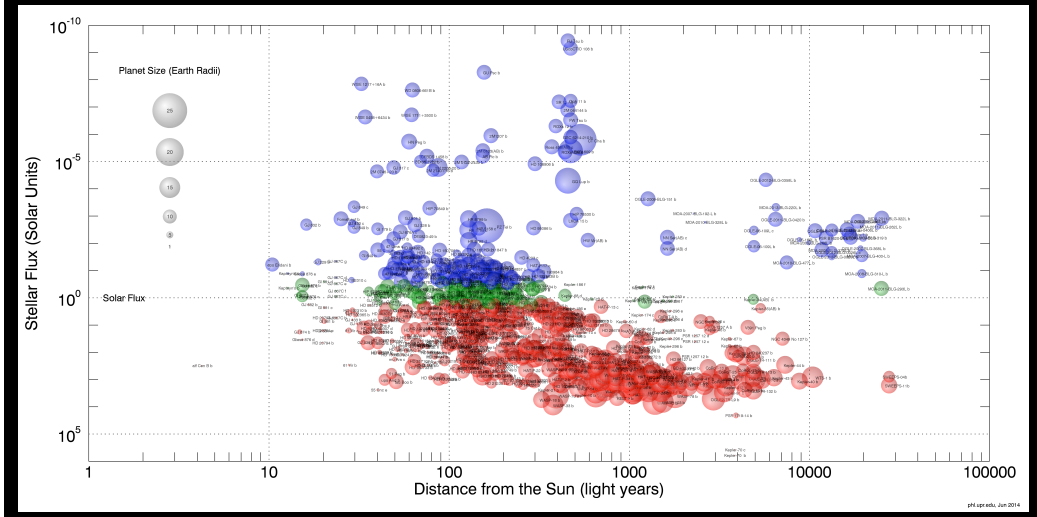
graphs and plots

Label your graphics

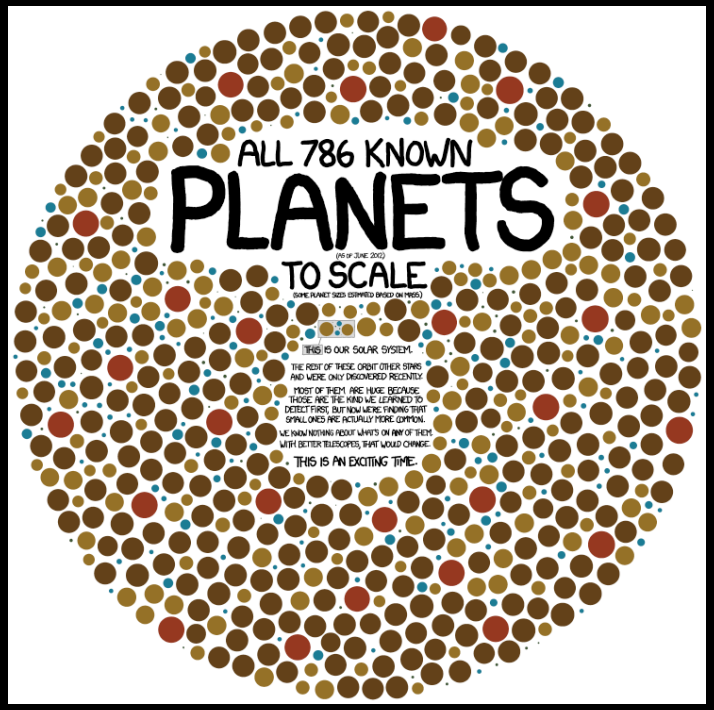


Standardize your graphics





Take time to orient your audience



equations

$$\nabla^2 c = \kappa^2 c,$$
$$\partial c_{\mathrm{a}}/\partial t = [J_{\mathrm{a}}^1 \alpha(c, c_{\mathrm{a}}) + J_{\mathrm{a}}(c_{\mathrm{a}})\beta(c, c_{\mathrm{a}})]R + D_{\mathrm{a}}\nabla^2 c_{\mathrm{a}} - k c_{\mathrm{i}} c_{\mathrm{a}}$$
$$\partial c_i/\partial t = D_{\mathrm{i}}\nabla^2 c_{\mathrm{i}} - k_{\mathrm{a}} c_{\mathrm{i}} c_{\mathrm{a}} + J_{\mathrm{i}}(c, c_{\mathrm{a}})\beta(c, c_{\mathrm{a}})R$$
$$\partial R/\partial t = [D_{\mathrm{cell}} - (\lambda + \lambda_2 \gamma(c, c_{\mathrm{a}}))R]\nabla^2 R - \lambda_2 \partial\gamma/\partial c_{\mathrm{a}} R^2 \nabla^2 c_{\mathrm{a}} - \lambda_2 \partial\gamma/\partial c R^2 \nabla^2 c + rR(R_{\mathrm{eq}} - R) - k_{23}\gamma(c, c_{\mathrm{a}})R.$$

