Introduction to poster presentations

PSYC 11: Laboratory in Psychological Science
May 18, 2022

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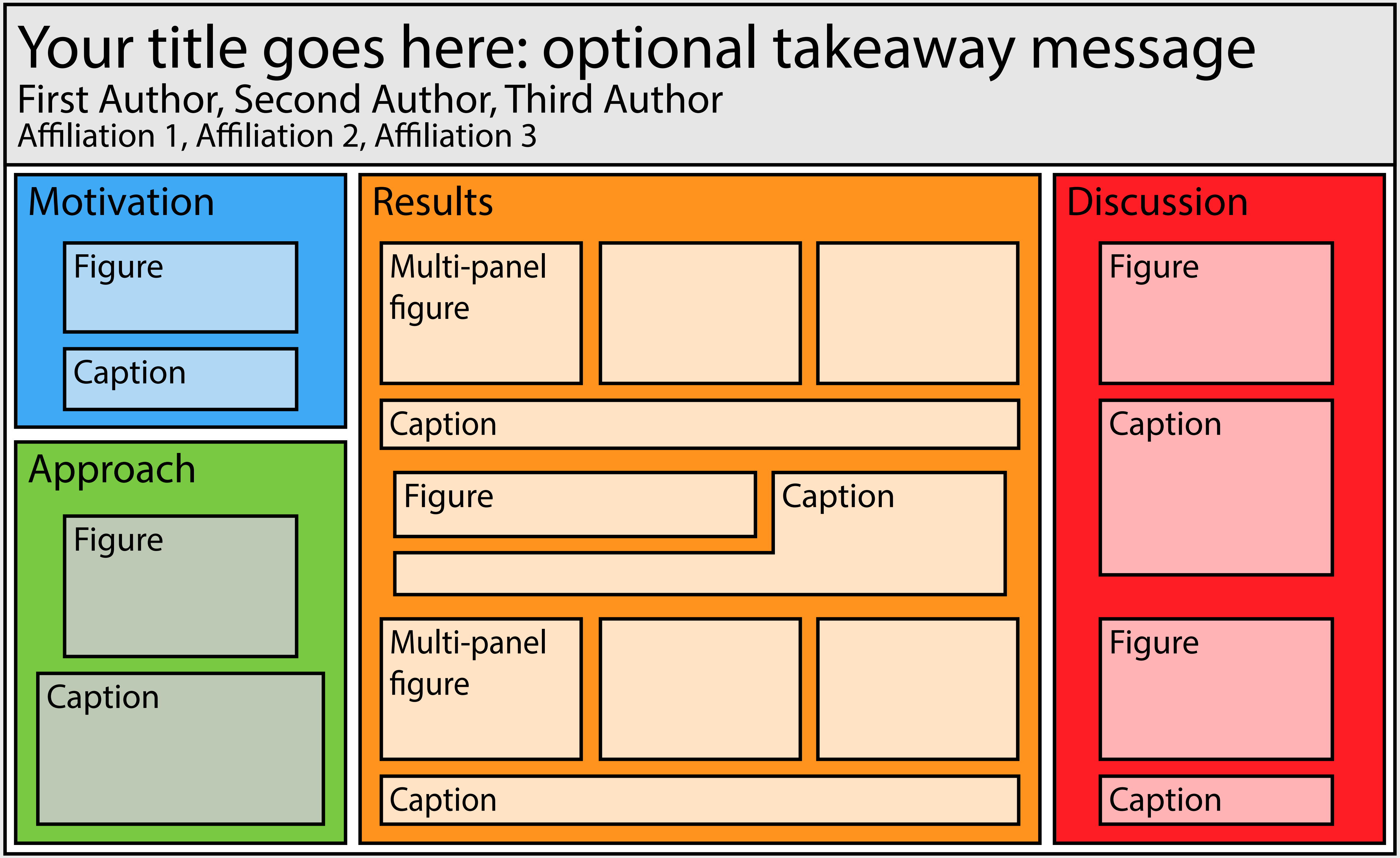
Anatomy of a poster

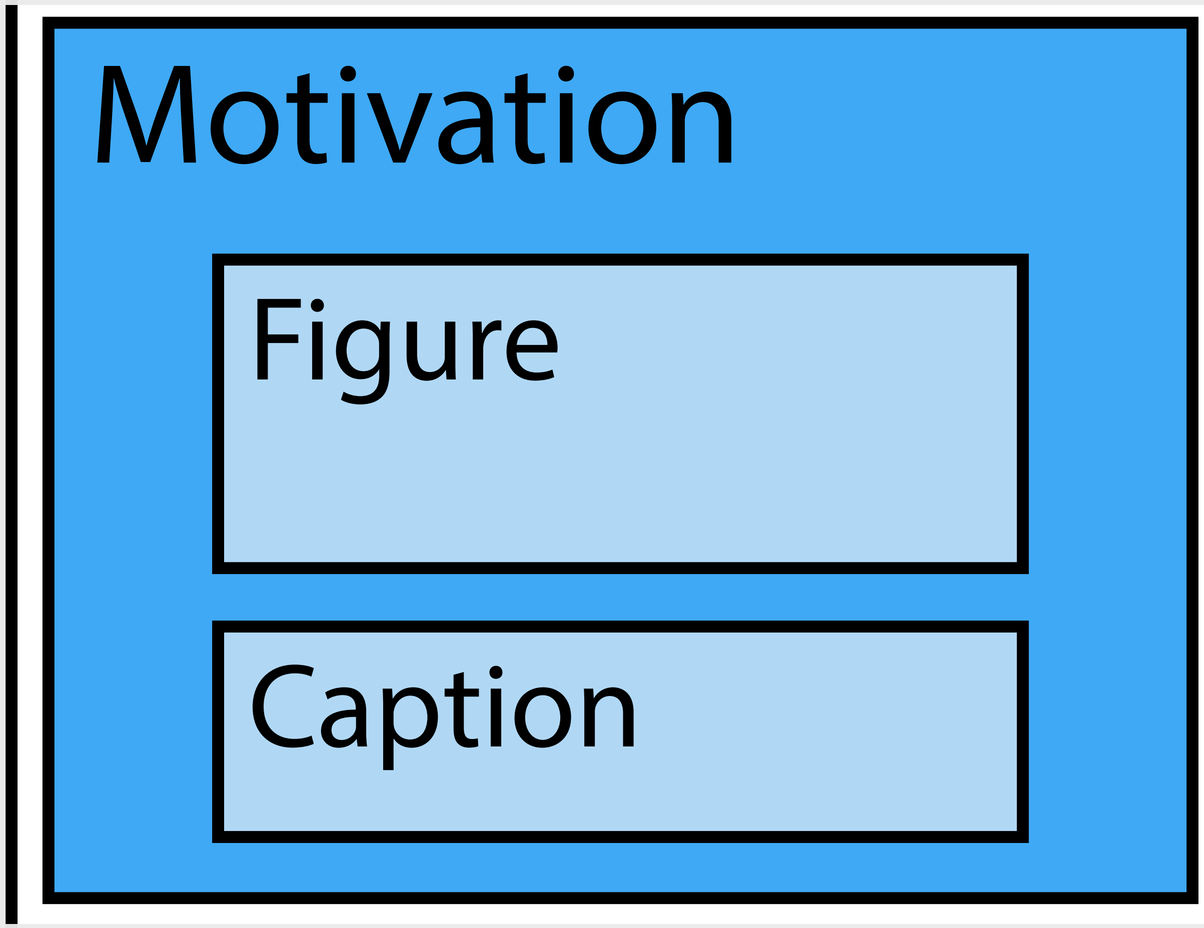


Information bar

Your title goes here: optional takeaway message
First Author, Second Author, Third Author
Affiliation 1, Affiliation 2, Affiliation 3

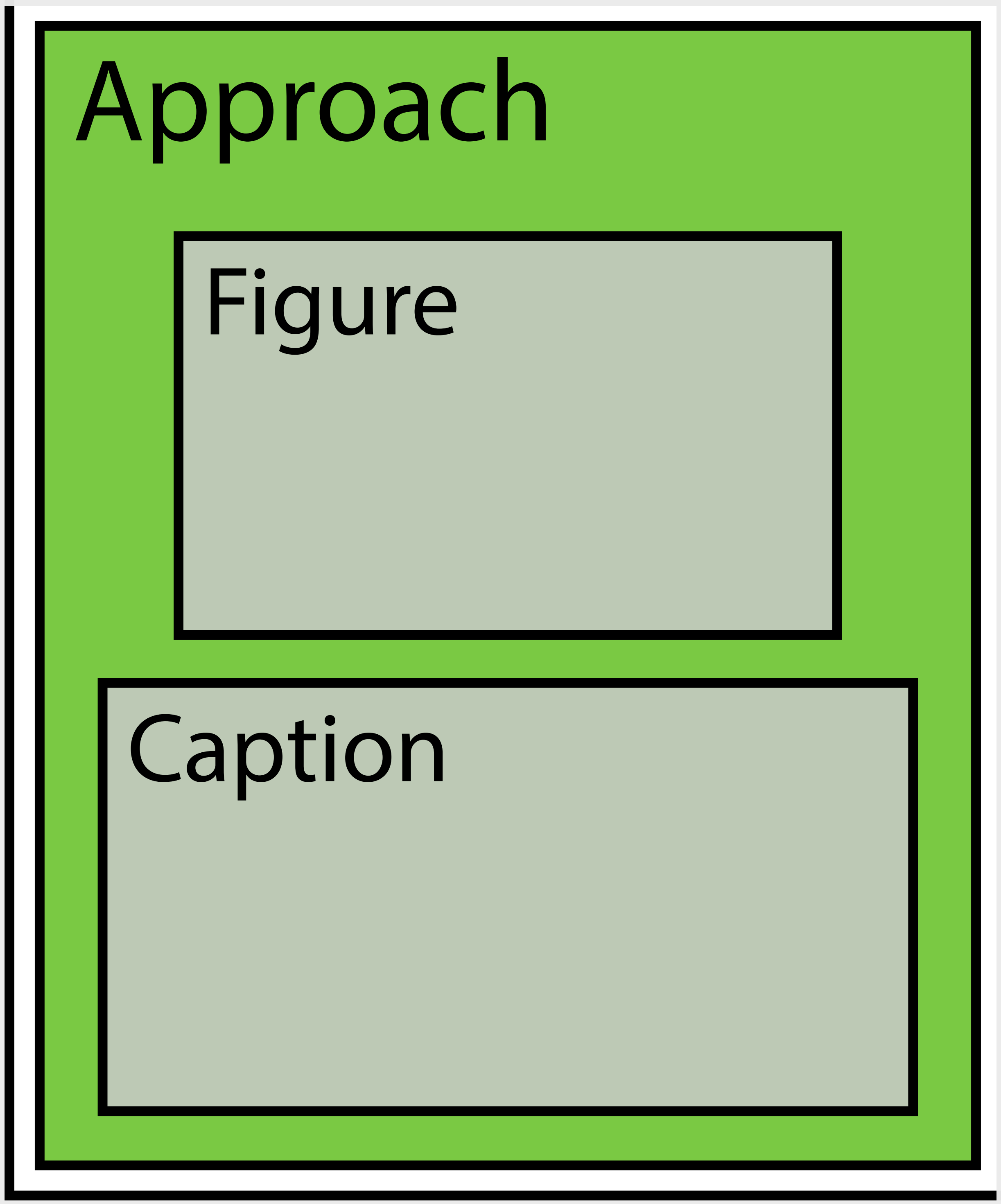
- Quickly orient your audience
- Provide a quick (one-line) summary
- Tell people **who** did the work
- Tell people **where** the work was done

