

Poster Guidelines and Design Suggestions

Poster Sizes and File Types:

- The three standard paper sizes that the math department has in stock for poster printing are 24", 36" and 42" wide. Regardless of whether the poster orientation is portrait or landscape, **one** side of your poster **cannot** exceed 42".
- The poster board size currently available for mounting your poster is 36" x 48". This can be trimmed based on the size of your poster. You are not required to have a poster this large.
- .pdf is ultimately the file format that will be used, however we can open/convert/read *just about* any file type in which you would like to create your poster.

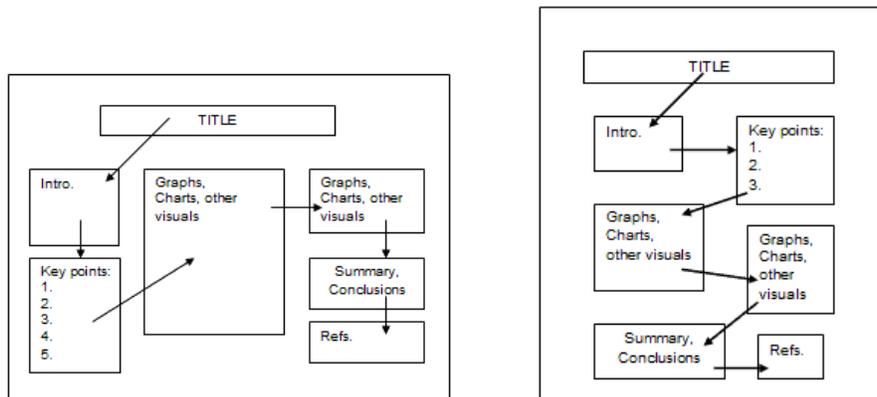
Design Suggestions

Who is your audience?

At poster sessions there is competition for audience attention. In the first few seconds your audience will determine whether to stay or leave. If they stay you have less than **30 seconds** to keep their attention by conveying an overall understanding of your subject matter.

What is your message?

A good poster will guide the reader through the project. Think about this in terms of design and laying out the parts of your poster. People tend to look "up to down" and "left to right" when reading a poster.



The size of all graphic elements should be determined by their relative importance and environment. Balance the space that is devoted to text, artwork, and white space.

Are your images appropriate for large scale printing?

Be conscious of the images you select. Small, low-resolution images will be pixelated when printed large.



Font Madness

Don't

- go crazy with artsy fonts
- use more than 2-3 fonts on the poster
- use lots of different text sizes or colors.

Color Combination - Good contrast

Color Combination - Clashing colors

Color Combination - Light letters/light background

Color Combination - Dark letters/dark background

Font Size Guidelines

Title
100 point or larger

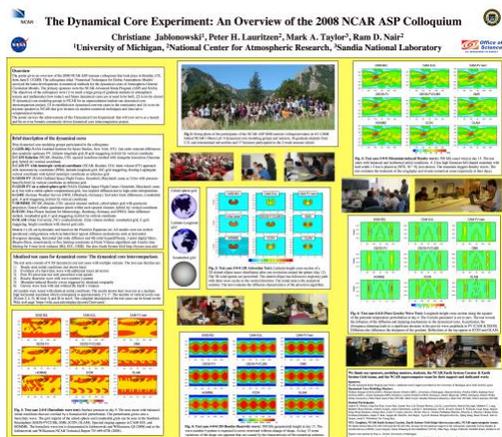
sub-titles
36 point bold

main text
30 point

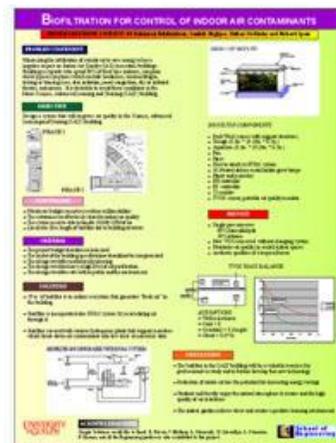
references
24 point

Color...Color...Color

When choosing colors for your poster, using 2-3 colors will give the best look. Too many colors make your poster look chaotic and unprofessional, but having no color makes it boring and plain.



Good example of multi color use



Bad example of multi color use

Other Tips and Ideas:

- Boxes around individual sections can be helpful – if it fits with the overall style you've chosen.
- Use clear headings.
- Simple flow charts provide visual interest and a lot of information to the audience.
- Avoid using a lot of text. Use images and white space to guide the eye of your audience through the poster.
- Avoid using ALL CAPITAL LETTERS in titles and text blocks.

Examples of 2 well-designed posters:

The Multiplicative Domain in Quantum Error Correction

Man-Duen Choi, Nathaniel Johnston, and David W. Kribs

Department of Mathematics, University of Toronto

Department of Mathematics & Statistics, University of Guelph

The Big Question

If we want to send some quantum data through a given noisy channel, how can we do it so that the information is preserved?