(Audience member is thinking: ” hm, pasta or a salad for dinner tonight?”)

equations

- Less is more
- Explain terms, maybe even highlight as you talk about them

rehearse

Rehearse, rehearse, rehearse

- Helps with nerves – write out and memorize first slide
- Once by yourself, once with a friend, once with a group
- Even Steve Jobs did it

The painful part: ask for feedback

- Do all parts of the talk make sense?
- What did you like?
- What can be improved?
- What questions do you have?
- What could I remove?
- Was it too long?
- Slide handouts for notes, feedback forms

questions

Questions after your talk

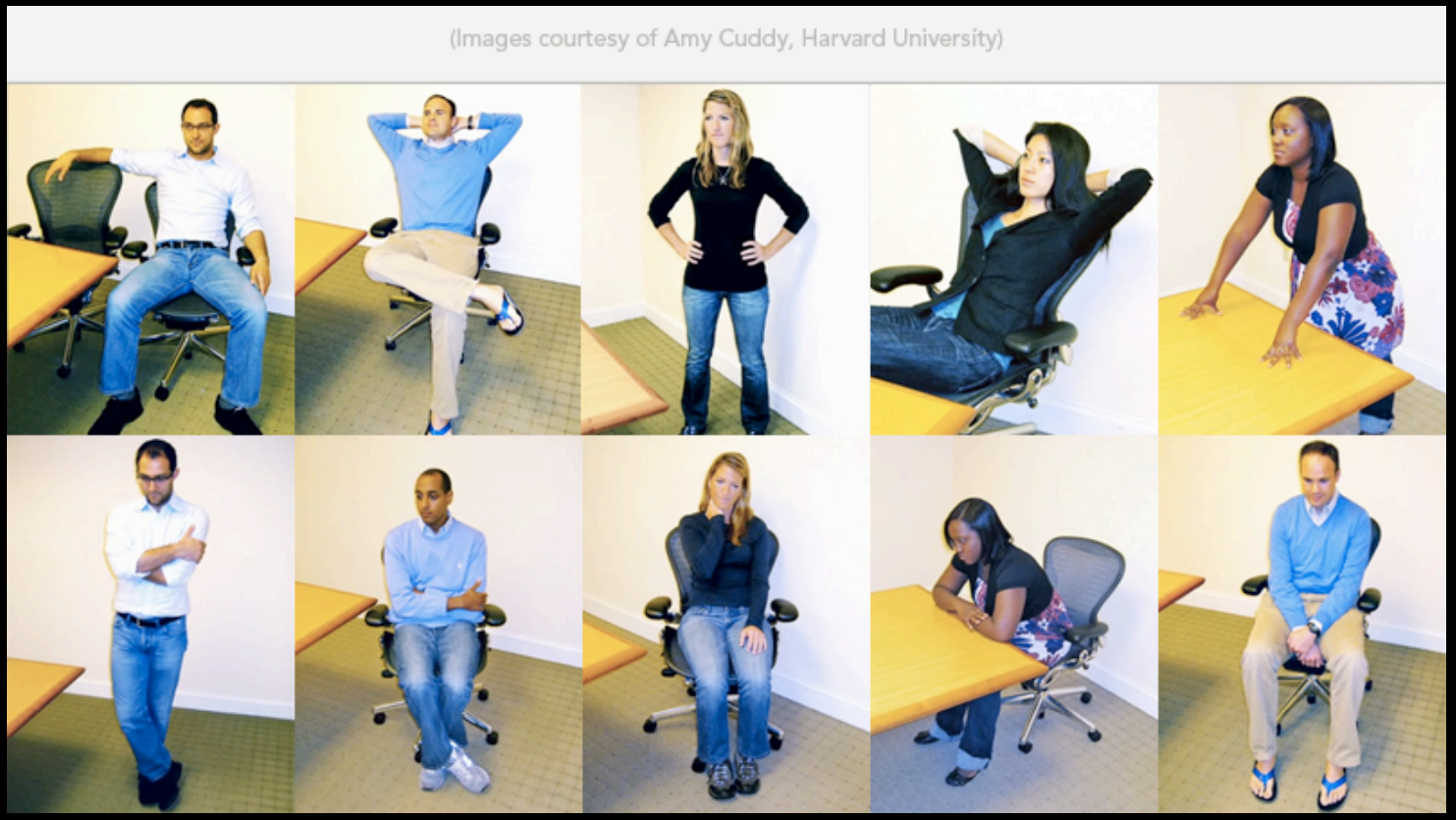
- Assume askers are being sincere
- Ask to have question rephrased
- Ok to say “I don’t know” or “We should talk more after the presentation”
- Senior scientists – please help keep the audience polite