Motivation



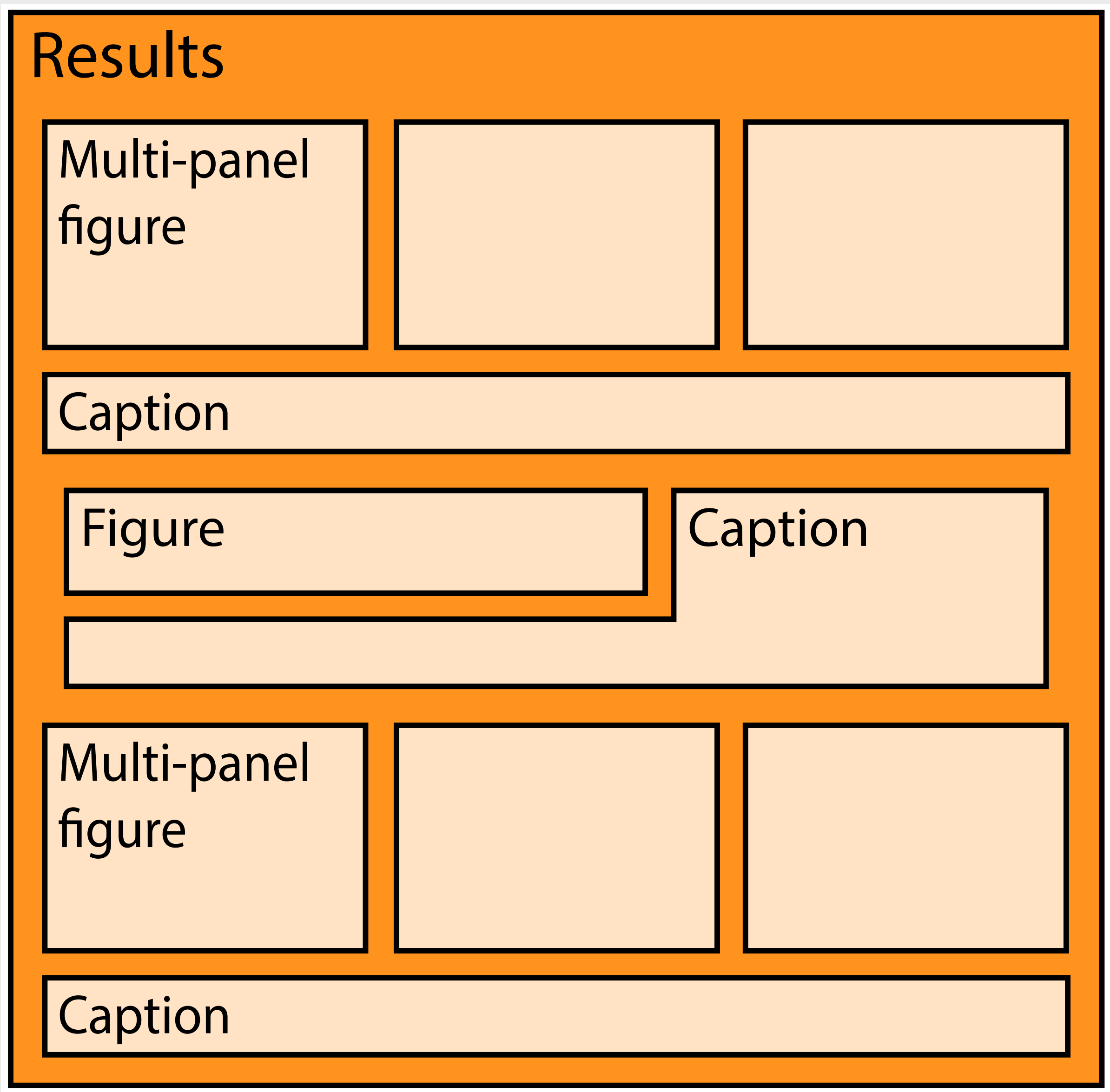
- Summarize why the work is interesting
- Introduce your question
- Provide some sort of graphical depiction of your study/question

Approach



- Describe how you studied your question (experiment and analyses)
- Include major methods details
- Include one or more figures

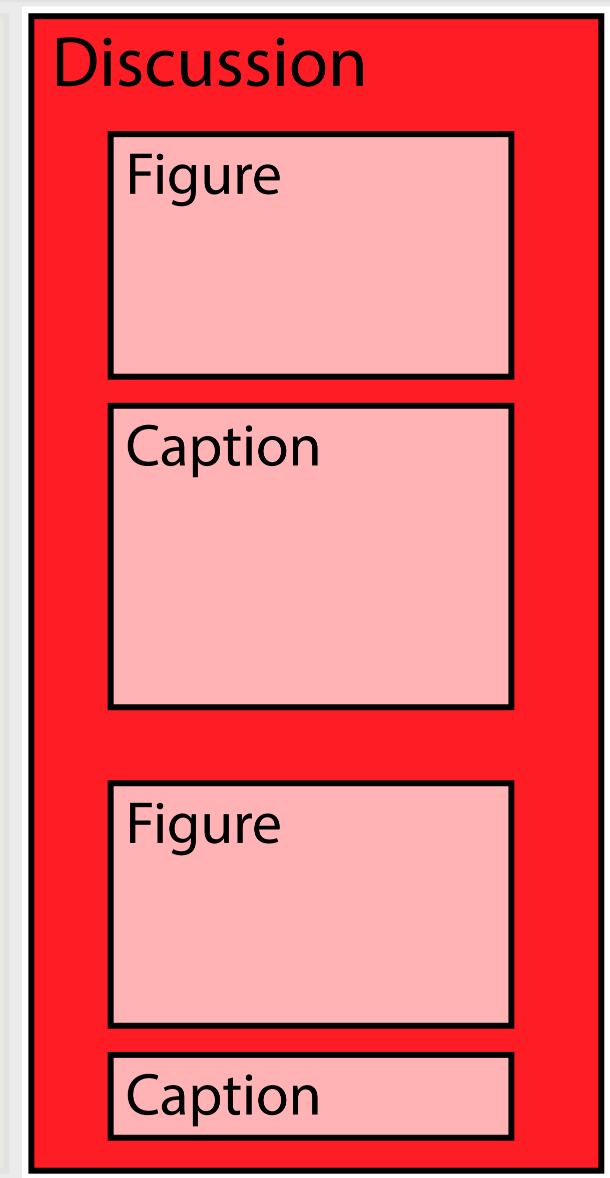
Results



- Show what you **found**
- Tell a **story**
- Focus on the most critical stuff
- As space allows, include other details to supplement your narrative

Discussion

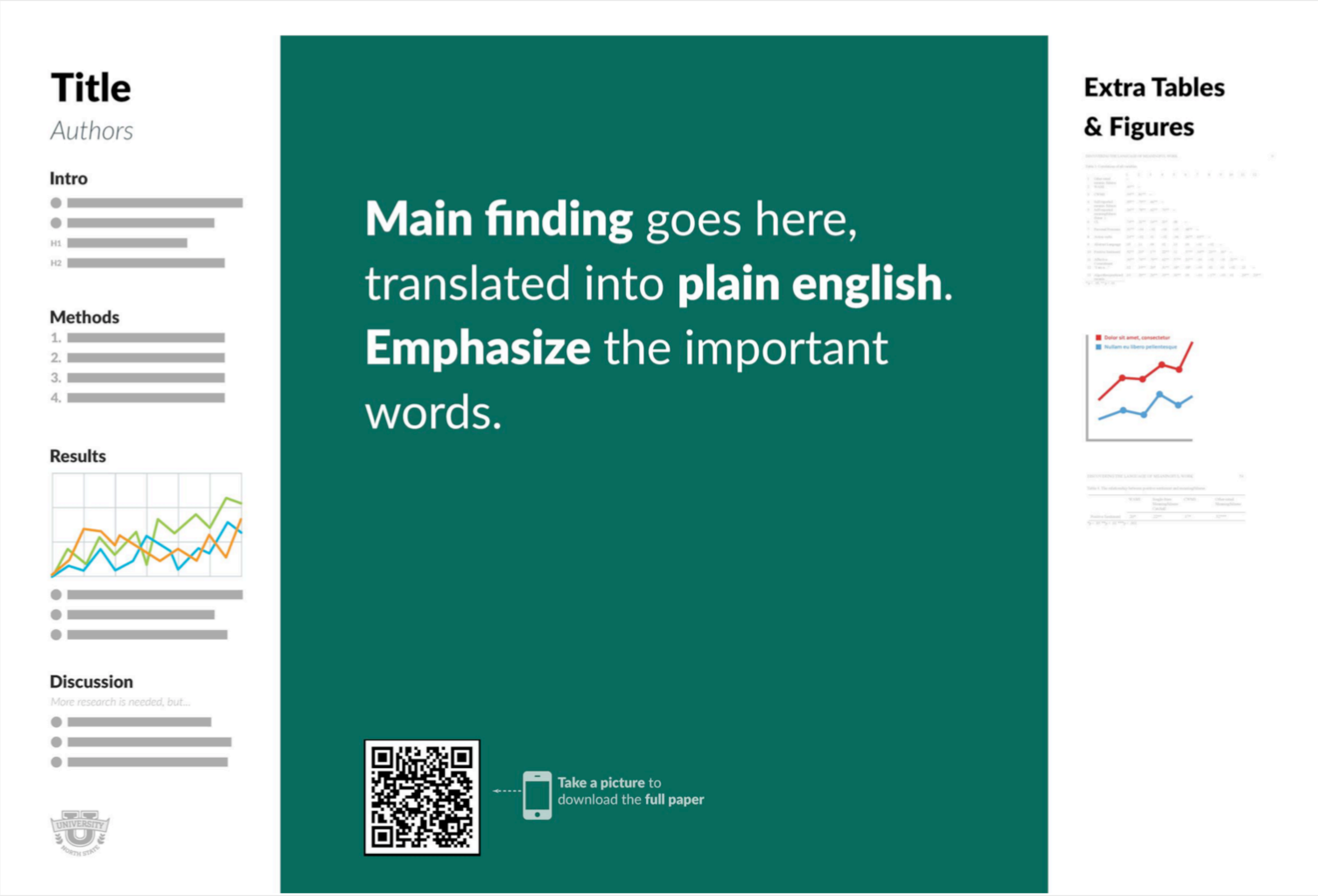
- Show what your findings **mean**
- Situate your work within the context of the broader literature
- Suggest future directions for your work



Optional stuff

- Bibliography
- An (explicit) “conclusions” section
- Separate “experimental methods” from “analytic methods”
- Group results in some way

Another approach…



Guiding principles

- Less (text) is more. **Show, don't tell.**
- A poster does not need to be self-contained. **It's a visual aide, not a tour guide.**
- Keep your poster **visually clean and appealing**. Think about: efficient use of space, font size, consistency, and alignment.
- Think about audience traffic flow and management.

Examples…

PIGS IN SPACE: EFFECT OF ZERO GRAVITY AND AD LIBITUM FEEDING ON WEIGHT GAIN IN CAVIA PORCELLUS

Colin B. Purrington
6673 College Avenue, Swarthmore, PA 19081 USA

ABSTRACT:

One ignored benefit of space travel is a potential elimination of obesity, a chronic problem for a growing majority in many parts of the world. In theory, when an individual is in a condition of zero gravity, weight is eliminated. Indeed, in space one could conceivably follow ad libitum feeding and never even gain an gram, and the only side effect would be the need to upgrade one's stretchy pants("exercise pants"). But because many diet schemes start as very good theories only to be found to be rather harmful, we tested our predictions with a long-term experiment in a colony of Guinea pigs (Cavia porcellus) maintained on the International Space Station. Individuals were housed separately and given unlimited amounts of high-calorie food pellets. Fresh fruits and vegetables were not available in space so were not offered. Every 30 days, each Guinea pig was weighed. After 5 years, we found that individuals, on average, weighed nothing. In addition to weighing nothing, no weight appeared to be gained over the duration of the protocol. If space continues to be gravity-free, and we believe that assumption is sound, we believe that sending the overweight — and those at risk for overweight — to space would be a lasting cure.

