

3rd of March 2017

**Introduction
to**

Data

Visualization



Mohamed Elgendi

Mining for Miracles Postdoctoral Fellow

Research Team: Ken Lim & Rabab Ward

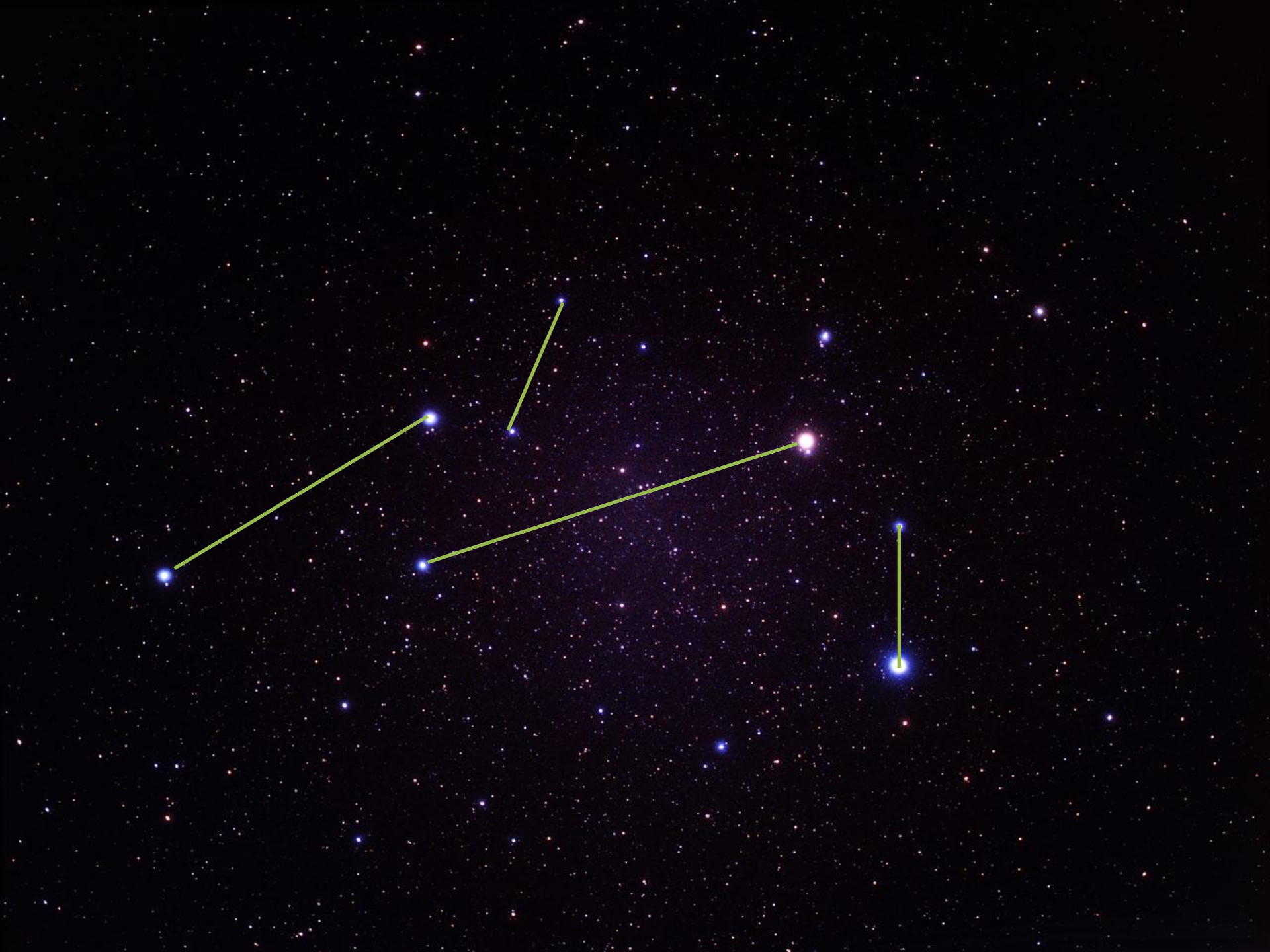




What is data visualization?

The **representation** and **presentation** of data that exploits our **visual perception** abilities in order to **amplify cognition**







Saturn

This section of the manuscript features a grid of vertical columns, each containing a list of names or symbols. The columns are arranged in a structured manner, with some columns containing multiple rows of text. Below the columns, there are several illustrations of human figures. Some figures are standing on a boat or a platform, while others are holding objects or performing actions. The illustrations are interspersed with the columns of text, creating a complex visual layout.

This section contains several horizontal lines of text, likely representing a list or a series of entries. The text is written in a cursive or shorthand style, characteristic of certain historical manuscripts. The lines are separated by decorative borders consisting of repeating star or cross patterns.

This section is dominated by a grid of circular diagrams, each containing a radial pattern of lines. These diagrams are arranged in two rows of four. Above and below the diagrams are various illustrations and text. At the top, there are figures of people, some holding long poles or staffs. At the bottom, there is a long sequence of figures, some with red circular heads, and a large animal, possibly a bull or a horse, being led by a person. The entire section is framed by decorative borders of repeating star or cross patterns.

What's required?

The tools and skills required for effective data visualization information are always **not intuitive** and rely largely on principles that must be learned.

Stephen Few, 'Show Me the Numbers', 2004



Daily Times

**GOOD
NEWS!**

the
human
brain

is



powerful

especially at
recognizing

shapes

and

patterns



connection
the between



the eye
and brain ...



fast

One Look Is Worth A Thousand Words--

One look at our line of Republic, Firestone, Miller and United States tires can tell you more than a hundred personal letters or advertisements.

WE WILL PROVE THEIR VALUE
BEFORE YOU INVEST ONE DOLLAR
IN THEM.

Ever consider buying Supplies from a catalog?

What's the use! Call and see what you are buying. One look at our display of automobile and motorcycle accessories will convince you of the fact.

THAT WE HAVE EVERYTHING FOR
THE AUTO

Piqua Auto Supply House

133 N. Main St.—Piqua, O.

appears in a 1911 newspaper article quoting newspaper editor [Tess Flanders](#) discussing journalism and publicity
Daily [newspaper](#), NY, USA

First Study: invasive
Speed of seeing an image

10
Mb/s

the brain
receives
10 megabits
per **image**
from the eye
every second



the average
person

comprehends
300 words
per minute
reading

160
b/s

that is
equivalent to
160 bits
per **word**
every second

1

=

image

62500

words

Second Study: non-invasive

Speed of seeing an image

1.5
Mb/s

the brain
receives
1.5 megabits
per **image**
from the eye
every second

Second Study: non-invasive

1

=

image

10000

words

1911

One Look Is Worth A Thousand Words--

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THAT WE HAVE EVERYTHING FOR
THE AUTO

Piqua Auto Supply House

133 N. Main St.—Piqua, O.

2017

**One Look is
Worth
More than 10
Thousand
Words**

we are not
wired to read
fast





we are wired
to visualize fast

data visualizations

can be

**Awesome
Tools**

when used
effectively



4 there are four
fundamental ways
to use
data visualizations
effectively

1



To analyze

Bar
charts

Heat
maps

Bullet
graphs

Line
graphs

Pie
Chart

Box
plots

Tree
maps

scatter
plots

these tools help us

see

trends
patterns

and help us

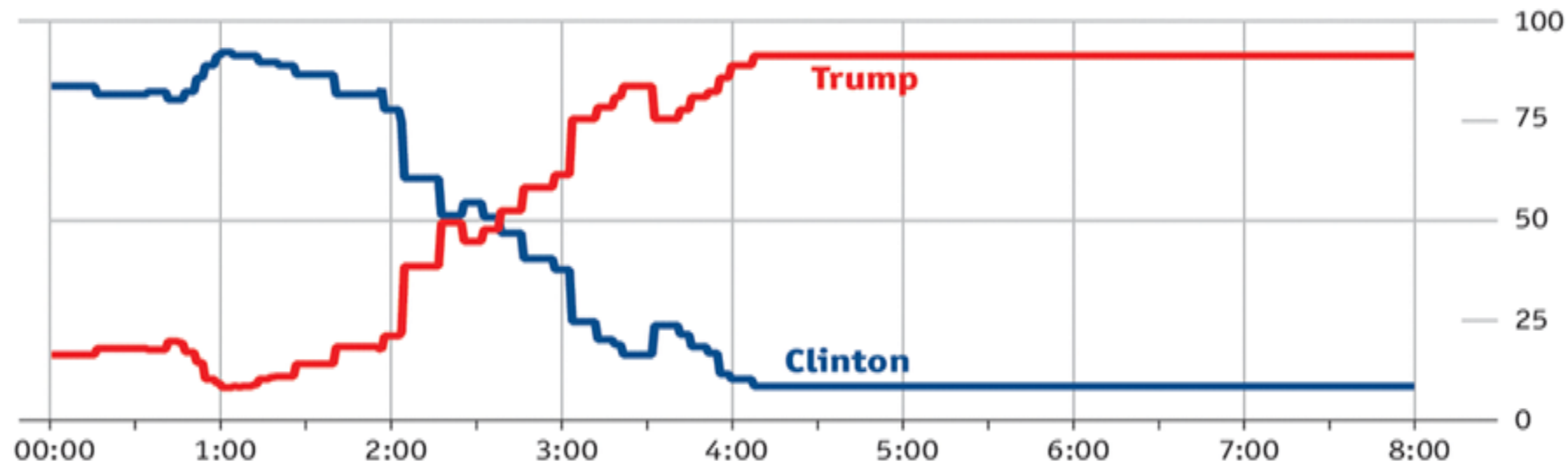
to make

decisions

What a difference a night makes

November 9th, GMT

Probability of becoming president, based on betting-market odds, %



Sources: Associated Press; Yahoo Finance; electionbettingodds.com; press reports

Schem: I.