Mathematical Basics

- Let \mathcal{H} be a finite-dimensional Hilbert space and let $\mathcal{L}(\mathcal{H})$ be the set of linear operators on \mathcal{H} .
- A completely positive (CP) trace-preserving linear map $\mathcal{E} : \mathcal{L}(\mathcal{H}) \rightarrow \mathcal{L}(\mathcal{H})$ is called a **quantum channel**.
- \mathcal{E} is said to be **unital** if $\mathcal{E}(I_{\mathcal{H}}) = I_{\mathcal{H}}$.
- \mathcal{A} and \mathcal{B} are called **subsystems of \mathcal{H}** if we can write $\mathcal{H} = (\mathcal{A} \otimes \mathcal{B}) \oplus (\mathcal{A} \otimes \mathcal{B}^{\perp})$.

Correctable Subsystems

- Given a quantum channel \mathcal{E} , a subsystem \mathcal{B} of \mathcal{H} is said to be a **correctable subsystem** [1] if there exists a quantum channel \mathcal{R} such that $\mathcal{R} \circ \mathcal{E}(\sigma^{\mathcal{A}} \otimes \rho^{\mathcal{B}}) = \sigma^{\mathcal{A}} \otimes \rho^{\mathcal{B}}$.
- The channel \mathcal{R} is known as the **recovery operation**.
- We can decompose \mathcal{R} into a two step form:
 - Perform a projective measurement.
 - Conjugate by a unitary (which can depend on the result of the measurement).
- If $\mathcal{R} = \text{id}_{\mathcal{B}}$ is the identity map then \mathcal{B} is called a **noiseless subsystem** [2].

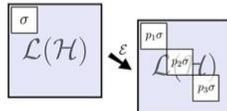


Figure 1: A correctable subsystem, depicted as a sub-block of the operators acting on the Hilbert space. To correct the error, project onto one of the three resulting sub-blocks and then conjugate by a unitary.

Unitarily-Correctable Codes

A correctable subsystem \mathcal{B} is said to be a **unitarily-correctable code (UCC)** for \mathcal{E} if the recovery operation is simply a conjugation-by-unitary channel $U(\cdot) = U(\cdot)U^{\dagger}$.

- Since finding correctable subsystems in full generality is an extremely difficult problem, restricting our attention to unitarily-correctable codes seems potentially wise.
- These codes are of physical interest; they are codes in which the two-step process of recovery only involves the conjugation-by-unitary step (and not the projective measurement step).
- It has been shown [3] that if a quantum channel \mathcal{E} is unital, then we can unambiguously define the **unitarily-correctable code algebra** of \mathcal{E} , denoted $UCC(\mathcal{E})$, to be the algebra composed of the direct sum of all of the unitarily-correctable codes.
- In terms of Figure 1, unitarily-correctable codes are those for which $p_1 = 1$ and $p_2 = p_3 = 0$ (i.e., there is just one block on the right).

The Multiplicative Domain

The **multiplicative domain** of \mathcal{E} [4], denoted $MD(\mathcal{E})$, is defined to be the following set:

$$\{a \in \mathcal{L}(\mathcal{H}) : \mathcal{E}(a)\mathcal{E}(b) = \mathcal{E}(ab) \text{ and } \mathcal{E}(b)\mathcal{E}(a) = \mathcal{E}(ba) \forall b \in \mathcal{L}(\mathcal{H})\}.$$

- \mathcal{E} behaves particularly nicely when restricted to $MD(\mathcal{E})$ (as a \ast -homomorphism, in fact).
- $MD(\mathcal{E})$ was first studied by operator theorists over thirty years ago.
- $MD(\mathcal{E})$ is an algebra, and hence [5] is unitarily equivalent to a direct sum of tensor blocks:

$$MD(\mathcal{E}) \cong \oplus_i (I_{\mathcal{A}_i} \otimes \mathcal{B}_i) \oplus 0_{\mathcal{C}}. \quad (1)$$

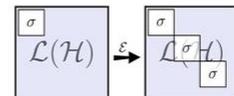


Figure 2: The action of a quantum channel on its multiplicative domain.

Conclusions and Outlook

This characterization provides a simple way to find all unitarily-correctable codes for unital channels and even some codes for non-unital channels. General correctable subsystems can be characterized in terms of algebras that are analogous to the multiplicative domain, though in general it is not clear how to calculate them – further research in this area would be of great interest.

For Further Information

- For the details of our work:
 - Choi, M.-D., Johnston, N., and Kribs, D. W. *Journal of Physics A: Mathematical and Theoretical* **42**, 245303 (2009).
 - Johnston, N., and Kribs, D. W. *Generalized Multiplicative Domains and Quantum Error Correction* (2009, preprint).
- Preprints and this poster can be downloaded from:
 - www.arxiv.org
 - www.math.utoronto.com

References

- D. W. Kribs, R. Lafamme, D. Poulin, M. Lossky, *Quantum Inf. & Comp.* **6** (2006), 383-390.
- P. Zanardi, M. Rasetti, *Phys. Rev. Lett.* **79**, 3306 (1997).
- D. W. Kribs, R. W. Spekkens, *Phys. Rev. A* **74**, 042329 (2006).
- M.-D. Choi, *Illinois J. Math.* **18** (1974), 565-574.
- K. R. Davidson, *C*-algebras by example*, Fields Institute Monographs, 6, American Mathematical Society, Providence, RI, 1996.