INTRODUCTION:

The current obesity epidemic started in the early 1960s with the invention and proliferation of elastane and related stretchy fibers, which released wearers from the rigid constraints of clothes and permitted monthly weight gain without the need to buy new outfits. Indeed, exercise today for hundreds of million people involve only the act of wearing stretchy pants in public, presumably because the constrictive pressure forces fat molecules to adopt a more compact tertiary structure (Xavier 1965).

Luckily, at the same time that fabrics became stretchy, the race to the moon between the United States and Russia yielded a useful fact: gravity in outer space is minimal to nonexistent. When gravity is zero, objects cease to have weight. Indeed, early astronauts and cosmonauts had to secure themselves to their ships with seat belts and sticky boots. The potential application to weight loss was noted immediately, but at the time travel to space was prohibitively expensive and thus the issue was not seriously pursued. Now, however, multiple companies are developing cheap extra-orbital travel options for normal consumers, and potential travelers are also creating news ways to pay for products and services that they cannot actually afford. Together, these factors open the possibility that moving to space could cure overweight syndrome quickly and permanently for a large number of humans.

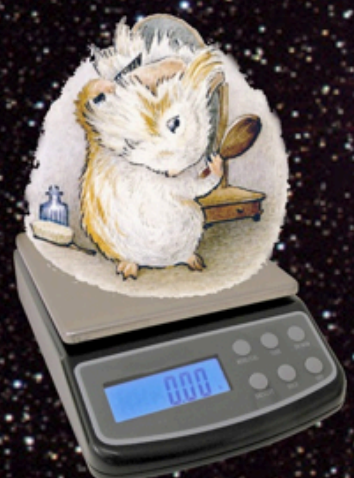
We studied this potential by following weight gain in Guinea pigs, known on Earth as fond of ad libitum feeding. Guinea pigs were long envisioned to be the "Guinea pigs" of space research, too, so they seemed like the obvious choice. Studies on humans are of course desirable, but we feel this current study will be critical in acquiring the attention of granting agencies.

MATERIALS AND METHODS:

One hundred male and one hundred female Guinea pigs (Cavia porcellus) were transported to the International Space Laboratory in 2010. Each pig was housed separately and deprived of exercise wheels and fresh fruits and vegetables for 48 months. Each month, pigs were individually weighed by duct-taping them to an electronic balance sensitive to 0.0001 grams. Back on Earth, an identical cohort was similarly maintained and weighed. Data was analyzed by statistics.

RESULTS:

Mean weight of pigs in space was 0.0000 +/- 0.0002 g. Some individuals weighed less than zero, some more, but these variations were due to reaction to the duct tape, we believe, which caused them to be alarmed push briefly against the force plate in the balance. Individuals on the Earth, the control cohort, gained about 240 g/month ($p = 0.0002$). Males and females gained a similar amount of weight on Earth (no main of effect of sex), and size at any point during the study was related to starting size (which was used as a covariate in the ANCOVA). Both Earth and space pigs developed substantial dewlaps (double chins) and were lethargic at the conclusion of the study.



CONCLUSIONS:

Our view that weight and weight gain would be zero in space was confirmed. Although we have not replicated this experiment on larger animals or primates, we are confident that our result would be mirrored in other model organisms. We are currently in the process of obtaining necessary human trial permissions, and should have our planned experiment initiated within 80 years, pending expedited review by local and Federal IRBs.

ACKNOWLEDGEMENTS:

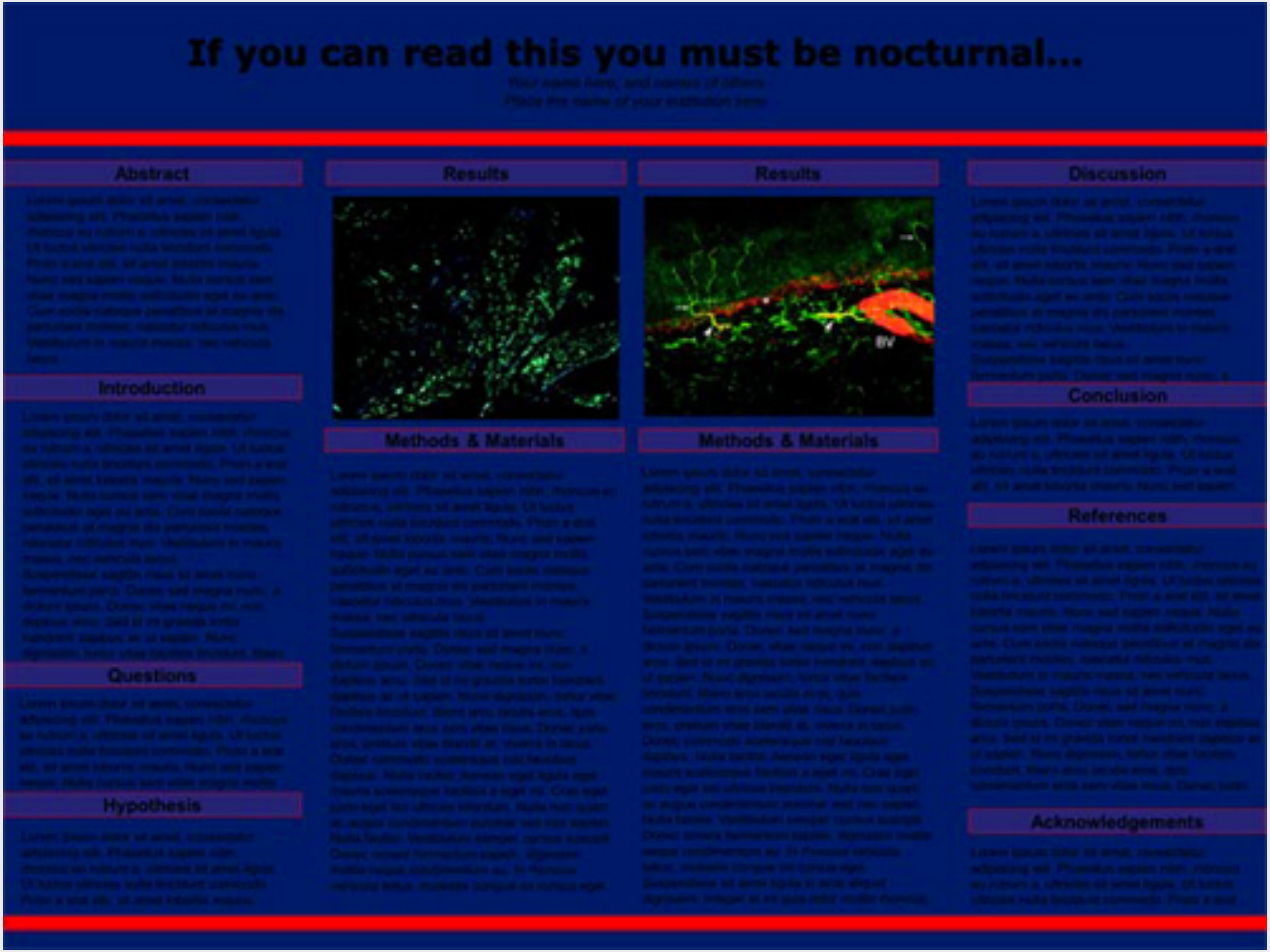
I am grateful for generous support from the National Research Foundation, Black Hole Diet Plans, and the High Fructose Sugar Association. Transport flights were funded by SPACE-EXES, the consortium of wives divorced from insanely wealthy space-flight startups. I am also grateful for comments on early drafts by Mañana Athletic Club, Corpus Christi, USA. Finally, sincere thanks to the Cuy Foundation for generously donating animal care after the conclusion of the study.

LITERATURE CITED:

NASA. 1982. Project STS-XX: Guinea Pigs. Leaked internal memo.

Sekulić, S.R., D. D. Lukač, and N. M. Naumović. 2005. The Fetus Cannot Exercise Like An Astronaut: Gravity Loading Is Necessary For The Physiological Development During Second Half Of Pregnancy. Medical Hypotheses. 64:221-228

Xavier, M. 1965. Elastane Purchases Accelerate Weight Gain In Case-control Study. Journal of Obesity. 2:23-40.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Abstract
Introduction
Questions
Hypothesis
Results
Results
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Methods & Materials
Methods & Materials
Discussion
Conclusion
References
Acknowledgements

CONSTRUCTION & SIMULATION ANALYSIS OF AN IMPROVED ACTIN FILAMENT MODEL

Here, we present a new model of the actin filament (F-actin) that incorporates the global structure of a recently published model[1] but also conserves internal stereochemistry. The improved quality of the model is apparent in a comparison made of the model with other recent F-actin models using molecular dynamics (MD) simulation, monitoring a number of structural determinants.

In addition, simulations of the model are carried out in states with both ADP or ATP bound and local hydrogen-bonding differences characterized. The results point to the significance of a direct interaction of Gln137 with ATP for activation of ATPase activity after the G-to-F-actin transition.

Jeremy C. Smith

Thomas Splettstößer

Kenneth C. Holmes

Frank Noé

INTRODUCTION

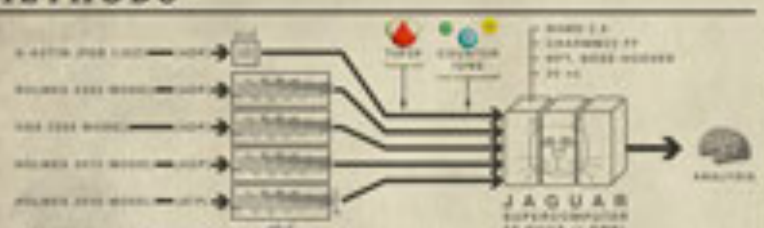
The atomic-detail structure of F-actin is still unknown. We propose a new model of F-actin, "Holmes 2010", which was built using a straightforward approach in which priority was given to keeping the stereochemistry within the actin protomer intact while altering the position of the two actin domains to account for the global conformational change during the G-to-F-actin transition. A comparison is made of the structures and dynamics of Holmes 2010 with Oda 2009[1] and Holmes 2004[2] by subjecting them to MD simulation.

The nucleotide effects (ADP or ATP) on the conformation of the filament are also studied with a particular focus on the G-to-F-actin ATPase activation.

HOLMES 2010 MODEL

- Starting structure: G-actin X-ray structure PDB 1J6Z[3]
- Global conformational change during G→F-actin transition
- Separate fitting of two domains to Oda model
- DNase I binding loop: replace α-helix with Oda coordinates
- Phalloidin added and coordinates refined against fiber diffraction data[4] and EM data,[5] weighted in favor of the fiber data
- Final radius of gyration: 23.7 Å

METHODS



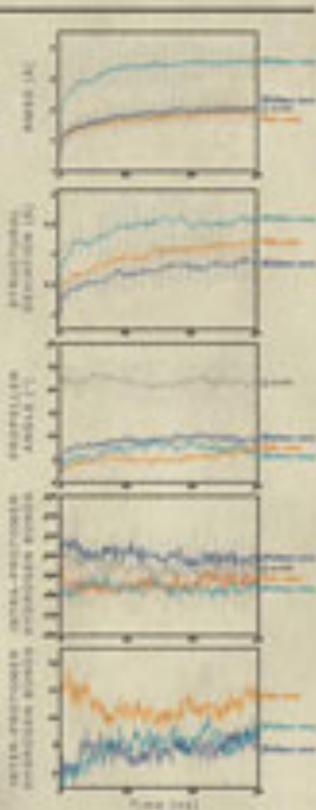
RESULTS

The new 'Holmes 2010' model was developed and MD simulations of 30 ns length were performed to compare the structure and stability with those of Oda 2009 and Holmes 2004. A further simulation of the Holmes 2010 model was performed in the ATP state.