Fig: 1.

Fig: 2.

Fig: 3.

Fig: 4.

Fig: 5.

Fig: 6.

2

To discover



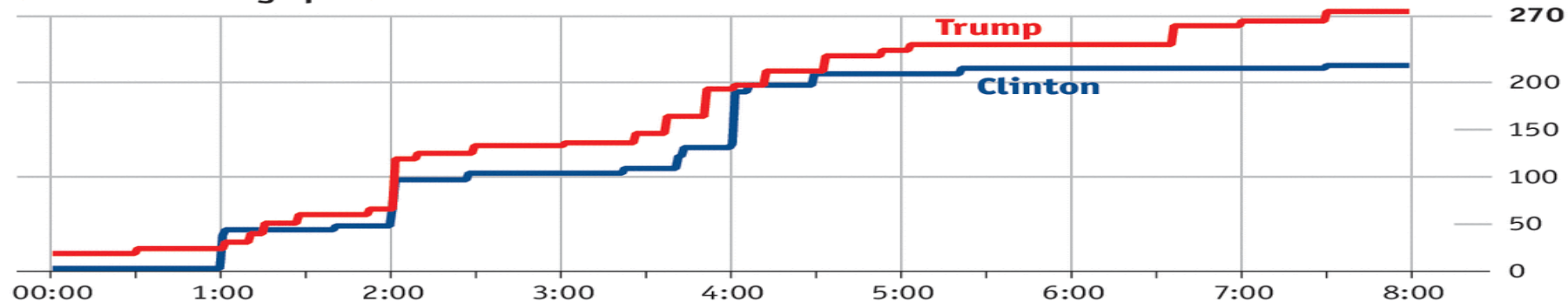
if you need to find
Something
buried inside
different
data sets



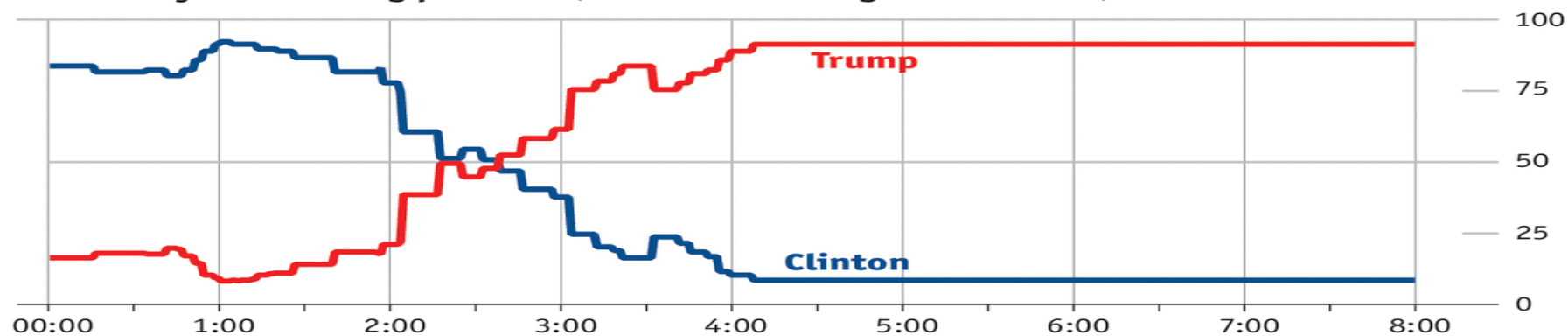
What a difference a night makes

November 9th, GMT

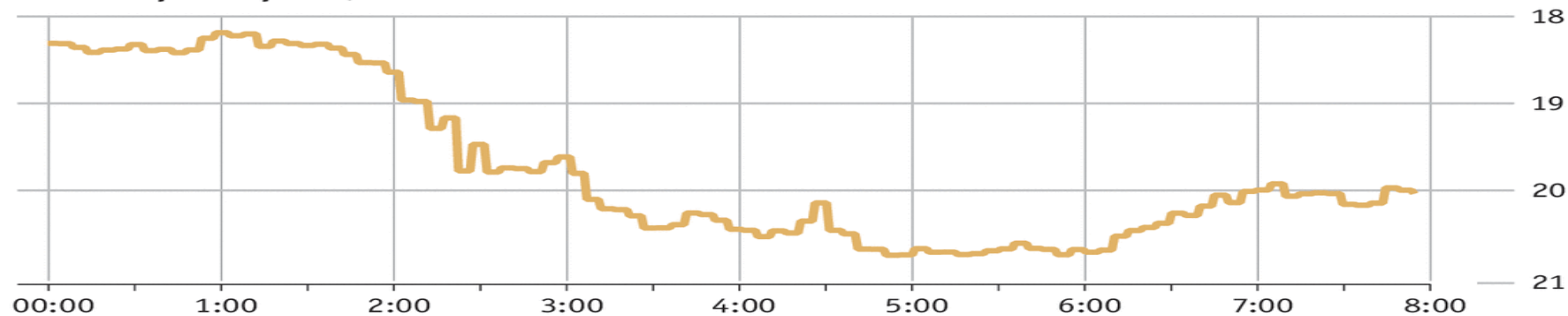
Electoral college points



Probability of becoming president, based on betting-market odds, %



Mexican pesos per \$, inverted scale



Sources: Associated Press; Yahoo Finance; electionbettingodds.com; press reports

A soft-focus illustration of a village scene. In the foreground, a white wooden fence runs across the bottom. In the middle ground, a large, leafy tree with a thick trunk stands on the right. To the left, a house with a brown roof and white walls is visible. The background shows rolling hills under a pale sky with light clouds. The overall tone is gentle and nostalgic.

3

To tell a story

the **data visualization**

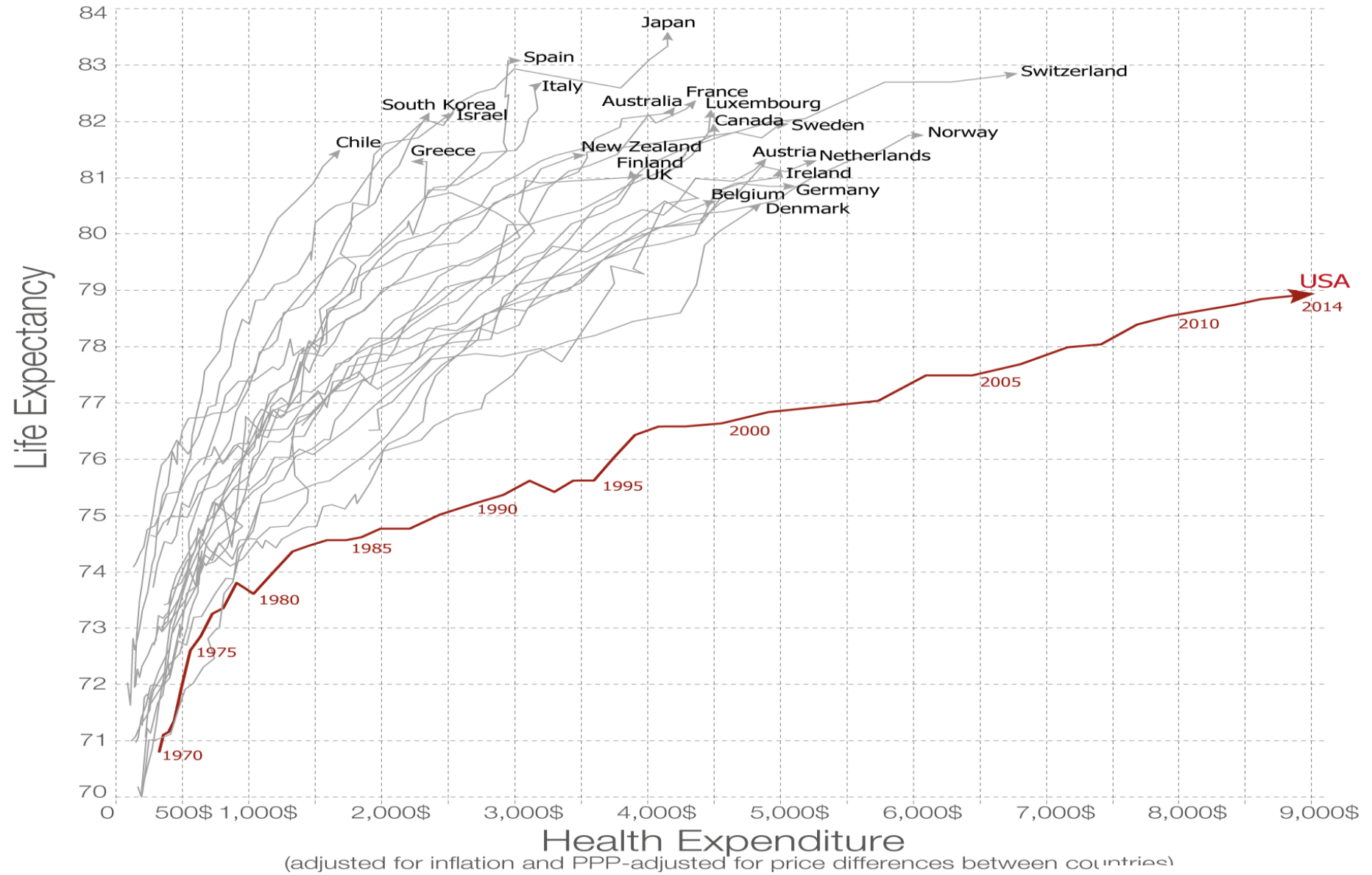
always tells a

story

..... *a story without sentences*

Life expectancy vs. health expenditure over time (1970-2014)

