Emerging Trends in Visual Science Communication: How to create informative and inspiring graphics for journals and presentations

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Co-Founder, BioRender.io
Science illustrator, National Geographic Magazine

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TODAY’S TALK (60 min):

Brief background
What is science/medical illustration?
Tools & techniques (and common mistakes!)
Q&A

Giveaway
(1 free customized science graphic, at end of talk, valued at $500)
WHY SCIENCE VISUALIZATION?
VALUE OF A GOOD SCIENTIFIC GRAPHIC:

- Communication - peer to peer, or to the public
- Publication
- Presentation slides
- Investors (VC pitch decks)
- Self-evaluation
- Promotional / Social media
**Facebook**

*Most Shared Posts from Facebook Pages Worldwide, March 2014*

<table>
<thead>
<tr>
<th>Type</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo</td>
<td>87%</td>
</tr>
<tr>
<td>Link</td>
<td>4%</td>
</tr>
<tr>
<td>Album</td>
<td>4%</td>
</tr>
<tr>
<td>Video</td>
<td>3%</td>
</tr>
<tr>
<td>Status</td>
<td>2%</td>
</tr>
</tbody>
</table>

*Note*: among the top 10% of posts in raw interactions from 30,000+ Facebook pages

*Source*: Socialbakers.com as cited in company blog, April 8, 2014

**Twitter**

*Source*: Twitter Media Blog, Get the data, Embed this chart
1. It fails the technical screening.

Before they even go to the editor-in-chief, articles are checked for technical elements. The main reasons they are rejected are:

Peter Thrower, PhD, is Editor-in-Chief of Carbon, the international journal of the American Carbon Society, and Professor Emeritus of Material Sciences and Engineering at Penn State University.

- The article contains elements that are suspected to be plagiarized, or it is currently under review at another journal. (Republishing articles or parts of articles, submitting to one or more journals at the same time or using text or images without permission is not allowed. See our ethical guidelines.)
- The manuscript is not complete; it may be lacking key elements such as the title, authors, affiliations, keywords, main text, references and all tables and figures).
- The English is not sufficient for the peer review process,
  - The figures are not complete or are not clear enough to read.
- The article does not conform to the Guide for Authors for the journal it is submitted to.

https://www.elsevier.com/connect/8-reasons-i-rejected-your-article
BACKGROUND
BACKGROUND

BSc. Life Science
Queen’s University, Kingston ON

BFA, Fine Art
Queen’s University, Kingston ON

MA, Medical Illustration
Johns Hopkins University School of Medicine, Baltimore, MD
BACKGROUND

National Geographic Magazine HQ, Washington, DC
National Geographic Magazine HQ, Washington, DC
PEAK INTO THE PROCESS
mostly of endothelial cells and smooth muscle cells that line the vasculature throughout the body. But the outer wall is unique to the brain and spinal cord.

It is made up of a projecting extension from a type of brain cell called an amyocyte, which performs a multitude of support functions for the interconnected network of neurons that relay signals throughout the organ by the trillions. The extensions called amygastic entoderm completely surround the arteries, capillaries, and veins in the brain and spinal cord, forming the outer enclosure for the perivascular space. The hollow tube-like cavity remains largely free of obstructions, creating a spillway that provides scant resistance for the rapid transport of fluid through the brain.

Scientists knew about the existence of the perivascular space, but had not identified any specific function for it. Twenty years ago, Patricia Grady at the University of Maryland reported - in a set of studies that proved seminal only in retrospect - that large proteins injected into the cerebrospinal fluid could later be found in the perivascular spaces, of both dog and cats. At the time, other groups could not replicate her findings.
Hippocrates observed that the brain is suspended in a fluid, but the functions of that cerebrospinal fluid (CSF) vital to brain function have only been slowly revealed.

François Magendie compared the brain suspended in CSF to the fetus suspended in amniotic fluid, and indeed, CSF does provide mechanical support for the brain. Since the brain is neutrally buoyant in this environment, CSF provides protection of neural tissue from the force of gravity and from sudden changes in position during head impact. The production of CSF by the choroid plexus in the lateral ventricles, its transit through the third and fourth ventricles, its course over the outer surface of the brain and spinal cord, and its ultimate uptake at the arachnoid granulations in the large draining veins was not fully described until the early 1900s (Figure 1A and ref 1).

### Into the soup

Virtually every cell throughout the body is surrounded by interstitial fluid, which plays critical roles in cellular homeostasis, including maintaining osmotic gradients, supplying nutrients, and equilibrating concentrations of molecules by diffusing through these channels.

The hypothesis that brain possesses a "vacuolar" system with the same physiological functions, but with different anatomy and physiology, is supported by the observations that CSF is removed from the lateral ventricle through a fenestra in the venous system in the brain parenchyma and around small cerebral blood vessels.

### Conflict of interest

The author has declared that no competing interests exist.

Citation for this article: Live Invest. doi:10.1172/JCI98431.

Scientists knew about the existence of the perivascular space but until very recently had not identified any specific function for it. Thirty years ago, it was thought that the cerebrospinal fluid could just pass through this space. But the outer wall is unique to the brain and spinal cord and is lined with extensions branching out from a specialized type of cell called the astrocyte.