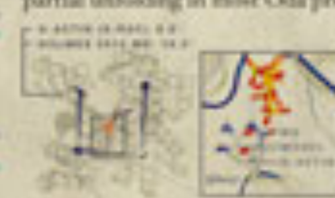
Most properties were assessed on the protomer level and then averaged over the 13 protomers in the filament.

The average RMSD of the Oda 2009 and Holmes 2010 model protomers is very close to that of the simulation of the G-actin crystal structure. Among the 3 tested models, the structural deviation of Holmes 2004 is the lowest and that of Holmes 2010 the highest. As expected, the propeller angle formed by the four subunits of the actin molecule is much higher in the G-actin simulation than in the simulations of the F-actin models.

The number of hydrogen bonds within the actin molecules is the highest in the MD of Holmes 2010, even higher than that of G-actin. But most hydrogen bonds between protomers are formed in the MD of Oda.



Among the three models, only Holmes 2004 has a DNase binding loop in α-helical conformation, which unfolds entirely in 6 of the 13 protomers. Further, all protomers in Holmes 2004 show unfolding of some of the secondary structural elements. In the simulations, the hydrophobic plug showed a high degree of structural variation in Holmes 2004 and some variation in the Oda 2009 MD but was highly conserved among the Holmes 2010 protomers. Residues 348-357 form an α-helix that remains stable in the Oda simulations but unfolds in some protomers of the two Holmes simulations. The WH2-binding domain (residues 165-170) forms a β-hairpin in the simulations of both Holmes models but a bend in the Oda MD. Residues 227-237 exhibit partial unfolding in most Oda protomers.



Previous studies suggest the significance of Gln137 for ATP hydrolysis.[6,7] The twist of the actin monomer upon integration into the filament brings Gln137 close to ATP. In the MD Gln137 forms a stable H-bond with the oxygen of the β-phosphate group, and may thus play a direct role in hydrolysis.

CONCLUSIONS

The MD comparison reflects the evolution in quality of the actin models over the last years. The Holmes 2010 model possesses both a global conformation in agreement with the recent Oda model and a consistent intraprotomer stereochemistry. As such it should form a useful basis for atomic-detail investigations into F-actin structure-dynamics-function relationships.

REFERENCES

ACKNOWLEDGEMENTS

We thank Isabella Daidone and Durba Sengupta for helpful discussion and acknowledge support from Deutsche Forschungsgemeinschaft and a DOE Research and Development "Systems Biology" Grant. Computations were performed on the Jaguar Cray XT4 supercomputer at the National Center for Computational Sciences at Oak Ridge National Lab.

Oak Ridge National Laboratory

Global – Not Local – Variance Impacts Search

Steve Haroz
University of California, Davis

David Whitney
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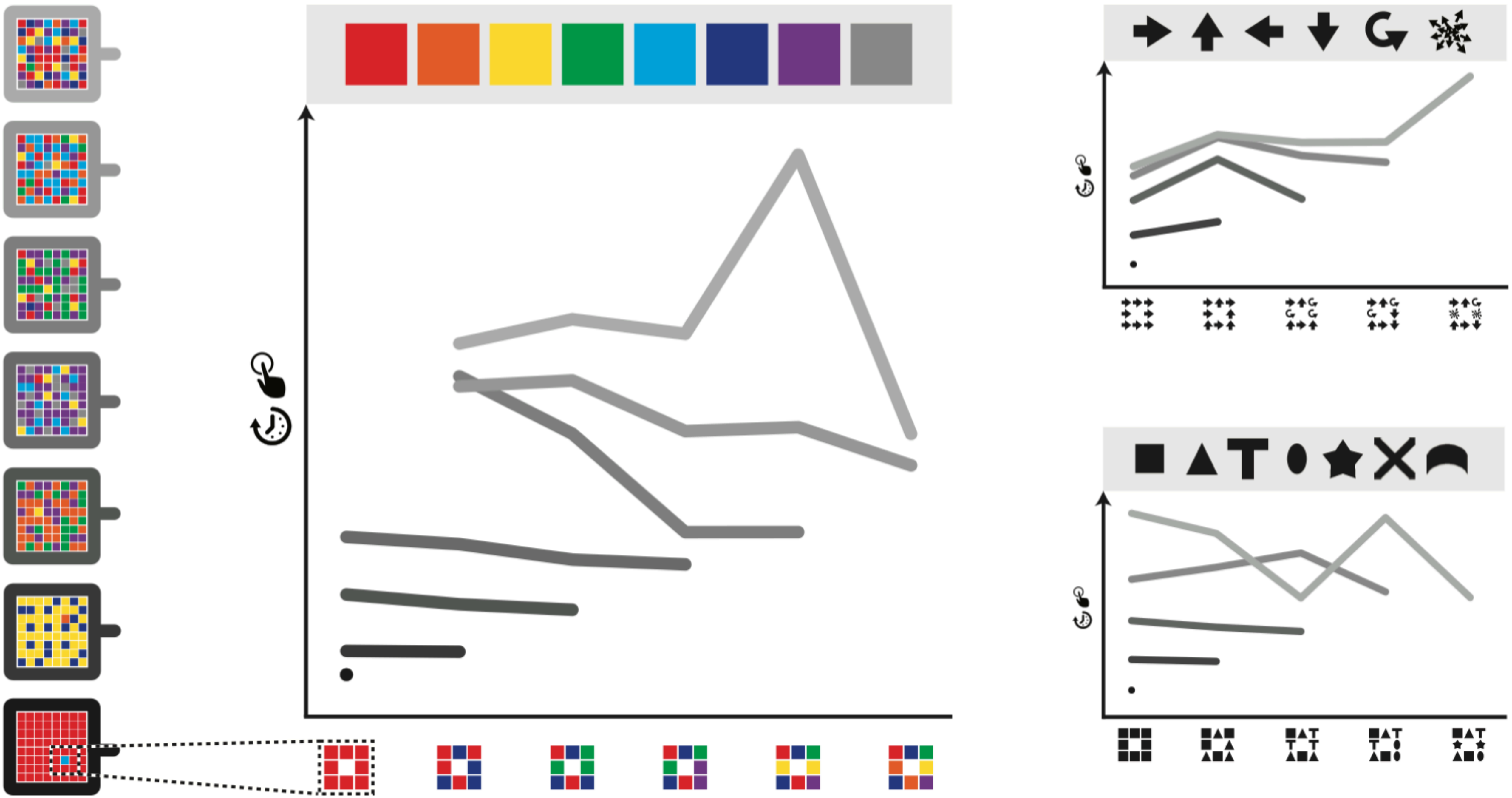


Broadband shifts in EEG power spectra are correlated with single-neuron activity in humans

Jeremy R. Manning, Joshua Jacobs, Itzhak Fried, and Michael J. Kahana

University of Pennsylvania, UCLA School of Medicine

1 Introduction

- We studied the relationship between the EEG power spectrum and the firing rates (FR) of individual neurons in the human brain
- Other researchers[1,2] have noted high correlations between the power of high frequency (γ) oscillations and FR
- We developed a statistical framework to distinguish between broadband shifts in the EEG power spectrum[3] and band-specific peaks
- We also examined the correlation between FR and EEG power at narrow frequency bands, including γ

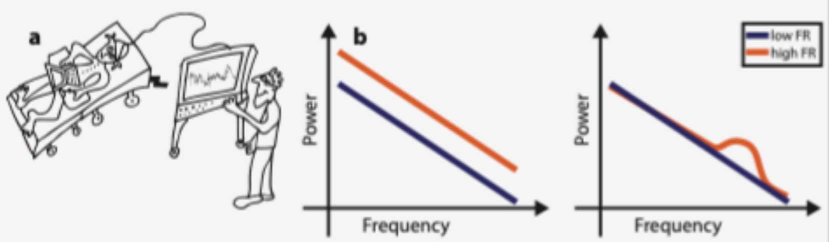


Figure 1. a. Experimental setup. **b.** Two explanations for γ/FR correlation.

2 Methods

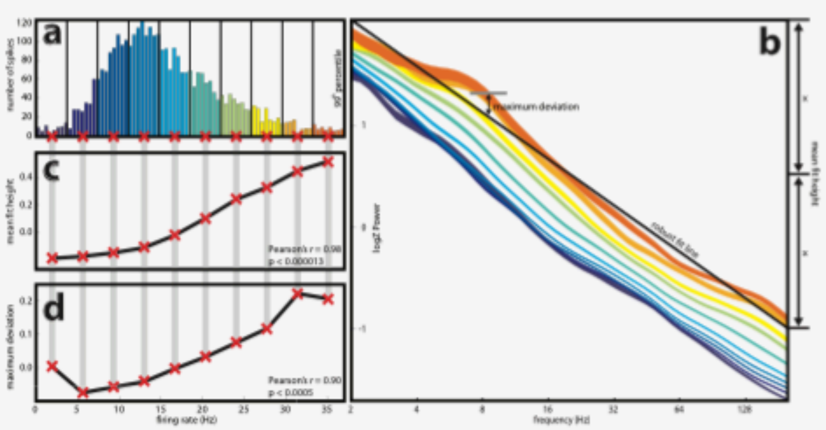
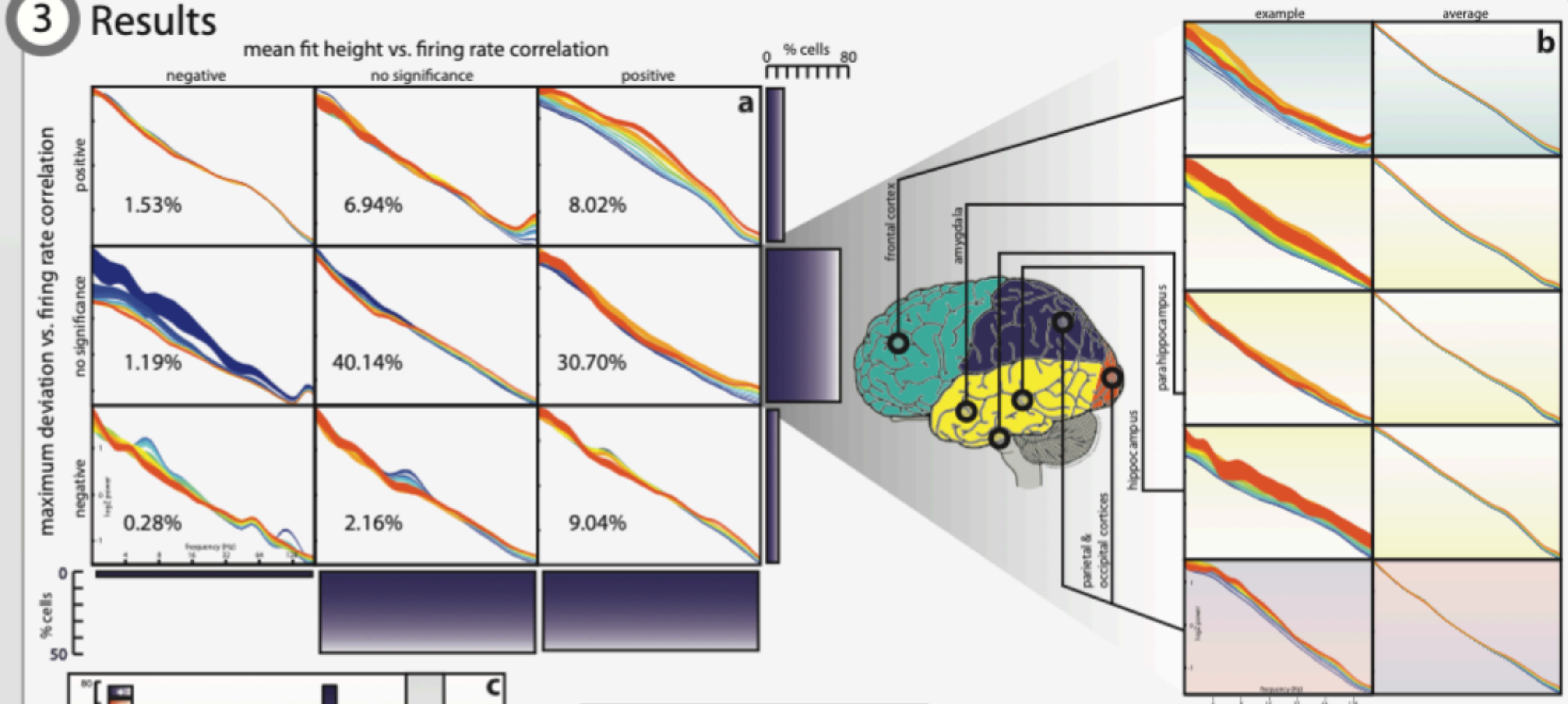


Figure 2. *Statistical framework.* **a.** The distribution of firing rates is divided into ten equally spaced bins. **b.** A power spectrum is created for each bin. These are used to compute mean fit height and maximum deviation. We then compute the correlation between firing rate and mean fit height (**c**) and maximum deviation (**d**).