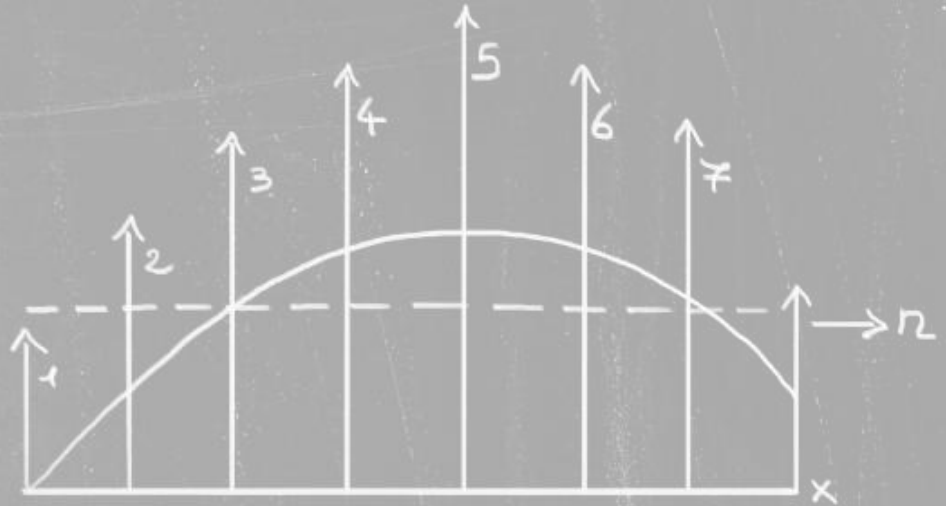
Health spending measures the consumption of health care goods and services, including personal health care (curative care, rehabilitative care, long-term care, ancillary services and medical goods) and collective services (prevention and public health services as well as health administration), but excluding spending on investments. Shown is total health expenditure (financed by public and private sources).



4

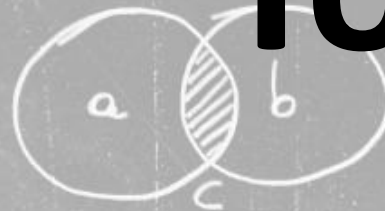
To teach

$$r_2 = x^2 \left(2x^4 + 2 + \frac{3}{\sqrt{ab}} \right)$$



$$a = \frac{\sqrt{b-c}}{xy(z-4)} \quad b = \frac{rs(xy)^2}{\sqrt{ac}} = n$$

$$a = \frac{\sqrt{c}}{bc} - (1 - \frac{1}{n})$$



$$n = \cos \phi \left(\frac{\sqrt{ab}}{x^2 - 32} \right)$$

$$c = \frac{e}{(xy)b}$$

x = 22 ←
y = 38

our brains perform
more efficiently

and

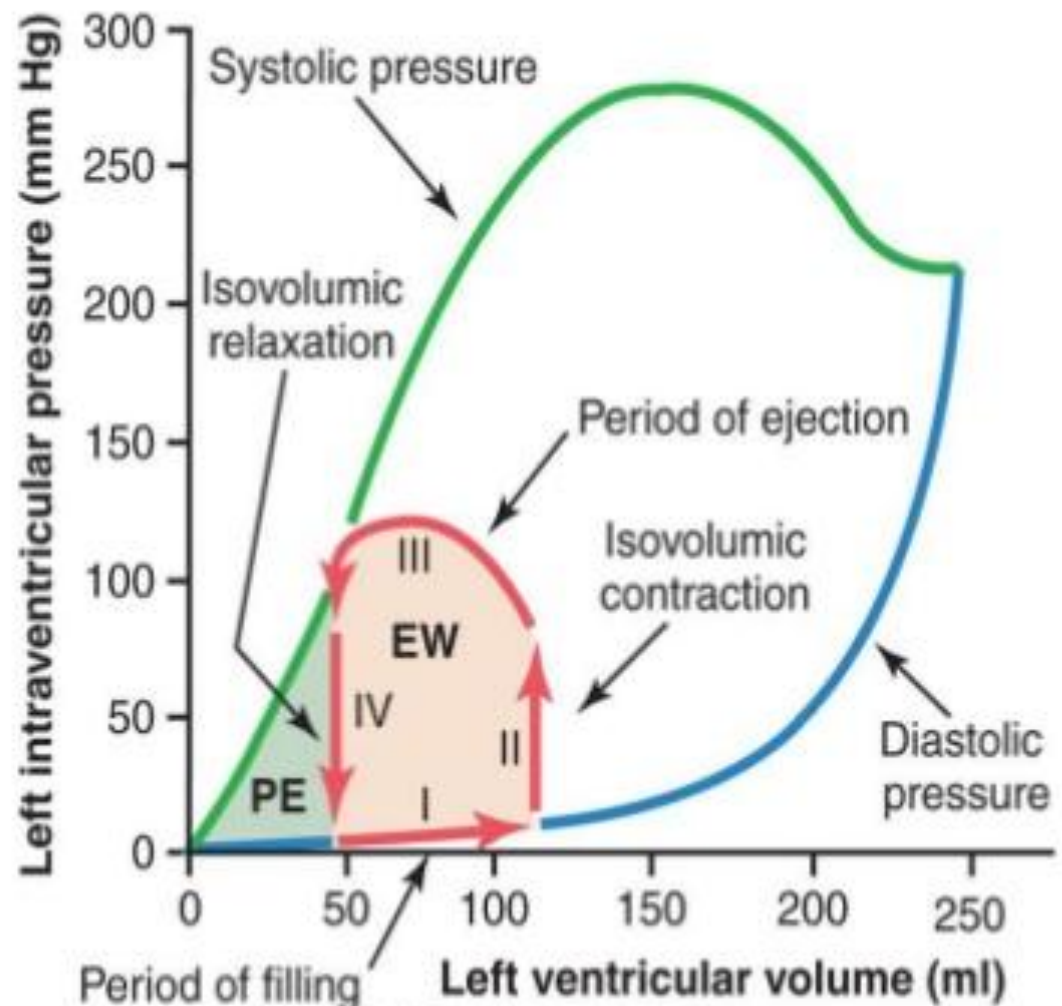
more information
is retained

when we learn from visuals

Relationship of left ventricular volume (LVV) and intra-ventricular pressure (IVP).

Red lines "volume-pressure diagram; EW= net external work.

It explains mechanics of the *left* ventricle.



Hall: Guyton and Hall Textbook of Medical Physiology, 12th Edition
Copyright © 2011 by Saunders, an imprint of Elsevier Inc. All rights reserved.

the fundamental ways we use
data visualization are:

- 1 to analyze
- 2 to discover
- 3 to tell a story
- 4 to teach

The common
ground is to

visually quantify

differences



7

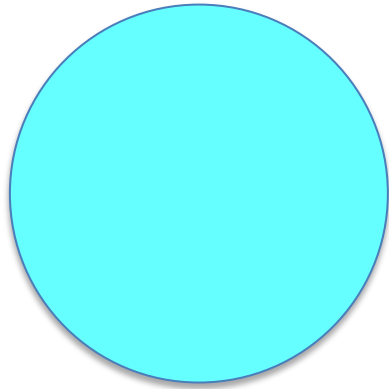
there are seven
fundamental
attributes to
articulate

relative

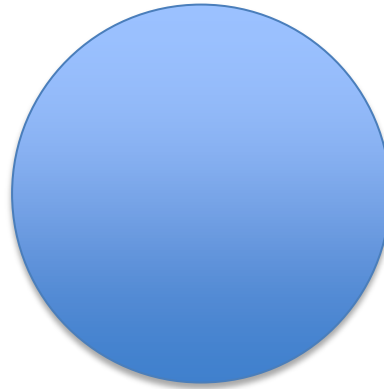
differences

1/attribute:

Color



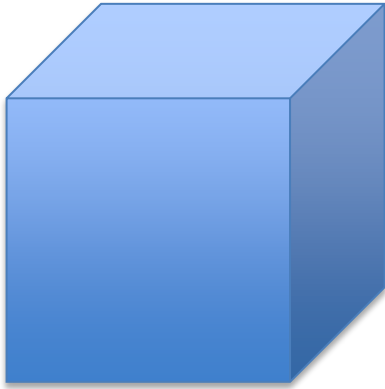
A



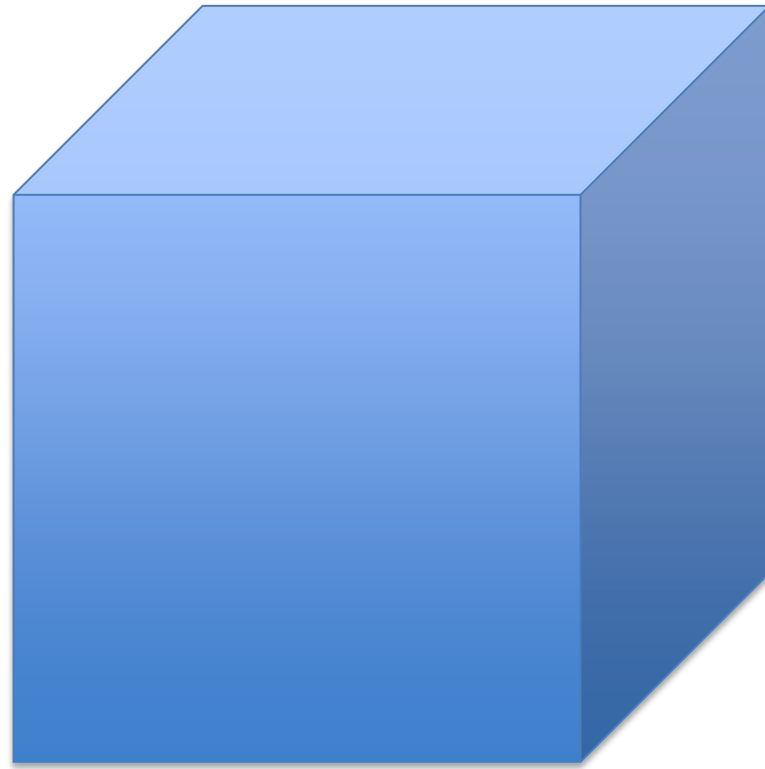
B

2/attribute:

Volume



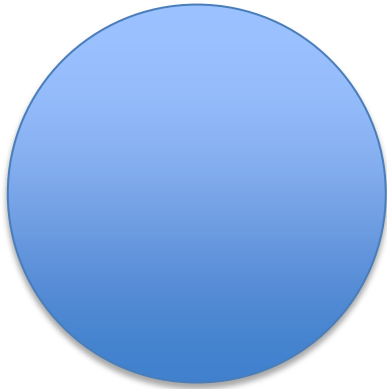
A



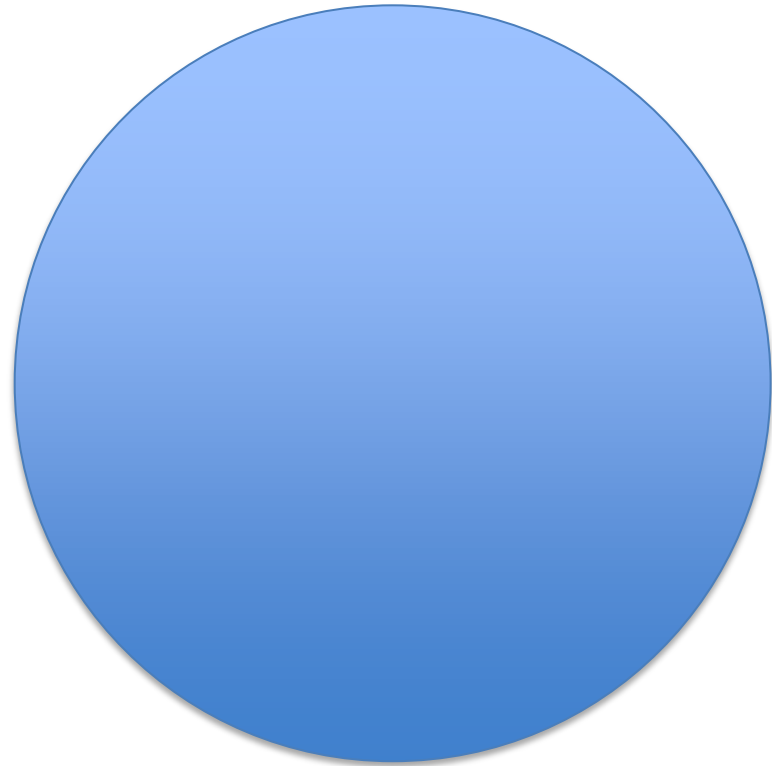
B

3/attribute:

Area



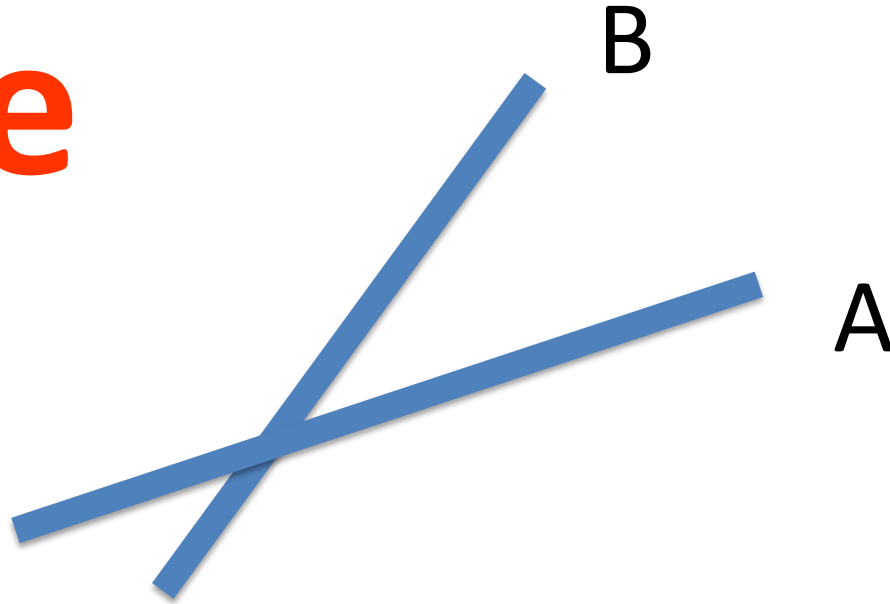
A



B

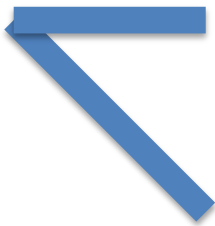
4/attribute:

Slope

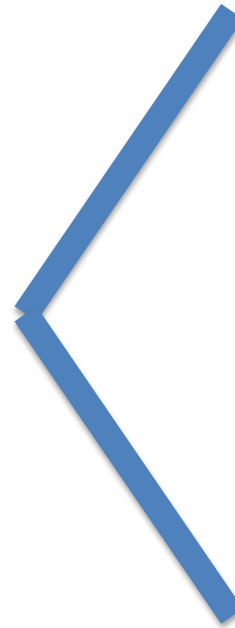


5/attribute:

Angle



A



B

6/attribute:

Length

B



A



7/attribute:

Position

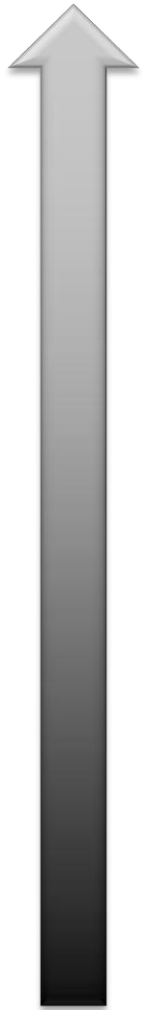
B



A



Ranking of attributes



1. Position 
2. Length 
3. Angle 
4. Slope 
5. Area 
6. Volume 
7. Color 



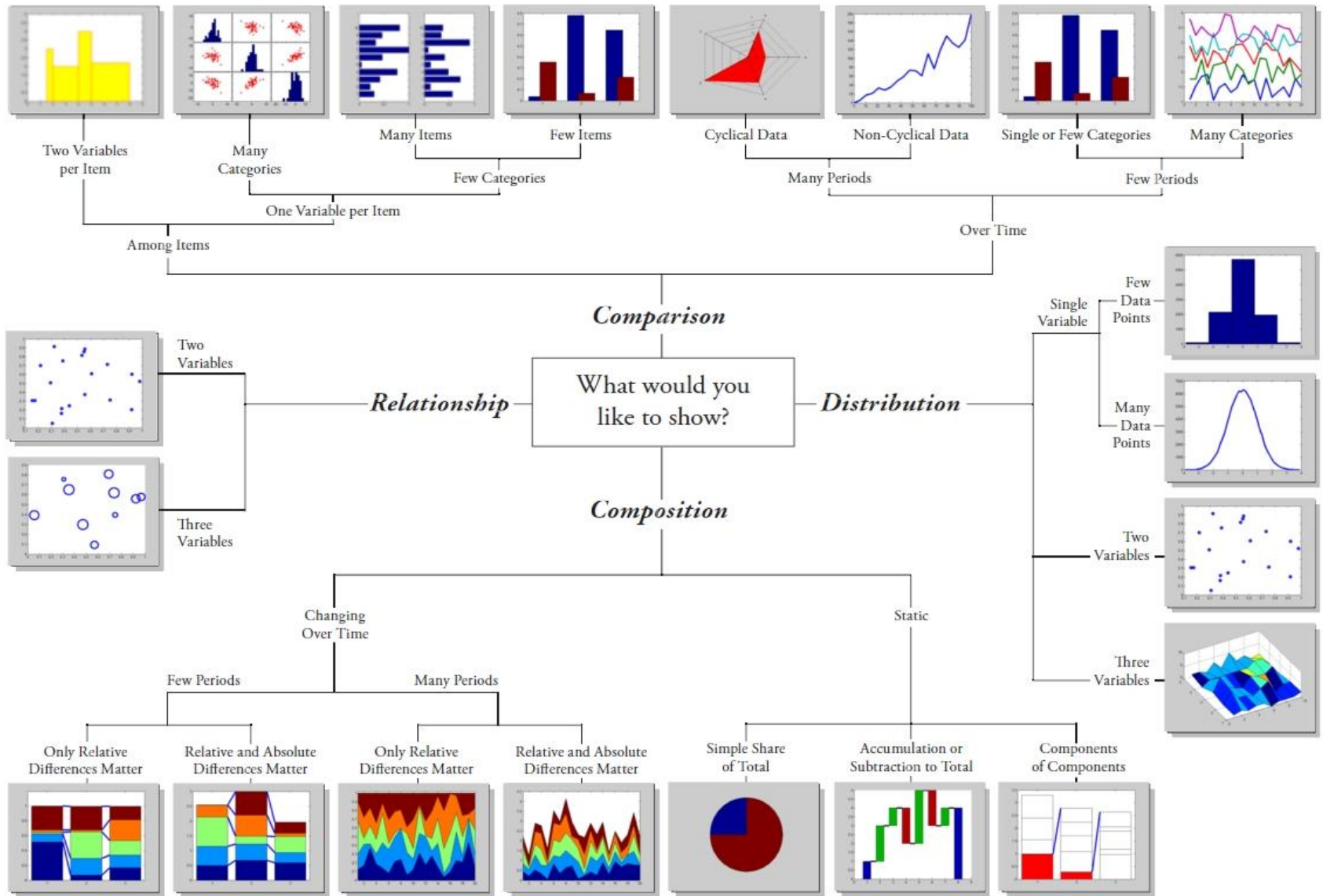
How to

choose a

chart?