Astrocytes are support cells that perform a multitude of tasks for the interconnected network of neurons that allows for the rapid transport of fluid through the brain.
ADVANCES

DEVELOPMENTAL BIOLOGY

First Impressions

We start to pick up words, food preferences and hand-eye coordination long before being born. Newborns are hardly blank slates devoid of knowledge and experience, contrary to historical notions about the infant mind. Sensory awareness and learning start in the womb, as the recently reinvigorated study of fetal perception has made clearer than ever. In the past few years, images and videos created by 3-D and 4-D ultrasound have divulged much more about physiology and behavior than the blurry 2-D silhouettes of typical ultrasound.

TOUCH
As early as seven weeks after fertilization, fetuses start to move. As they grow, they swing their umbilical cords, climb the walls of the amniotic sac and stick their limbs in their mouth. Much of this activity could be random fumbling, but recent 4-D scanning studies suggest that by 24 weeks fetuses anticipate these motions, opening their mouth before bringing their hands toward it, for example. And their coordination improves as they grow.

HEARING AND LANGUAGE
A fetus begins to hear between 24 and 27 weeks. It has been known for a decade that fetuses learn general features of their native language, such as rhythm and intonation, but two studies in 2013 confirmed that they also pick up distinct words and syllables. Brain activity of newborns in one of those studies revealed that they recognized three-syllable nonsense words that had been repeatedly played in their environment prior to birth, whereas newborns never exposed to the words were indifferent.

SMELL AND TASTE
By the 19th week of pregnancy, a fetus's taste buds have formed. The olfactory cells in its nose are working around the 24th week. Studies in the past decade have shown that new borns prefer flavors and odors, such as garlic, anise and carrot, that they grew accustomed to in the womb. Other research with rats in the past couple of years suggests that the foods a mother eats can mold a fetus's brain in unhealthy ways, too. Baby rats whose mothers ate a diet of junk food were born with brains primed to crave such foods.

VISION
Of all the senses, vision takes longest to mature. A fetus does not open its eyes until its 28th week, and researchers debate what it can see, if anything. New evidence from animal studies indicates, however, that light filtering through the womb is crucial for eye development: when deprived of light, a mouse fetus will grow too many neurons and blood vessels in its eyes, causing damaging pressure to build up.

Fetus shown at 27 weeks

Illustration by Shinako Adti
ALL ABOUT THE BENJAMINS

ORGANIC GROWTH

INITIAL self-funded INVESTMENT: $45,000

TRIPLED REVENUE EVERY YEAR

7000%↑ REVENUE INCREASE IN LAST 2 YEARS

3 WEEKENDS WORKED

NUMBER OF INVESTORS TURNED DOWN 90%

COMPANIES LAUNCHED

{ CLEVERFOX TBA TBA TBA }

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TOOLS & TECHNIQUES
HARDWARE

Wacom tablet
- Wacom Intuos series (tablet)
- Cintiq series (screen/tablet)

Macbook and iMac - iOS (all wacom products and most software compatible on both PC and Mac)
SOFTWARE

- Adobe Photoshop & Illustrator (80%)
- Adobe After Effects
- Screenflow (‘whiteboard’ type animations)
- ToonBoom (storyboarding)
- Google Drive (Google Drawing)
- Dropbox Paper (share ideas)
- Powerpoint (with a grain of salt…)
- QuteMol (free, beautiful 3D renders of Pymol or pdb files)

- Others (I have not tried but have been recommended)
  - Graph Pad
  - Mind the Graph (infographics online)

- Tutorials: Lynda.com, YouTube
- Squarespace.com (Easy website for startups, labs, products)
TECHNICAL BASICS

**Raster (pixels)**
- jpegs, png, gif, pdf

**Vector (paths)**
- ai, svg, pdf, eps

[Diagram of a cell with labeled parts: pilus, capsule, cell wall, plasma membrane, nucleoid (DNA), cytoplasm, ribosomes, flagellum.]
Lines, arrows, fonts, margins

- Watch your margins! Equal on all sides
- Pick 1 or 2 fonts!
- Fonts - kerning (in Photoshop/Illustrator, select “Optical”)
- Keep arrow strokes thinner than the text thickness
- Don’t use dropshadows or rounded edges! (dated)
VISUAL DESIGN CHOICES - ‘Kerning’

No kerning

Kerning applied
VISUAL DESIGN CHOICES - ‘Kerning’

The cat in the hat

The cat in the hat
key lime tarts

8.6 oz. (245 g)
Color and Grayscale

- Don’t use black, use dark grey
- Pick ONE accent color for slides and design
- Be careful of color “values”
VISUAL DESIGN CHOICES - Color and “Value”
VISUAL DESIGN CHOICES - Color and “Value”
Science behind colors (use complementary hues)

Red + green
Orange + blue
Purple + yellow
VISUAL DESIGN CHOICES - Color and "Value"
TECHNICAL BASICS

THINGS TO AVOID:

- Word Art
TECHNICAL BASICS

THINGS TO AVOID:

- Gradients (defaults on powerpoint)
THINGS TO AVOID:

- Gradients (defaults on powerpoint)
TECHNICAL BASICS

(Don’t do this)
Format your photos

- Crop tightly to area of interest
- Adjust “levels” in photoshop or any image editing app
- Remove backgrounds more easily using the “magic wand” tool in photoshop
- Expand and live trace photos in Illustrator to convert to vector
The urge for **good design** is the same as the urge to go on living.
FINAL TIPS

- Start on paper
- Test print
- Fresh eyes
- Consult with a science/medical illustrator!
THANK YOU!
Giveaway
(one free customized science graphic)
Email: aoki@anatomize.com
Subject: NNLM Webinar