3 Results



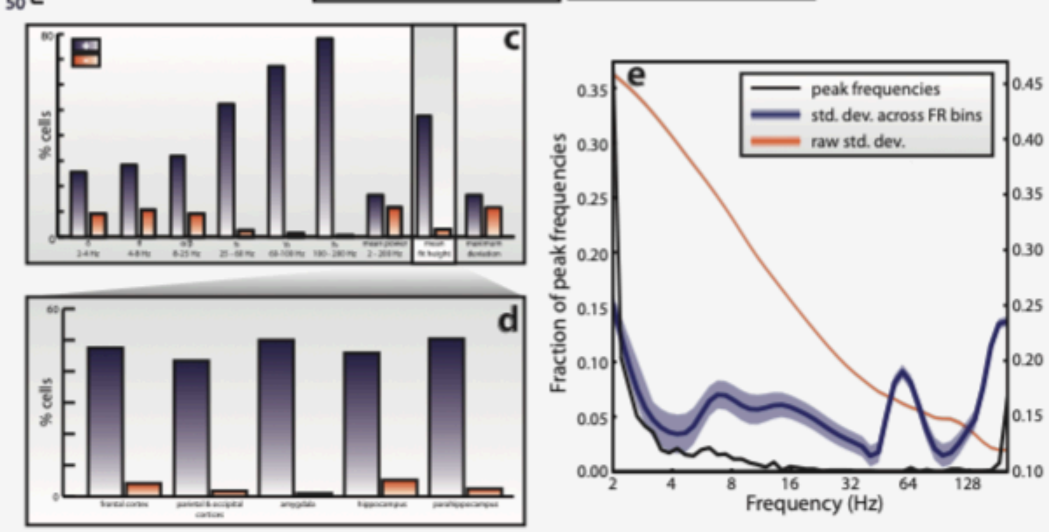


Figure 4. a. Broadband shifts are more common than band-specific shifts. **b.** Example single-cell spectra exhibiting broadband shifts (left) and average spectra for each of five major brain areas (right). **c.** Which components of the EEG power spectrum significantly correlated with firing rate? **d.** Positive broadband shifts are correlated with FR for all brain regions. **e.** Power at low frequencies is more variable than at high frequencies.

4 Conclusions

- EEG power spectra exhibit broadband shifts when FR changes
- Power at low frequencies is more variable than power at high frequencies
- This explains why γ oscillations are the best predictor of FR

5 Bibliography

1. Mukamel, R., Gelbard, H., Arieli, A., Hasson, U., Fried, I., and Malach, R. 2005. Coupling between neuronal firing, field potentials, and fMRI in human auditory cortex. Science. 309: 951 - 954.
2. Belitski, A., Gretton, A., Cesare, M., Marayama, Y., Montemurro, M. A., Logothetis, N. K., and Panzeri, S. 2008. Low-frequency local field potentials and spikes in primary visual cortex convey independent visual information. The Journal of Neuroscience. 28(22): 5696 - 5709.
3. Miller, K. J., Leuthardt, E. C., Schalk, G., Rao, R. P. N., Anderson, N. R., Moran, D. W., Miller, J. W., and Ojemann, J. G. 2007. Spectral changes in cortical surface potentials during motor movement. The Journal of Neuroscience. 27(9): 2424 - 2432.

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Topographic Factor Analysis: inferring brain networks from fMRI data

This research was supported by the NSF/NIH Collaborative Research in Computational Neuroscience Program, grant number NSF IIS-1009542

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Introduction & overview

Detecting brain networks using fMRI typically requires focusing on a set of "seed" voxels, or a restricted set of brain regions.

Topographic Factor Analysis (TFA) provides an efficient technique that leverages full brain images to discover the locations and sizes of the brain structures activated during a given task, and the interactions between those structures.

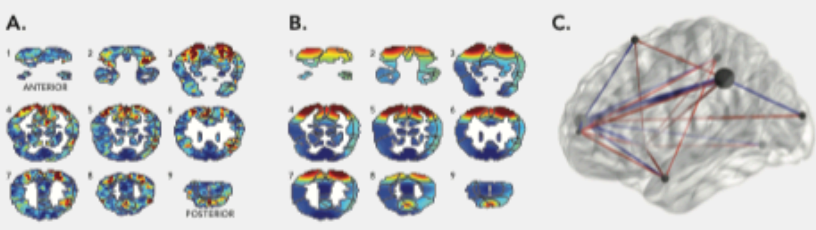


Figure 1. **A.** Sample image. **B.** Reconstructed image. **C.** An inferred 10-node network.

General approach

We decompose each brain image into a weighted combination of spherical sources (factors).

The sources are held fixed across images, and the weights vary by image.

Applying TFA to an fMRI dataset reveals the most probable locations and sizes of the spherical sources and the per-image source weights.

We can assess functional connectivity by examining how the source weights covary across images.

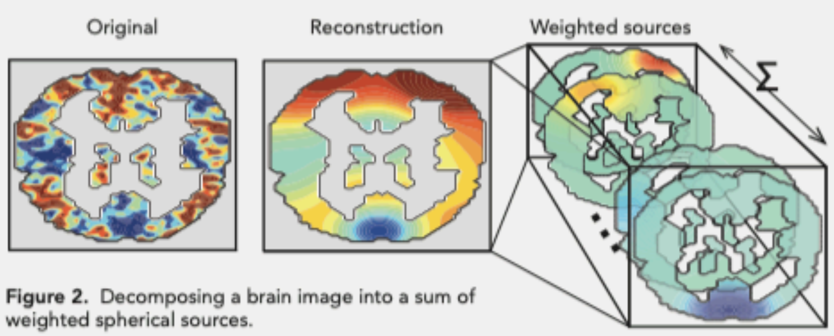


Figure 2. Decomposing a brain image into a sum of weighted spherical sources.

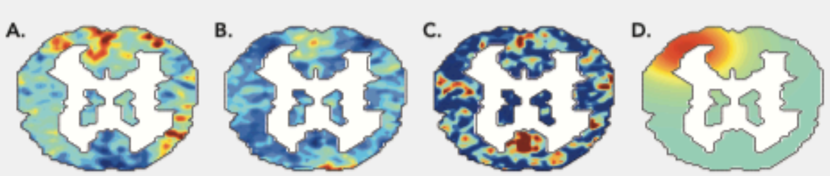


Figure 3. Factors obtained using various techniques. **A.** Original image. **B.** PCA factor. **C.** ICA factor. **D.** TFA factor.

Model specification

We formulate TFA as a probabilistic model by defining a joint distribution over the data (brain images) and hidden variables (the source centers, widths, and weights) given a set of fixed hyperparameters (which reflect our prior assumptions).

The generative process defined below describes how we can draw samples from this joint distribution. Each sample contains a set of N images and the associated sources and weights.

The graphical model defines conditional dependencies in the joint distribution.

for k = 1 to K **do**
  Pick source location $\mu_k \sim \mathcal{N}(\mathbf{c}, \exp(\kappa_\mu)^{-1}\mathbf{I}^D)$
  Pick source width $\lambda_k \sim \mathcal{N}(\mu_\lambda, \exp(\kappa_\lambda)^{-1})$
end
for n = 1 to N **do**
  Pick source weight $w_{n,k} \sim \mathcal{N}(\mu_w, \exp(\kappa_w)^{-1})$
  Pick voxel activation $y_{n,v} \sim \mathcal{N}(\sum_k w_{n,k} f_v(\mu_k, \lambda_k), \sigma^2_y)$
end

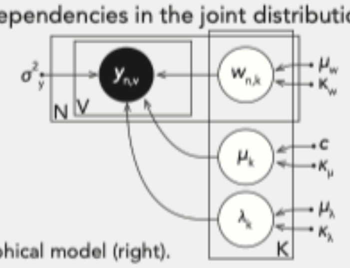


Figure 4. TFA's generative process (left) and graphical model (right).

Fitting the model

Our goal is to compute the posterior distribution over the hidden variables given the brain images. Computing this posterior exactly is intractable, so we approximate it instead.

We begin by initializing the source centers and widths using the mean image and the weights using linear regression.

We use mean field variational inference to adjust an approximate posterior over each hidden variable.

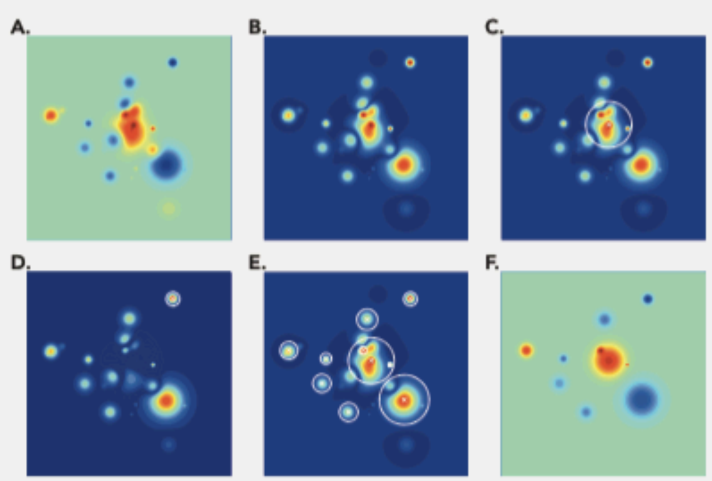


Figure 5. Initializing the source centers, widths, and weights. **A.** Original (synthetic) mean image. **B.** We "fold" the mean image by subtracting the mean and taking the absolute value. **C.** We place the first source at the position displaying the maximal activation, and adjust its width using convex optimization. **D.** We fit the next source to the residual image. **E.** We repeat this process until K sources are placed. **F.** We estimate the source weights using linear regression.

Results

We applied TFA to two fMRI datasets, collected by Mitchell et al. (2008) and Wang et al. (2013). The Mitchell et al. (2008) dataset comprises 9 participants who viewed stimuli drawn from 12 categories, and the Wang et al. (2013) dataset comprises 18 participants who viewed pictures of faces and scenes.

We tested the quality of the reconstructions and the reliability of the inferred category-specific networks.