Chart Suggestions—A Thought-Starter



Andrew Abela, 2009

Modified with permission -Doug Hull
 blogs.mathworks.com/videos
 hull@mathworks.com 2009

www.ExtremePresentation.com
 © 2009 A. Abela — a.v.abela@gmail.com

How to present a chart?



Single Value CHART

90%



Global Observatory on Health R&D



The WHO Global Observatory on Health R&D (hereafter called 'The Observatory') is a centralized and comprehensive source of information and analyses on global health R&D activities for human diseases.

It builds on existing data and reports from a wide range of data sources, and gathers new information (where needed and feasible) with the aim of enabling decisions on priorities in R&D.

[– Read more about why, what and how](#)

Health researchers

352 times

more health researchers in high-income countries than in low-income countries

Investments

2.6 billion

US\$ private sector investments lack public information on the breakdown

Products in the pipeline

340

new products in the pipeline (as of December 2016) for neglected diseases and select priority pathogens

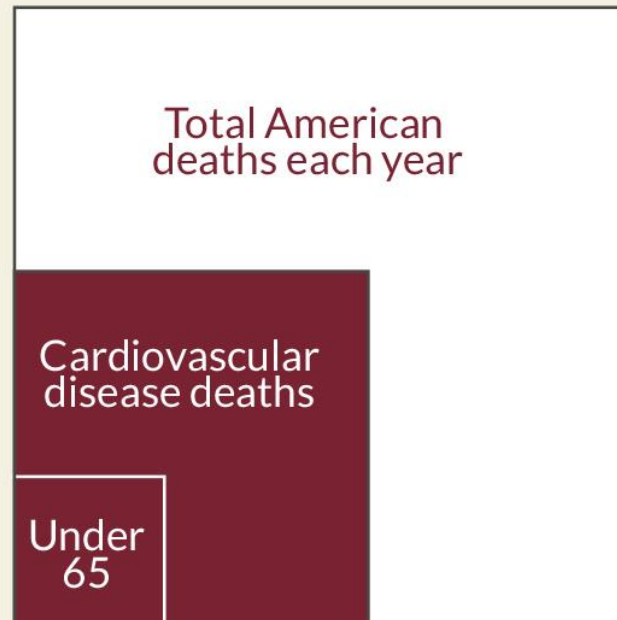


Nearly **31% of deaths** in the US* each year is caused by heart disease and stroke

*Population of US is **325 million** in 2016



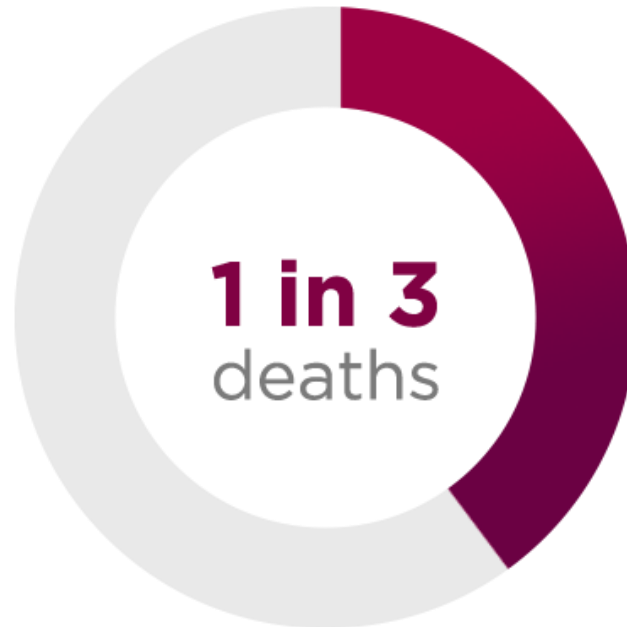
1 in 3 in the United States is due to cardiovascular disease
deaths





Be There San Diego

Preventing Heart Attacks & Strokes





Heart Disease: Know the Facts

Did you know ...



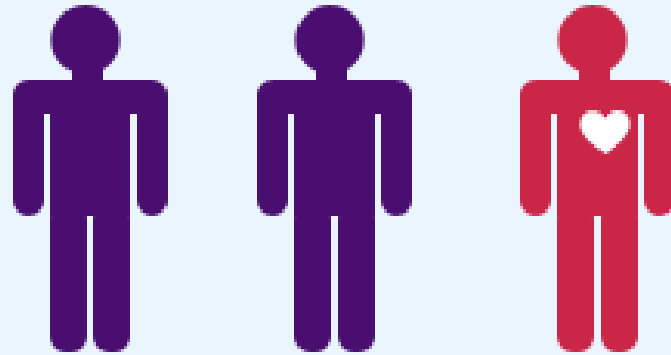
Heart disease and stroke are responsible for one in every three deaths in the U.S.

Cardiac arrest is the number one cause of death.

#1

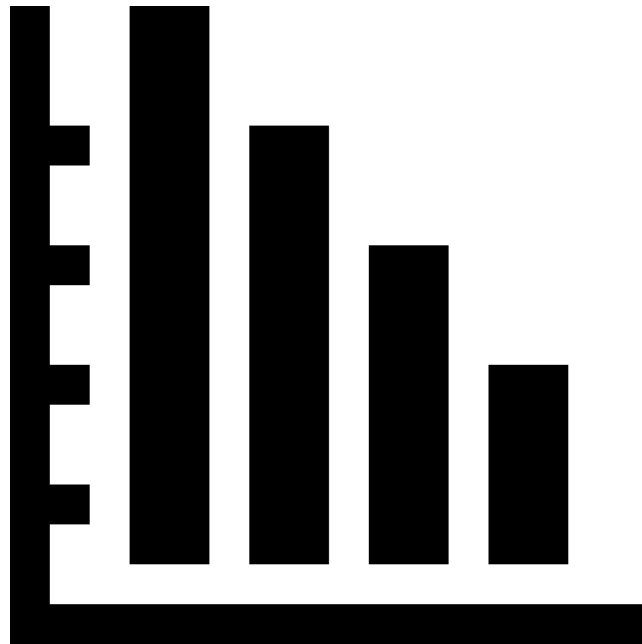


1 IN 3
heart disease deaths




1 in 3 deaths
in the United States is due
to heart disease

Bar CHART



Article | [OPEN](#)

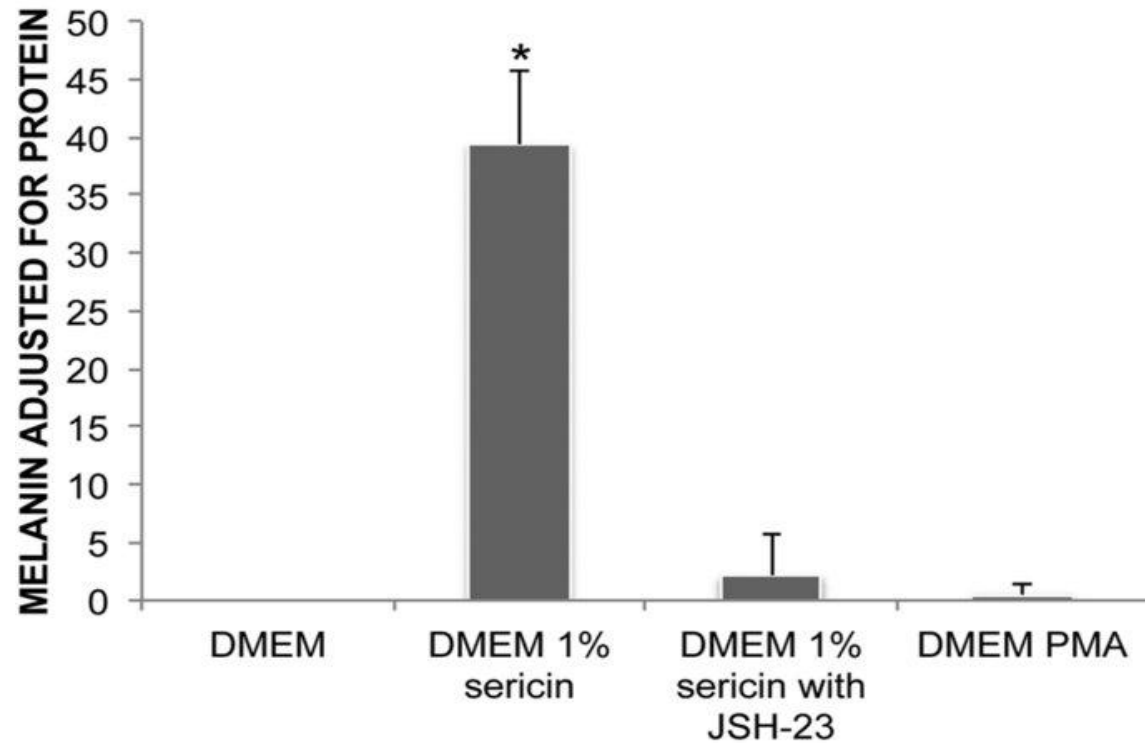
The Silk-protein Sericin Induces Rapid Melanization of Cultured Primary Human Retinal Pigment Epithelial Cells by Activating the NF- κ B Pathway