Acknowledgements

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The Great Connection

By looking at Figures 1 and 2, we expect that there might be some connection between correctable subsystems for a channel \mathcal{E} and its multiplicative domain. Indeed, one of our main results is that the two situations coincide when \mathcal{E} is unital and the subsystem is unitarily-correctable.

Main Result

Theorem. Let \mathcal{E} be a unital quantum channel. Then $MD(\mathcal{E}) = UCC(\mathcal{E})$.

- This theorem says that when we write $MD(\mathcal{E})$ in the form of Equation (1), the \mathcal{B}_i 's are exactly the unitarily-correctable codes for \mathcal{E} .
- When \mathcal{E} is not unital, $MD(\mathcal{E})$ in general only captures a subclass of the unitarily-correctable codes for \mathcal{E} .
- Because $MD(\mathcal{E})$ is easy to compute, this provides a concrete method of finding some UCCs.

Generalization

- In the same spirit as the multiplicative domain, we can define "generalized multiplicative domains" for channels by requiring not that the channel be multiplicative with itself, but rather that it be multiplicative with some \ast -homomorphism.
- Generalized multiplicative domains capture all correctable codes for arbitrary channels.
- Unlike the multiplicative domain, these algebras in general are very difficult to compute.

<http://www.njohnston.ca/2009/08/latex-poster-template/>

Counting Polynomials as Hilbert Functions
Felix Breuer, Aaron Dall

Theorem: Let G be a graph. Then the modular and integral flow polynomials and the modular and integral tension polynomials of G are Hilbert functions of relative Stanley-Reisner ideals.

Example \mathbb{Z}_2 -flows: $\phi_G(k) = H_{\Delta}(k) = (k-1)(k-2)!$

Relative Polytopal Complexes: A d -dimensional polytope P is integral if all vertices of P have integer coordinates. P is called compressed if every pulling triangulation of P is unimodular. A relative polytopal complex is a pair (C, Δ) of polytopal complexes.

Relative Stanley-Reisner Ideals: Stanley-Reisner ideal $I_{\Delta} = \langle \sigma^f \mid \text{supp}(f) \notin \Delta \rangle \subseteq \mathbb{K}[x_1, \dots, x_n]$. Stanley-Reisner ring $\mathbb{K}[\Delta] = \mathbb{K}[x_1, \dots, x_n] / I_{\Delta}$. Relative Stanley-Reisner ideal $I_{\Delta}(C) = \langle \sigma^f \mid \text{supp}(f) \notin \Delta \rangle \subseteq \mathbb{K}[x_1, \dots, x_n]$. The Hilbert function $H_{\Delta}(C, k)$ counts monomials of degree k in $\mathbb{K}[x_1, \dots, x_n] / I_{\Delta}(C)$.

Hilbert equals Ehrhart: Theorem. Let C be a polytopal complex. If all faces of C are compressed lattice polytopes, then for any subcomplex $C' \subseteq C$, there exists a relative Stanley-Reisner ideal $I_{\Delta}(C')$ such that for all $k \geq 2$, Ehrhart polynomial $\rightarrow H_{\Delta}(C', k) = H_{\Delta}(C', k)$ Hilbert function.

<http://blog.felixbreuer.net/2010/10/24/poster.html>

Examples of 2 poorly designed posters:

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, what 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 8 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 chairs 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 new 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 robot 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 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 déwéaps (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 Mariana Athletic Club, Corpus Christi, USA. Finally, sincere thanks to the Ouy Foundation for generously donating animal care after the conclusion of the study.

LITERATURE CITED:
NASA, 1962. Project STS-XX: Guinea Pigs. Unpublished internal memo.
Sokal, S.R., D. D. Lixson, and N.M. Anumovic. 2005. The Fetus Gannet Exercise Like An Astronaut: Gravity Loading Is Necessary For The Physiological Development During Second Half Of Pregnancy. *Medical Hypotheses*, 64:221-225.
Xavier, M. 1965. Elastane Purchases Accelerate Weight Gain In Case-control Study. *Journal of Obesity*, 2:23-40.

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Chaotic Psychedelic Poster

Be thankful you name isn't on this poster

Introduction
Insert your text here. You can place your organizational logo on either side of the title of the poster. Insert your text here.
Remember to use your font to fit your information into the space. The larger your font, the easier it will be for others to read your poster. Insert your text here.
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Methods
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Tools

Literature Cited
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Disclosure
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Expected Results
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Doctors/Technician Training Modules
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<http://www.makesigns.com/tutorials/poster-design-layout.aspx>