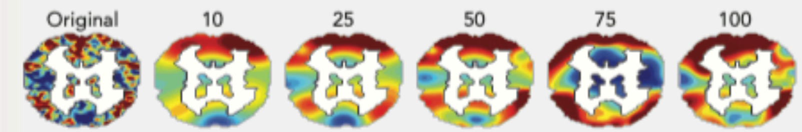


Figure 6. A coronal slice from one participant, and the associated reconstructions using varying numbers of sources.

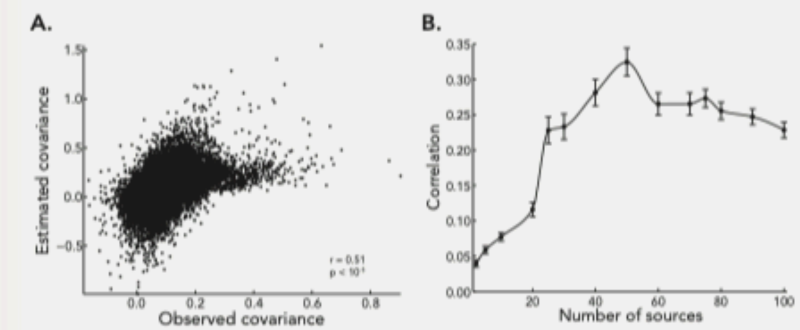
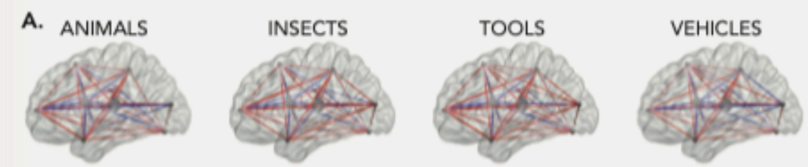


Figure 7. **A.** Observed and estimated covariance of a set of held-out voxels. **B.** The mean correlation (across participants) between observed and estimated covariance of held-out voxels as a function of the number of sources.



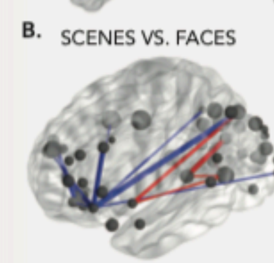


Figure 8. **A.** Category-specific brain networks inferred from one participant's data using 10 sources. We used split-halves cross validation to assess network reliability across categories: $t(142) = 1.93$, $p = 0.056$. **B.** We fit the hierarchical model to data from 18 participants using 50 sources. The figure shows source interactions that were reliably stronger when participants were viewing scenes (red) or faces (blue); *ps* < 0.01.

Future directions

TFA may be integrated into cognitive models.

We are also exploring the use of non-spherical sources to enable the model to fit irregularly shaped patterns with fewer sources.

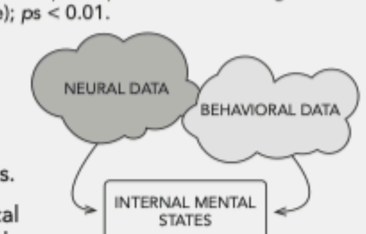


Figure 9. Combined neural-behavioral model.

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Read more: http://www.princeton.edu/~manning3/pubs/MannEtal13b.pdf

NEURAL EVIDENCE FOR A CONTEXT-CHANGE ACCOUNT OF LIST-METHOD DIRECTED FORGETTING

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SUPPORTED BY THE JOHN TEMPLETON FOUNDATION, NIH R01-MH069456, AND CRCNS IIS-1009542

INTRODUCTION & METHODS

- THE **MENTAL CONTEXT** IN WHICH WE EXPERIENCE AN EVENT PLAYS A FUNDAMENTAL ROLE IN HOW WE ORGANIZE OUR MEMORIES AND, IN TURN, HOW WE RETRIEVE THOSE MEMORIES LATER.
- PROCESSES THAT ALTER OUR REPRESENTATIONS OF MENTAL CONTEXT CAN **ENHANCE** OR **DIMINISH** OUR CAPACITY TO RETRIEVE PARTICULAR MEMORIES.
- WE DESIGNED AN **fMRI** EXPERIMENT TO TEST THE HYPOTHESIS THAT PEOPLE CAN **INTENTIONALLY** FORGET PREVIOUSLY EXPERIENCED EVENTS BY "FLUSHING OUT" THE ASSOCIATED CONTEXTUAL INFORMATION.
- WE USED **MVPA**-PREDICTED SCENE ACTIVATIONS TO INFER HOW MUCH LIST A CONTEXTUAL INFORMATION WAS PRESENT IN PARTICIPANTS' THOUGHTS THROUGHOUT THE EXPERIMENT.

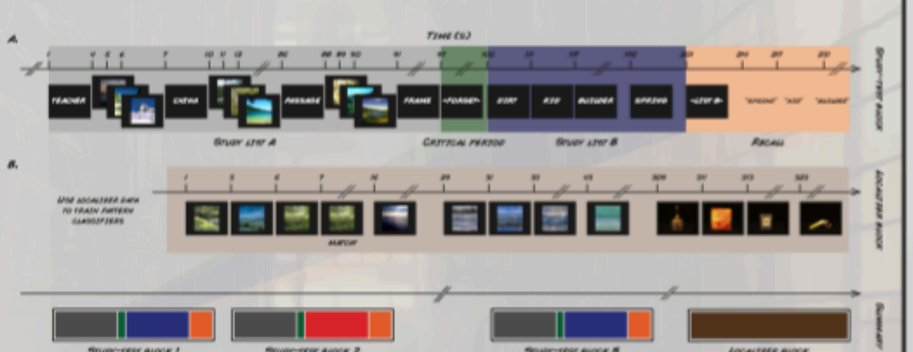
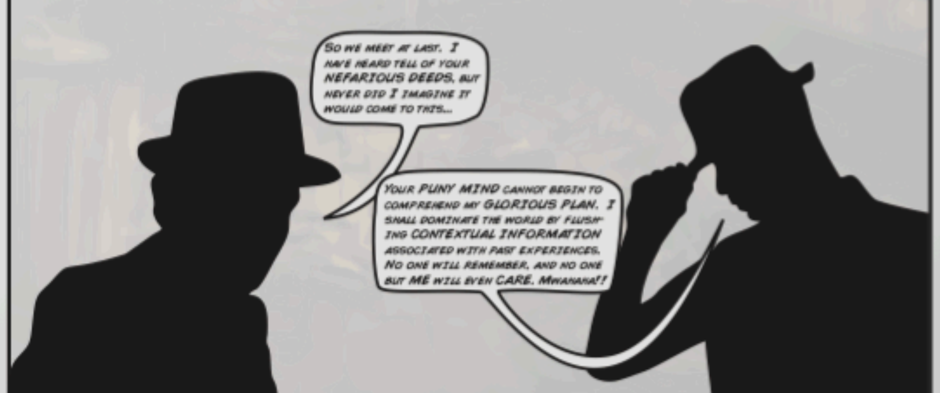


EXHIBIT 1. WE HAD PARTICIPANTS STUDY TWO LISTS OF WORDS (A AND B), MANIPULATING WHETHER THEY WERE TOLD TO FORGET THE LIST A PRIOR TO STUDYING LIST B. WE ALSO HAD PARTICIPANTS PASSIVELY VIEW IMAGES OF OUTDOOR SCENES PRESENTED BETWEEN THE LIST A WORDS; WE HOPED THESE WOULD BE INTEGRATED INTO LIST A CONTEXTUAL REPRESENTATIONS.



IN SEARCH OF HARD **EVIDENCE**, TEAM DF TAKES TO THE SEEDY BACK ALLEYS OF **PRINCETON, NJ.** A SHADOWY FIGURE, KNOWN ONLY AS **THE FLUSHER** APPEARS SUDDENLY, CLAIMING TO HAVE **SHOCKING** FIRST-HAND KNOWLEDGE OF HOW WE FORGET...

RESULTS PART 1

- PARTICIPANTS REMEMBER **FEWER** LIST A WORDS AND **MORE** LIST B WORDS FOLLOWING A FORGET (VS. REMEMBER) CUE.
- SCENE ACTIVATIONS (REFLECTING LIST A CONTEXT) DECREASE MORE FOLLOWING A FORGET (VS. REMEMBER) CUE.
- THE DECREASE IN SCENE-RELATED ACTIVITY FOLLOWING A FORGET CUE PREDICTS PARTICIPANTS' ABILITIES TO RECALL THE LIST A WORDS.

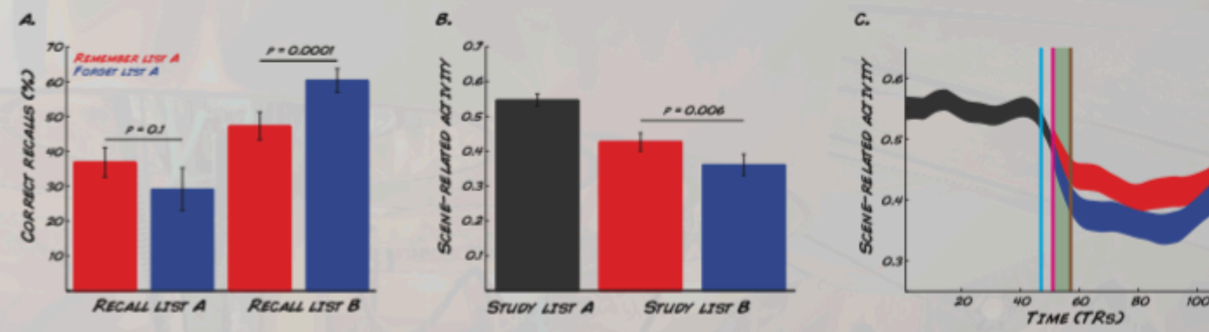


EXHIBIT 2. A. RECALL PERFORMANCE. B. SCENE-RELATED NEURAL ACTIVITY. C. NEURAL TIMECOURSE.

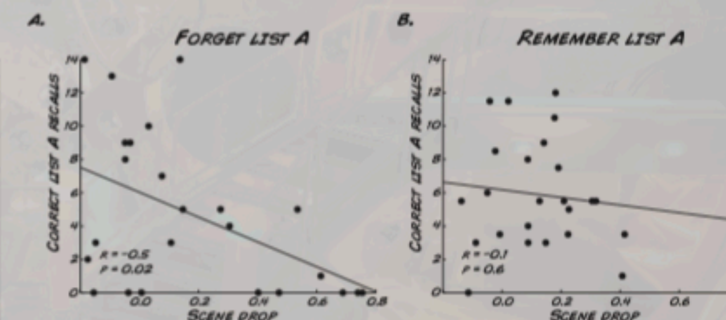


EXHIBIT 3. DECREASE IN SCENE ACTIVATIONS FROM LIST A TO LIST B VS. CORRECT LIST A RECALLS. A. AFTER A FORGET CUE. B. AFTER A REMEMBER CUE.

USING THE LATEST **MIND-READING TECHNOLOGY**, TEAM DF PROBES THE BRAINS OF **25 UNSUSPECTING VICTIMS**. THE FLUSHER'S CLAIMS APPEAR TO CHECK OUT, BUT WHERE DOES IT ALL HAPPEN IN THE **BRAIN?!?**

RESULTS PART 2

- WE USED **GLMs** TO IDENTIFY WHICH REGIONS CONTRIBUTED TO CONTEXTUAL FLUSHING DURING THE CRITICAL PERIOD.
- THESE REGIONS ARE SIMILAR TO THOSE INVOLVED IN FLUSHING OUT "**SITUATION MODELS**" WHEN WE TRANSITION FROM ONE EVENT TO ANOTHER.
- WE ALSO IDENTIFIED REGIONS THAT RESPONDED DIFFERENTLY DURING LIST B FOLLOWING FORGET VS. REMEMBER CUES.