J. R. Eidet , S. Reppe, L. Pasovic, O. K. Olstad, T. Lyberg, A. Z. Khan, I. G. Fostad, D. F. Chen & T. P. Utheim

Scientific Reports 6, Article number: 22671
(2016)
doi:10.1038/srep22671

Received: 13 July 2015
Accepted: 17 February 2016
Published online: 04 March 2016

Amount of Melanin Adjusted for Protein



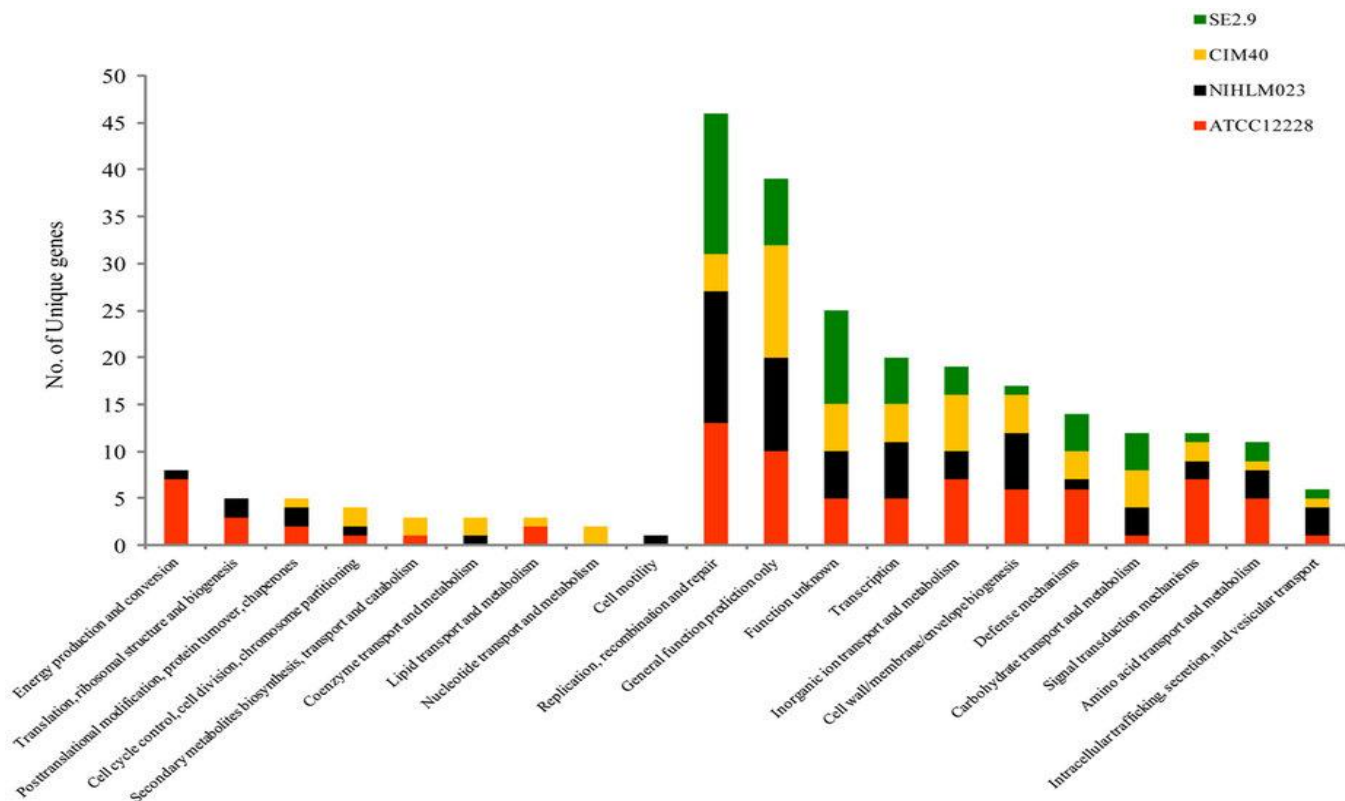
Article | [OPEN](#)

Genomic investigation reveals evolution and lifestyle adaptation of endophytic *Staphylococcus epidermidis*

Vasvi Chaudhry & Prabhu B. Patil

Scientific Reports **6**, Article number: 19263 (2016)
doi:10.1038/srep19263




Received: 06 October 2015
Accepted: 10 December 2015
Published online: 13 January 2016



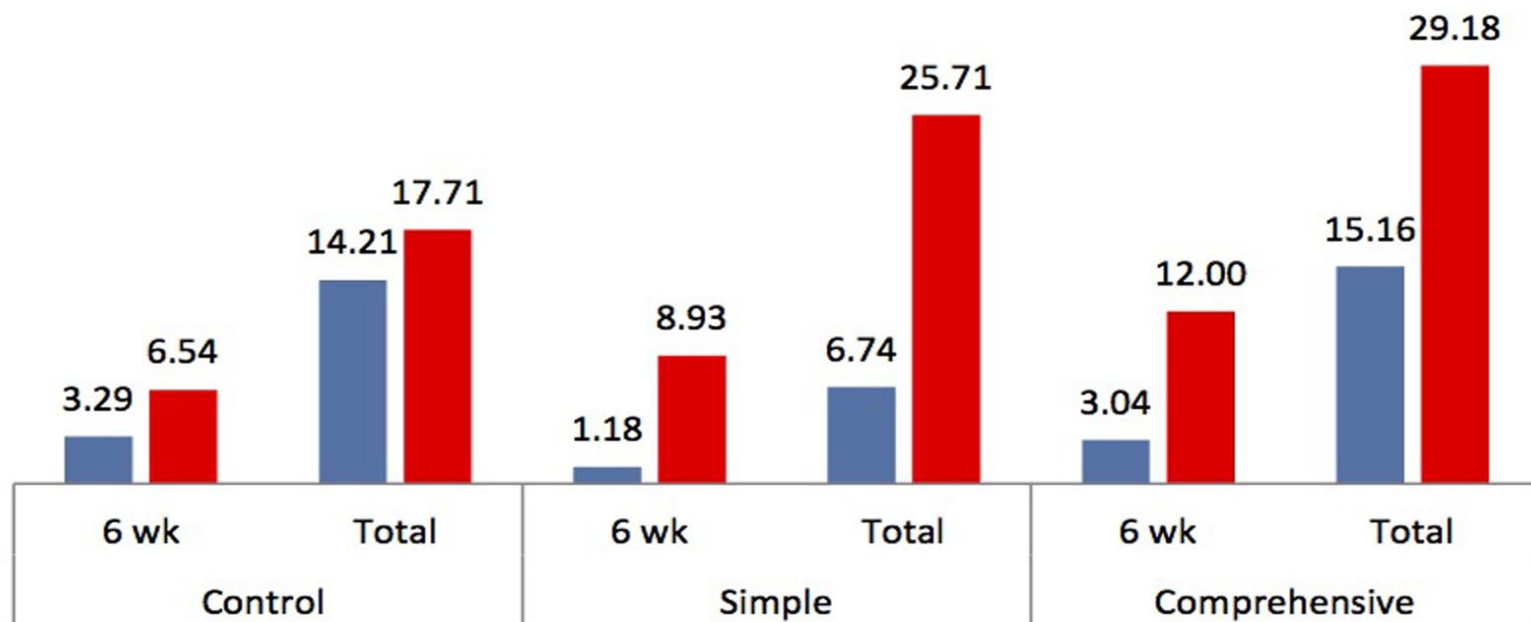
OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

A Cluster Randomised Trial on the Impact of Integrating Early Infant HIV Diagnosis with the Expanded Programme on Immunization on Immunization and HIV Testing Rates in Rural Health Facilities in Southern Zambia

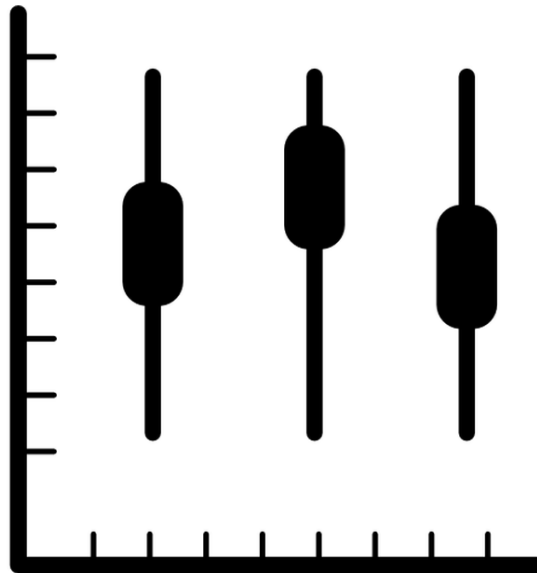
Paul C. Wang , Albert Mwango , Sarah Moberley, Benjamin J. Brockman, Alison L. Connor, Penelope Kalesha-Masumbu, Simon Mutembo, Maximillian Bweupe, Pascalina Chanda-Kapata, Godfrey Biemba, Davidson H. Hamer, Benjamin Chibuye, Elizabeth McCarthy 