Summary slide is seen the longest

- Craft the story. Build your slides. PRACTICE.
- Less is more, one point per slide
- Simple language and design
- Images are good
- Many ways to handle questions

psychology of communication

Confidence



Confidence

Power poses displayed by calm, confident people

Confidence

Using a power pose can affect your own calm and confidence (as measured by testosterone and cortisone levels)

2 min. practice

- Pick a sitting power pose. Make yourself bigger.
- While I cover the next few slides keep this pose.

Despite our best intentions…

- Tips for good talks all over internet
- So why do we rarely see a good talk?

What is a good talk, really?

The PlanetS seniors weigh in

- Nicolas Thomas
- Klaus Mezger
- Maria Schönbächler
- Yann Alibert

What is the goal of journal club?

How should a speaker prepare?

What is the goal of a research group presentation?

How should a speaker prepare?

What is the goal of a conference talk?

How should a speaker prepare?

What actually counts?

How do we judge a speaker?

Beliefs about intelligence: Carol Dweck

Fixed mindset

- Intelligence innate, inborn
- Doesn't change with time
- Expending effort = not as smart
- "You must be really smart."

Beliefs about intelligence: Carol Dweck

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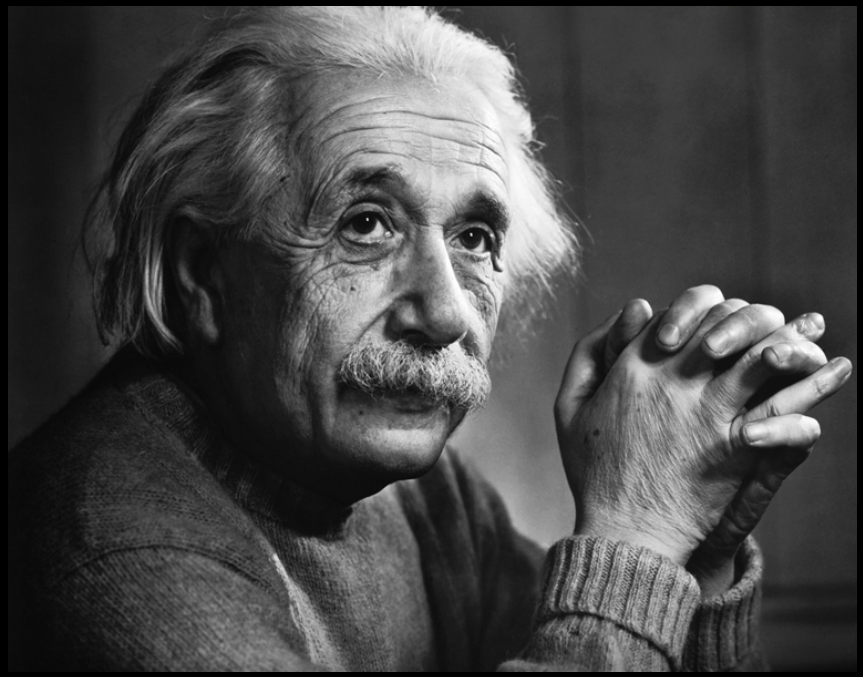

"Well, you're no Einstein"

Beliefs about intelligence: Carol Dweck

Growth mindset

- Intelligence can change over a lifespan
- You can train to become more intelligent
- Effort is a good thing
- “You must have worked hard.”

Beliefs about intelligence: Carol Dweck

Growth mindset

- Intelligence can change over a lifespan
- You can train to become more intelligent
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Beliefs about intelligence: Carol Dweck

Fixed mindset

- People hide effort
- Fear of looking stupid
- Entrenched belief in academia, hard to counteract

Growth mindset

- Asking simple questions is good, and encouraged
- No one has to have all the answers
- Speed of thinking isn't as important

Giving a good talk

- Takes time
- Takes practice
- The meaning of “good” depends on the audience, the setting and the discipline