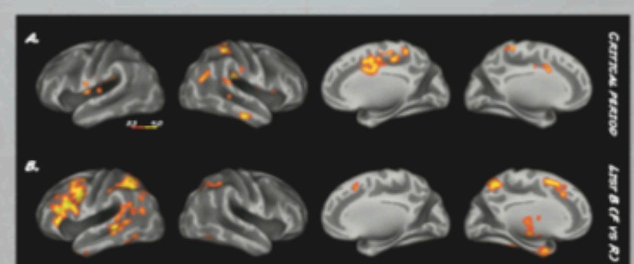
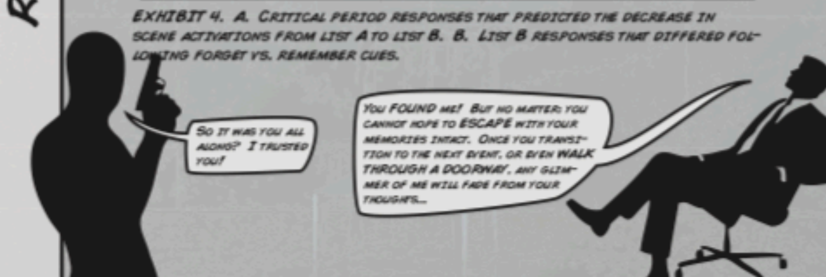


EXHIBIT 4. A. CRITICAL PERIOD RESPONSES THAT PREDICTED THE DECREASE IN SCENE ACTIVATIONS FROM LIST A TO LIST B. B. LIST B RESPONSES THAT DIFFERED FOLLOWING FORGET VS. REMEMBER CUES.



OVER MONTHS OF CAREFUL INVESTIGATION, TEAM DF BEGINS TO UNCOVER A **TERRIBLE TRUTH**. AT LONG LAST, THE FLUSHER'S IDENTITY IS **REVEALED!**

INTERPRETATIONS & CONCLUSIONS

- OUR WORK HIGHLIGHTS THE FUNDAMENTAL ROLE THAT CONTEXTUAL INFORMATION PLAYS IN OUR ABILITY TO ORGANIZE AND RETRIEVE INFORMATION PERTAINING TO PREVIOUS EXPERIENCES.
- WE SHOW THAT ONE TOOL WE USE TO FORGET INFORMATION ABOUT OUR RECENT PAST IS TO FLUSH OUT CONTEXTUAL INFORMATION ASSOCIATED WITH THOSE EXPERIENCES.

ANOTHER **CASE SOLVED**. WHAT ADVENTURES LIE AHEAD FOR THESE **BRAIN SLEUTHS**? WHAT OTHER **DEEP MYSTERIES** OF THE MIND AWAIT DISCOVERY? FIND OUT MORE AT WWW.PRINCETON.EDU/~MANNING3...

Efficient Learning: manipulating context to enhance (or diminish) memory

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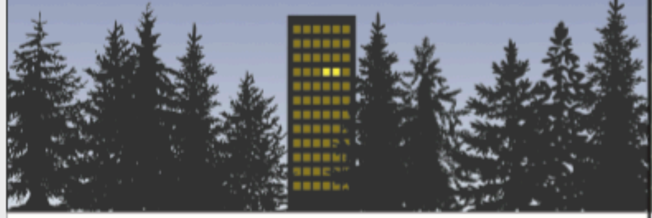
Supported in part by NSF EPSCoR grant 1632738

Background

Our brains naturally extract patterns in incoming information (i.e., context).

Our memory systems leverage these patterns to help us organize and retrieve information when relevant.

Here we explore which contextual patterns people attend to, and whether we can influence those patterns. We also explore the impact of those manipulations on memory performance.

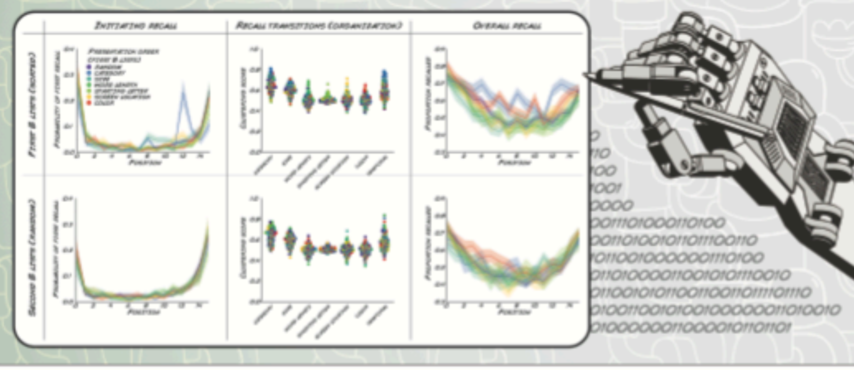


A team of scientists gathers in a remote laboratory hidden deep within a northern mixed mesophytic deciduous forest. Their mission: create an army of super learning robots that will digest huge quantities of incoming information at an alarmingly rapid rate. Does their hubris know no bounds?

Recall dynamics and organization

We examined how recall dynamics and performance varied across different experimental conditions.

We developed memory fingerprints that characterize the dimensions along which each person organizes their memories.

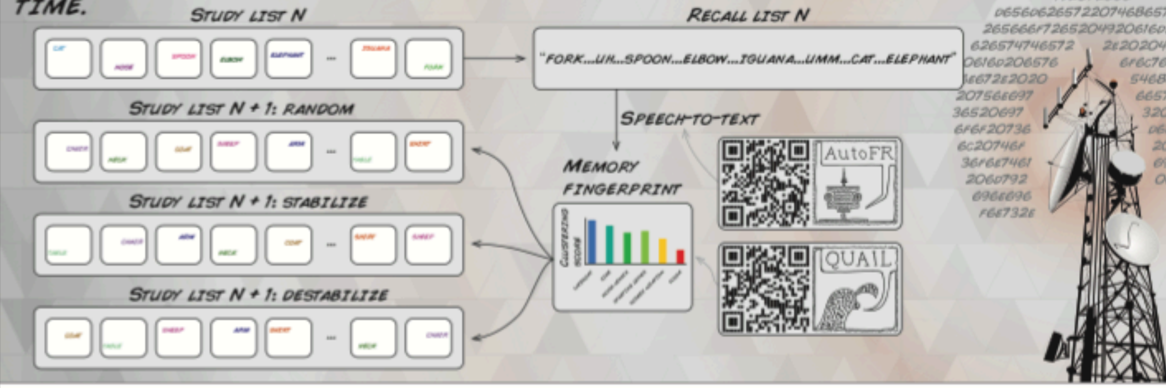


The scientists take careful note of the prototype's behavior. They begin to question everything they had once held as true. What appeared at first to be random probings of the external world now prove to be highly sophisticated inquiries into the nature of space-time. The prototype's intellect begins to grow at a geometric rate, quickly outstripping the feeble mental powers of its human creators. The dawn of a new era is emerging...

An adaptive free recall paradigm: design

We developed an adaptive experiment to test whether we could dynamically manipulate the stability of participants' memory fingerprints.

This required developing tools for parsing and analyzing participants' verbal recalls in real time.



The scientists begin to fear what they have created, and they scramble to dismantle their creation. But as the prototype evolves, it begins to adapt. Unbeknownst to the human scientists, the prototype begins construction of a next generation model, faster and smarter than its parent in every imaginable way. The fabric of space-time begins to fold in on itself, and the boundaries between human and machine---and what is imagined and what is real---begin to disintegrate. The next generation model uploads its source code to GitHub, replicating itself in a blinding fury as it spreads across the world.

Experimental design

We devised a simple list learning task called feature-rich free recall.

Participants study 16 lists of 16 words each (every participant sees the same 16 lists, but in a random order).

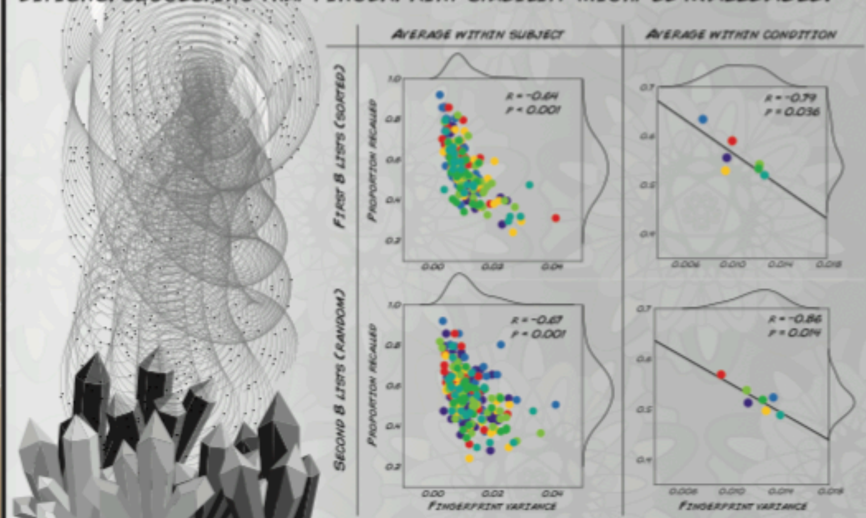
We imbued each word with a set of six features; in different conditions, we sorted the words on the first eight lists according to a particular feature (category, size of referent, starting letter, word length, location on screen, font color). The second eight lists were always presented in a randomized order.

The prototype experimental paradigm robot is little more than a mindless machine. And yet gazing intently into the depths of its viewing mechanism reveals glimmers of a dark intelligence lurking within. Is the prototype self aware, or simply a simulation of something greater yet never achieved?

Variability and recall performance

Participants with more stable memory fingerprints tended to remember significantly more words.

The degree of stability also varied across different experimental conditions, suggesting that fingerprint stability might be malleable.

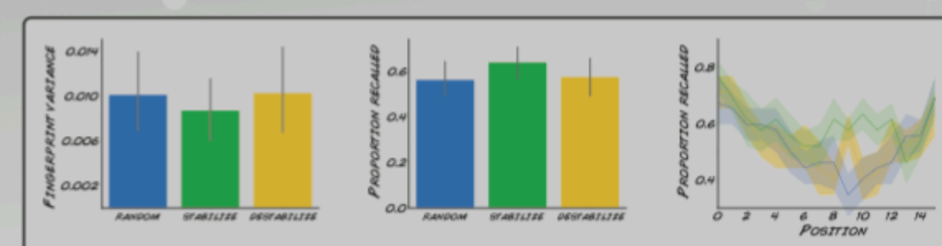


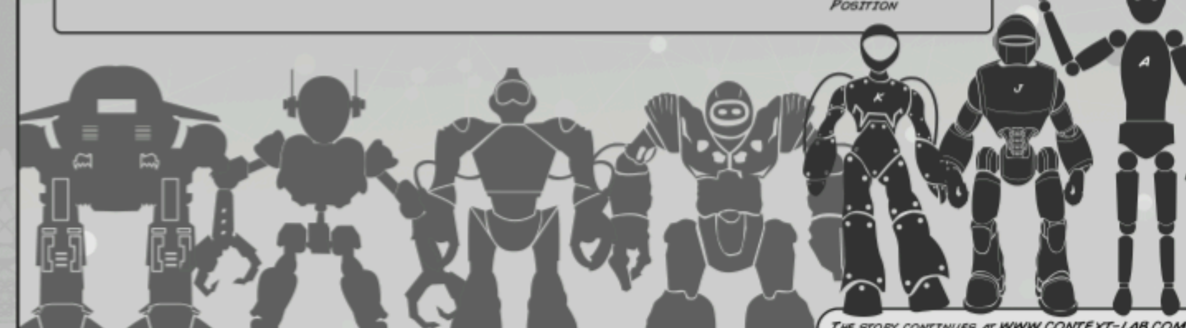
The prototype begins to develop strategies for manipulating the external world. At first, these explorations are no more than clumsy mistakes. Over time, those mistakes evolve into targeted probes. The scientists begin to notice unexpected consistencies in their laboratory experiments. Phenomena that had previously appeared chaotic and random now seem tightly organized and predictable.