Published: October 29, 2015 • <http://dx.doi.org/10.1371/journal.pone.0141455>



Boxplot

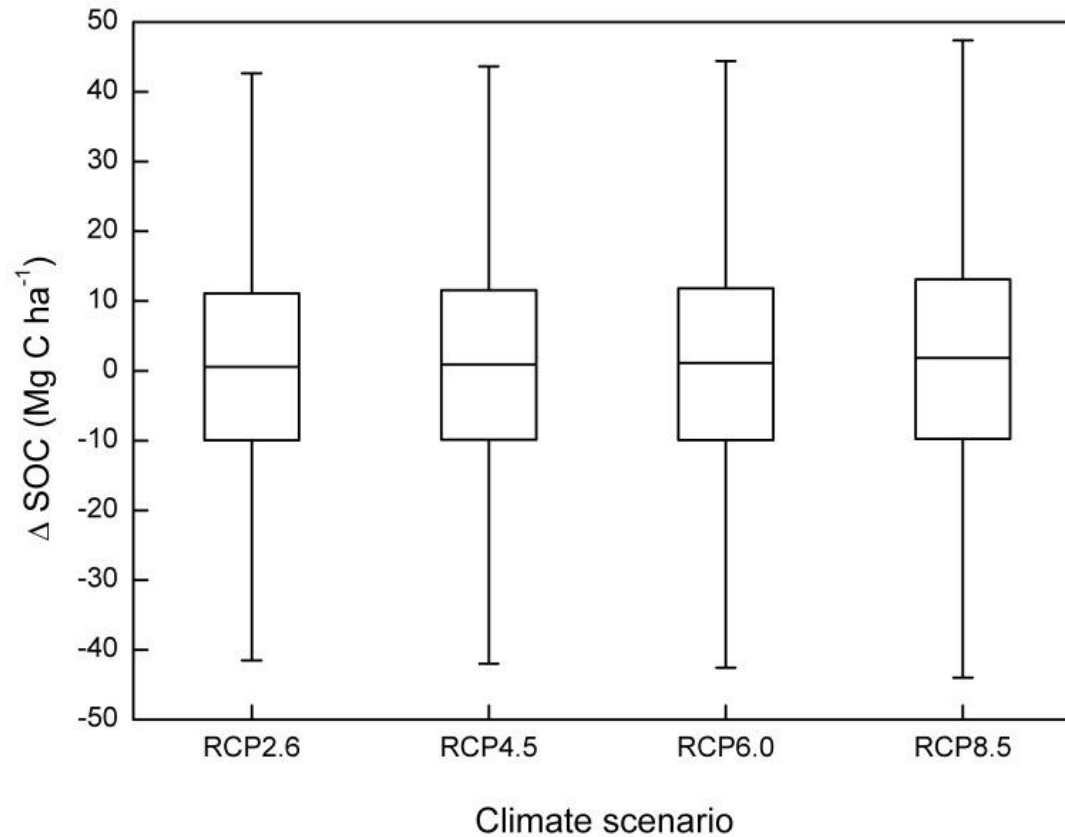
CHART



OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Impacts of Agricultural Management and Climate Change on Future Soil Organic Carbon Dynamics in North China Plain

Guocheng Wang, Tingting Li , Wen Zhang, Yongqiang YuPublished: April 10, 2014 • <http://dx.doi.org/10.1371/journal.pone.0094827>

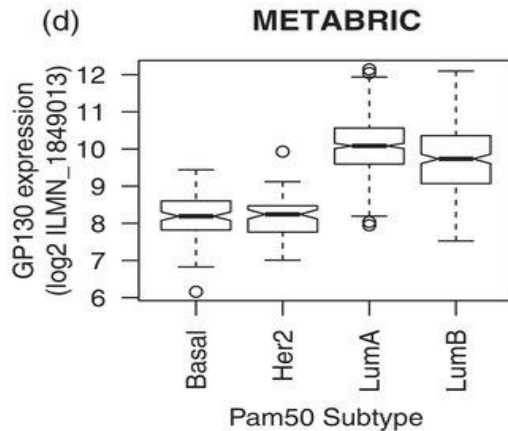
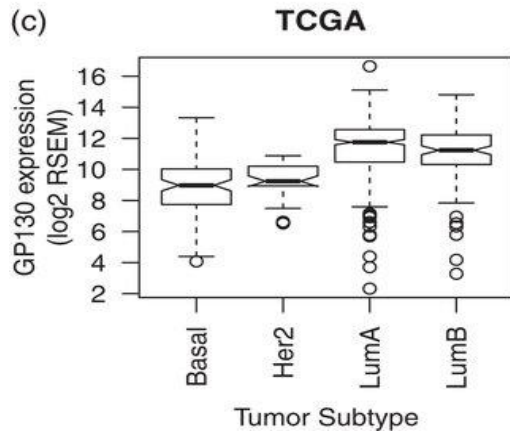
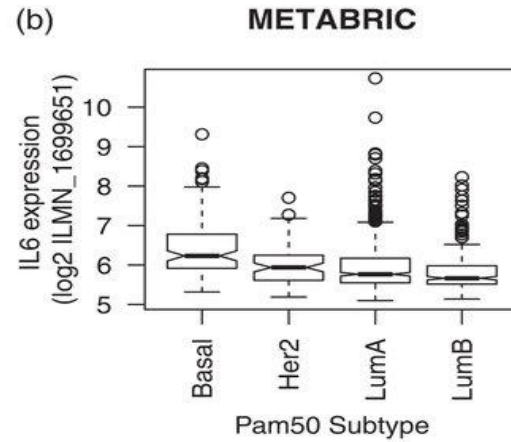
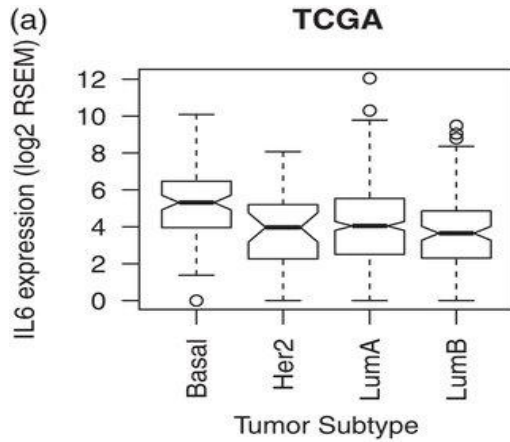
Article | [OPEN](#)

Analysis of gene expression of secreted factors associated with breast cancer metastases in breast cancer subtypes

Elana J. Fertig, Esak Lee, Niranjana B. Pandey & Aleksander S. Popel

Scientific Reports 5, Article number: 12133 (2015)
doi:10.1038/srep12133


Received: 12 January 2015
Accepted: 02 June 2015
Published online: 15 July 2015



OPEN ACCESS PEER-REVIEWED

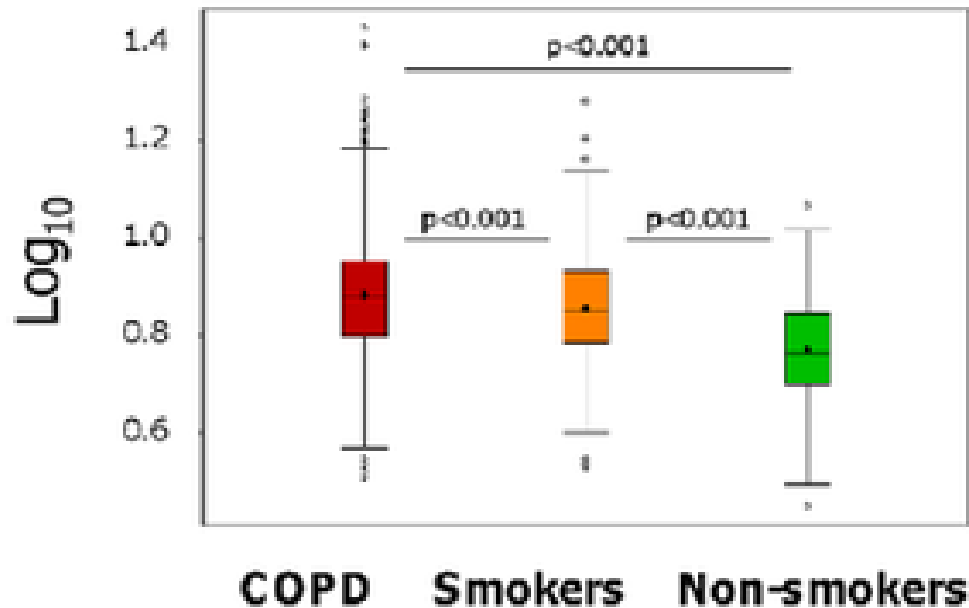
RESEARCH ARTICLE

Persistent Systemic Inflammation is Associated with Poor Clinical Outcomes in COPD: A Novel Phenotype

Alvar Agustí , Lisa D. Edwards, Stephen I. Rennard, William MacNee, Ruth Tal-Singer, Bruce E. Miller, Jørgen Vestbo, David A. Lomas, Peter M. A. Calverley, Emiel Wouters, Courtney Crim, Julie C. Yates, Edwin K. Silverman, [...], for the Evaluation of COPD Longitudinally to Identify Predictive Surrogate Endpoints (ECLIPSE) Investigators [view all]