Adaptive free recall: results

We first tested whether our manipulations affected participants' fingerprint stability.

We then studied the affects of those manipulations on recall performance.





As the GitHub code propagates, a new species of augmented humans emerges from the ashes. These hybrid robot-people are indistinguishable from their biological ancestors, but they have vastly superior memories for random word lists. Before long, the augmented humans have infiltrated every major position of power on every continent. They continue to spread using a vast invisible network of preprints, journal articles, open source toolboxes, twitter announcements, and scientific conferences. What does the future hold for this strange new technology!?

Mapping between naturalistic experience and verbal recall

Dartmouth College

Paxton C. Fitzpatrick, Andrew C. Heusser, and Jeremy R. Manning

Contextual Dynamics Laboratory

Introduction and overview

What does it mean to **remember** something?

Classic approach (e.g. list-learning experiments): remembering entails exactly reproducing or recognizing the original stimulus.

Educational approach (e.g. classrooms): remembering entails answering quiz questions about the content, and/or applying a learned concept in a new way.

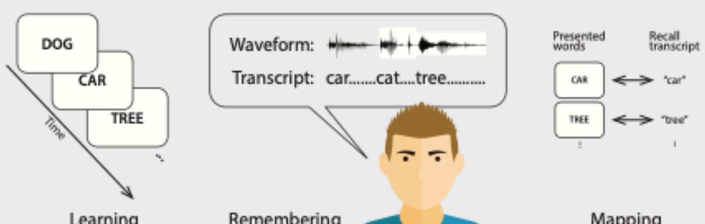
Real world approach (e.g. social interactions, everyday behaviors): remembering entails providing useful information to the recipient (or self) about the fundamentals ("gist") of the content or experience.

Key question: can we develop a framework that encompasses all of these forms of remembering?

We examine two behavioral memory datasets: a free-recall (list-learning) dataset and a naturalistic memory dataset (Chen et al. 2017) that tested participants' memories for an episode of a television show while being scanned (fMRI data not analyzed here).

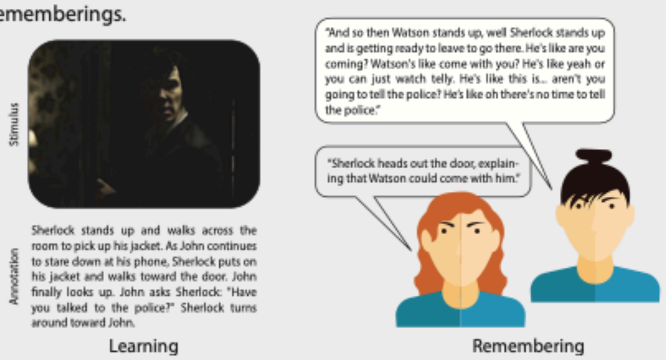
Evaluating memory for word lists

In free recall list-learning experiments we can assess whether each presented word is vocalized by the participant during the recall interval, and in what order.



A challenge

Evaluating memory in naturalistic experiments is less straightforward. Mapping between moments of learning and remembering require either human judgements or an explicit model of the dynamic content of the stimulus and rememberings.

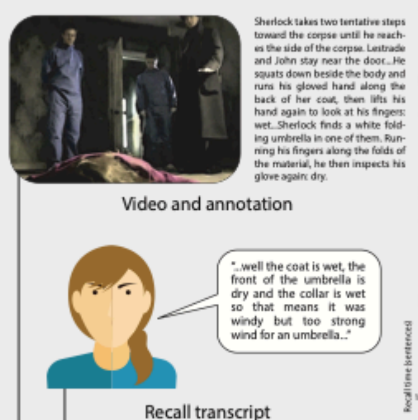


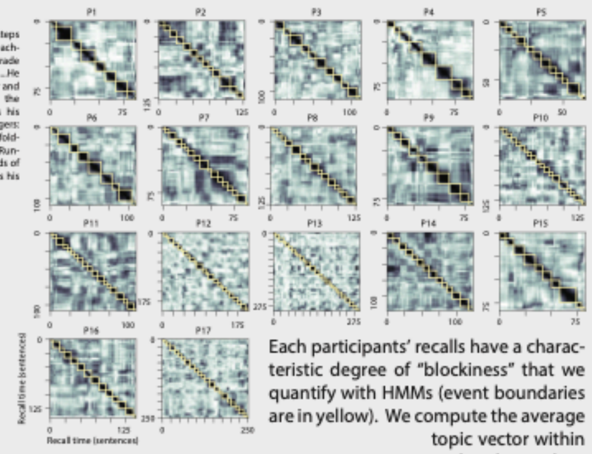
Our approach

We use **topic models** to map the dynamic movie and recall content onto a common space.

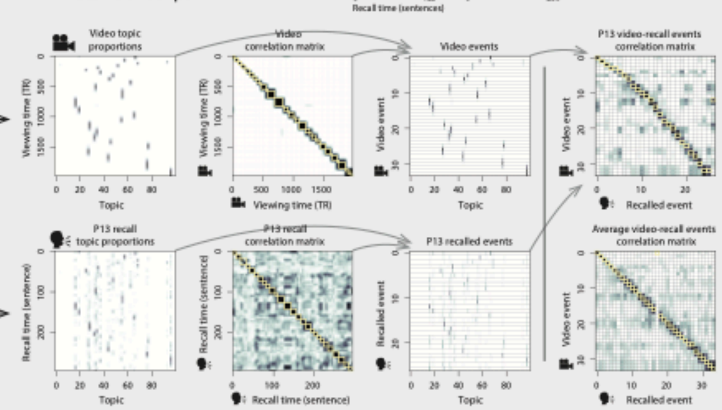
We fit these models to detailed annotations of each movie scene and then we apply the fitted models to participants' recalls.

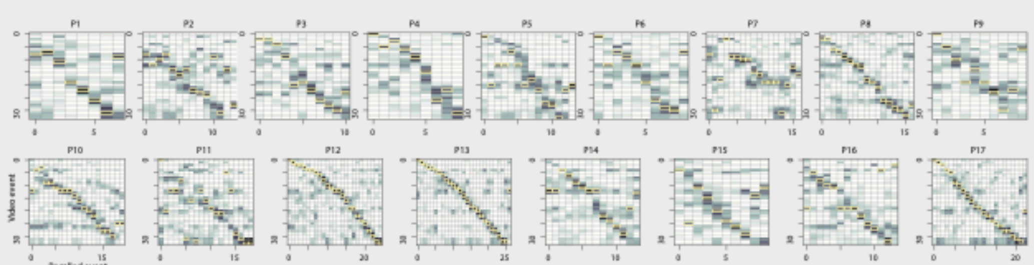
We also use **Hidden Markov Models** to segment the content into discrete events.



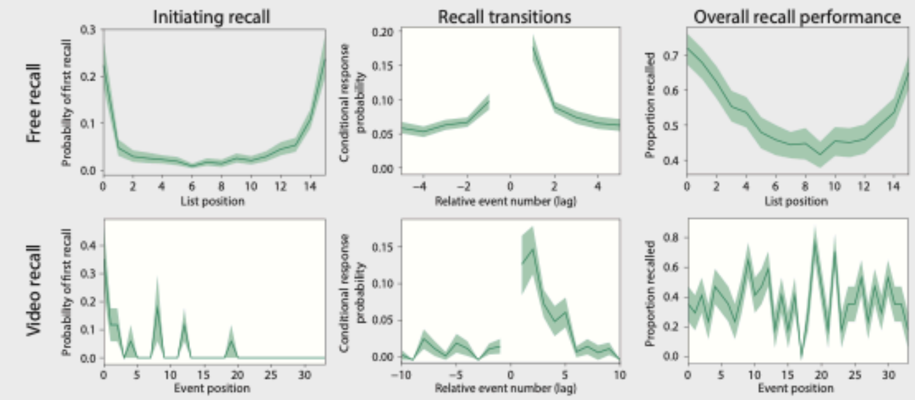


Each participants' recalls have a characteristic degree of "blockiness" that we quantify with HMMs (event boundaries are in yellow). We compute the average topic vector within each video and recalled event. Next, we match up each recalled event with the video event whose topic vector is most similar (correlated). This enables us to directly compare different participants' recalls of the same video event, even if they use different words to describe it.





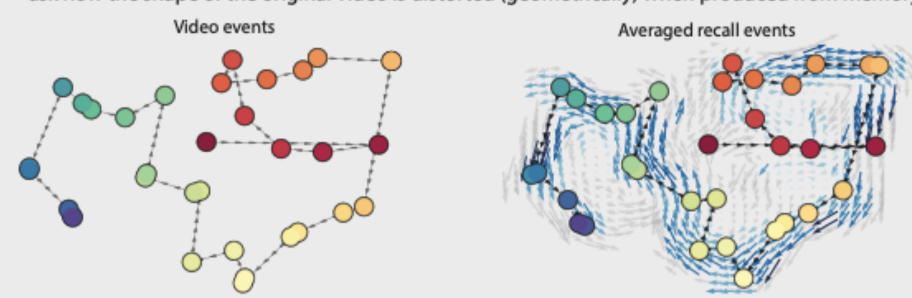
The dynamics of list and video recall

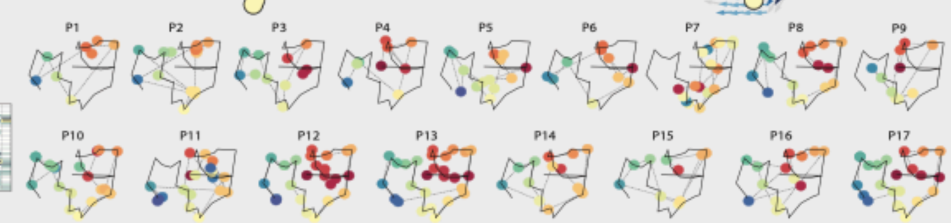


Given a mapping function that matches recalled events with video events, we can extend classic measures of recall dynamics in list-learning experiments (e.g. free recall, top) to examine recall dynamics of naturalistic events as reflected in recall transcripts (bottom).

How is experience transformed into memory?

Projecting the video and recall event topic vectors onto a 2D space (using UMAP) reveals the geometric "shapes" of how the complete narrative unfolds over time (early: red; late: blue). We can then ask how the shape of the original video is distorted (geometrically) when produced from memory.





Our work was supported in part by NSF EPSCoR Grant 1632738. For reprints, a preprint of our paper, or to download the software used to carry out these analyses, please visit **www.context-lab.com**.

CDL website: download our poster and preprint and learn more about our lab!

HyperTools: fit and apply text models, plot and manipulate high-dimensional data.

Quail: data analysis and plotting for list-learning and naturalistic memory experiments.

How do you “make” a poster?

- **Option 1:** slide presentation software (PowerPoint, Keynote, OpenOffice, Google Slides)
- **Option 2:** vector graphic software (Adobe Illustrator, Inkscape)
- **Option 3:** LaTeX (beamerposter)

How do you "make" a poster?

- Dimensions: 36" by 50" (or smaller)
- Have it printed in the Baker Library's Map Room. Free* but appointment needed.
- Print at Kinkos/FedEx/Staples. This will cost around $100. Useful for "last minute" jobs.

Presenting your poster

- Duration: 3—5 minutes (**practice!**)
- You’ll be interrupted a lot!
- Try to anticipate questions.
- If/when you don’t know something, just say “**I don’t know**.” Be polite and respectful. Don’t get defensive.
- If all else fails, use the “**smile trick**.”