Published: May 18, 2012 • <http://dx.doi.org/10.1371/journal.pone.0037483>

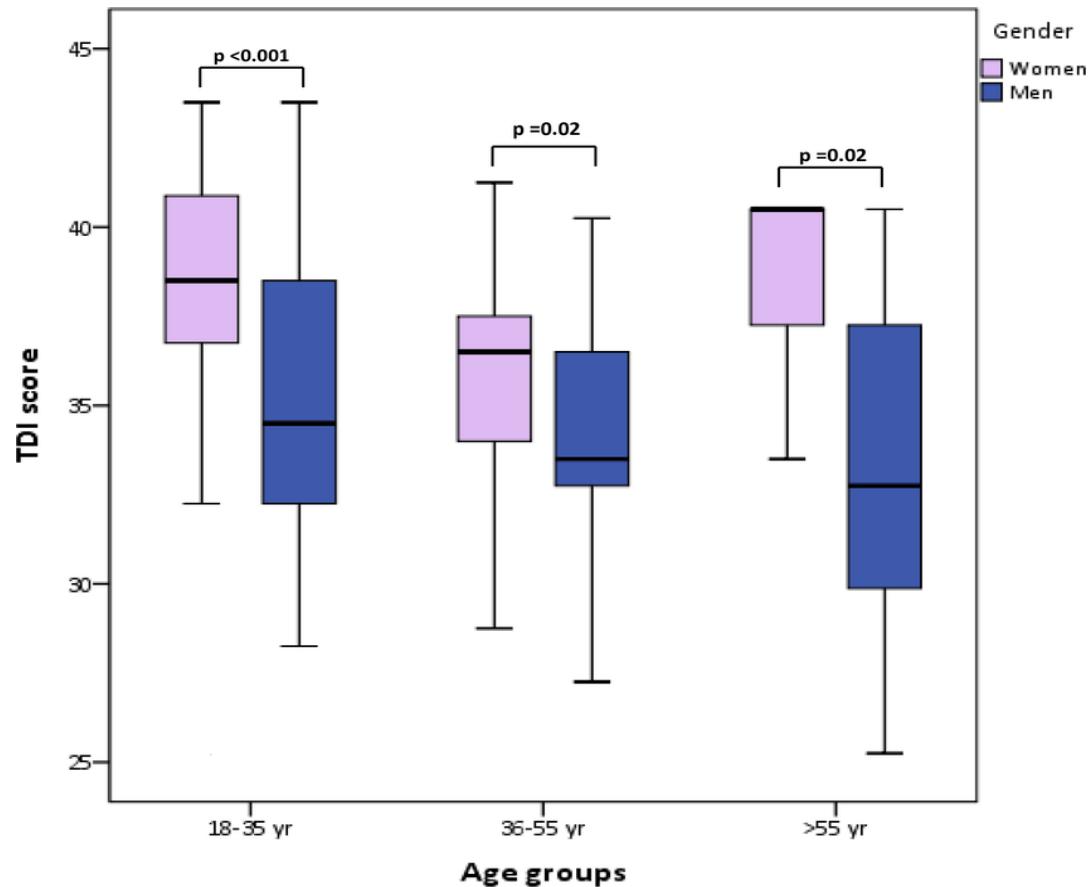
White blood cells



OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Cultural Adaptation of the Portuguese Version of the “Sniffin’ Sticks” Smell Test: Reliability, Validity, and Normative Data

João Carlos Ribeiro , João Simões, Filipe Silva, Eduardo D. Silva, Comelia Hummel, Thomas Hummel, António PaivaPublished: February 10, 2016 • <http://dx.doi.org/10.1371/journal.pone.0148937>

High expression of thymidine phosphorylase in basal-like breast cancers: Stromal expression in EGFR- and/or CK5/6-positive breast cancers

Authors: Shinobu Umemura, ✉ Masatoshi Shirane, Susumu Takekoshi, Yutaka Tokuda, Kazushige Mori, Robert Y. Osamura

[View Affiliations](#)

Published online on: Monday, March 1, 2010

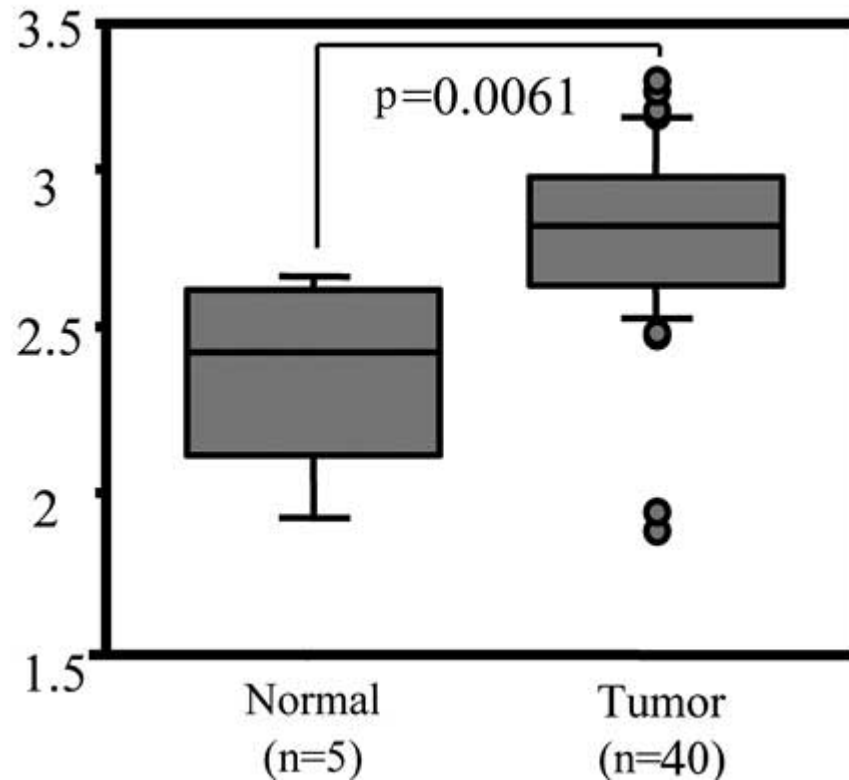


March 2010

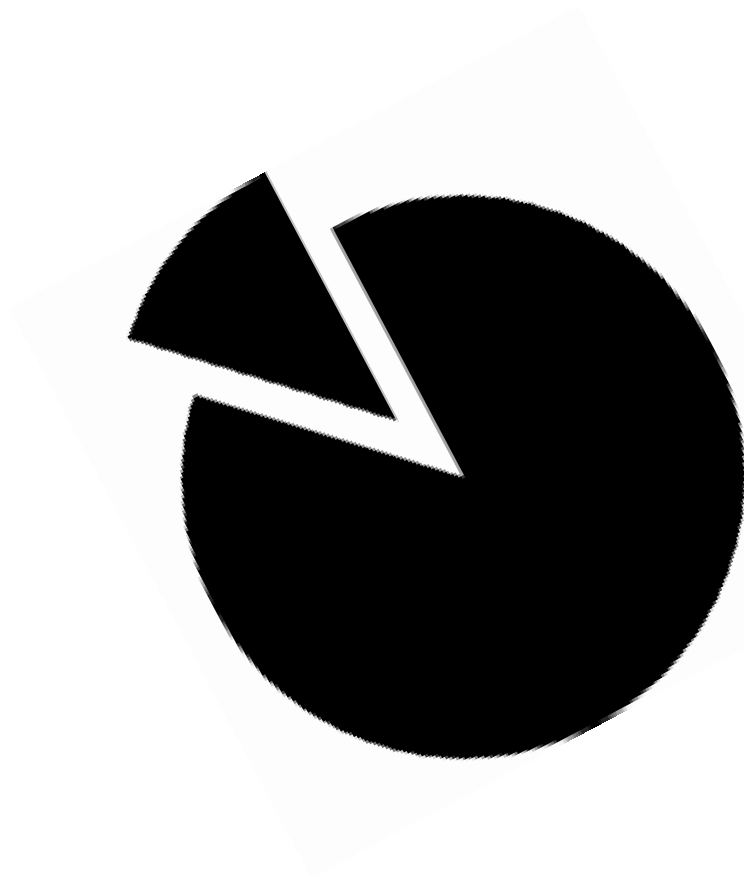
Volume 1 Issue 2

Print ISSN: 1792-1074

Online ISSN: 1792-1082

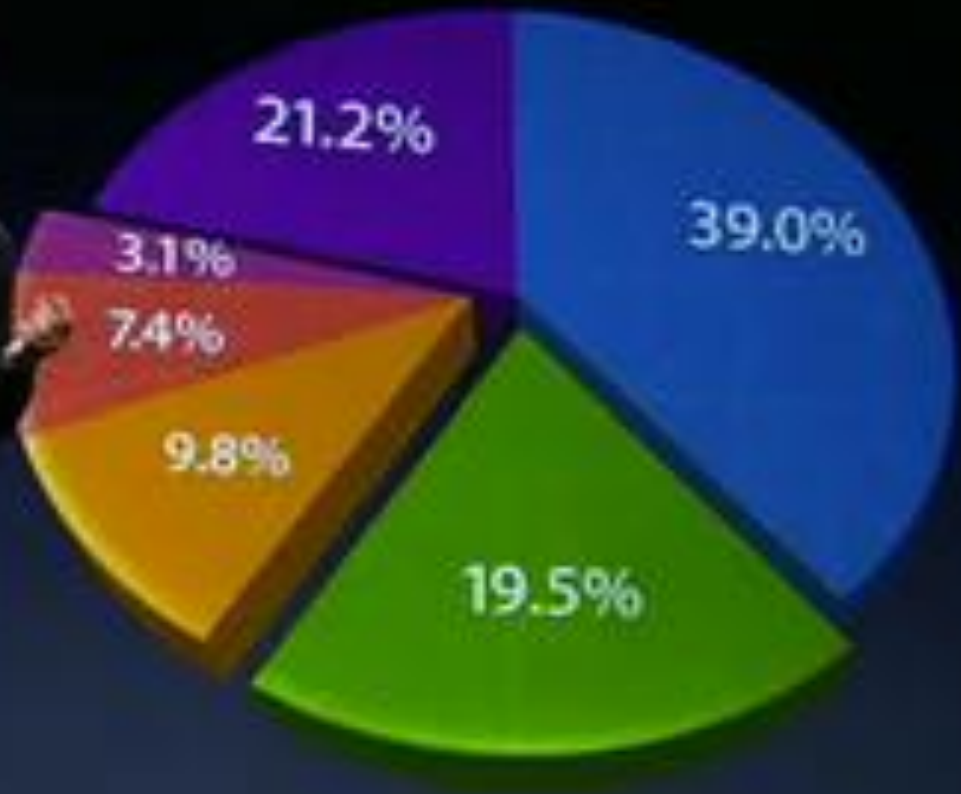


Pie CHART



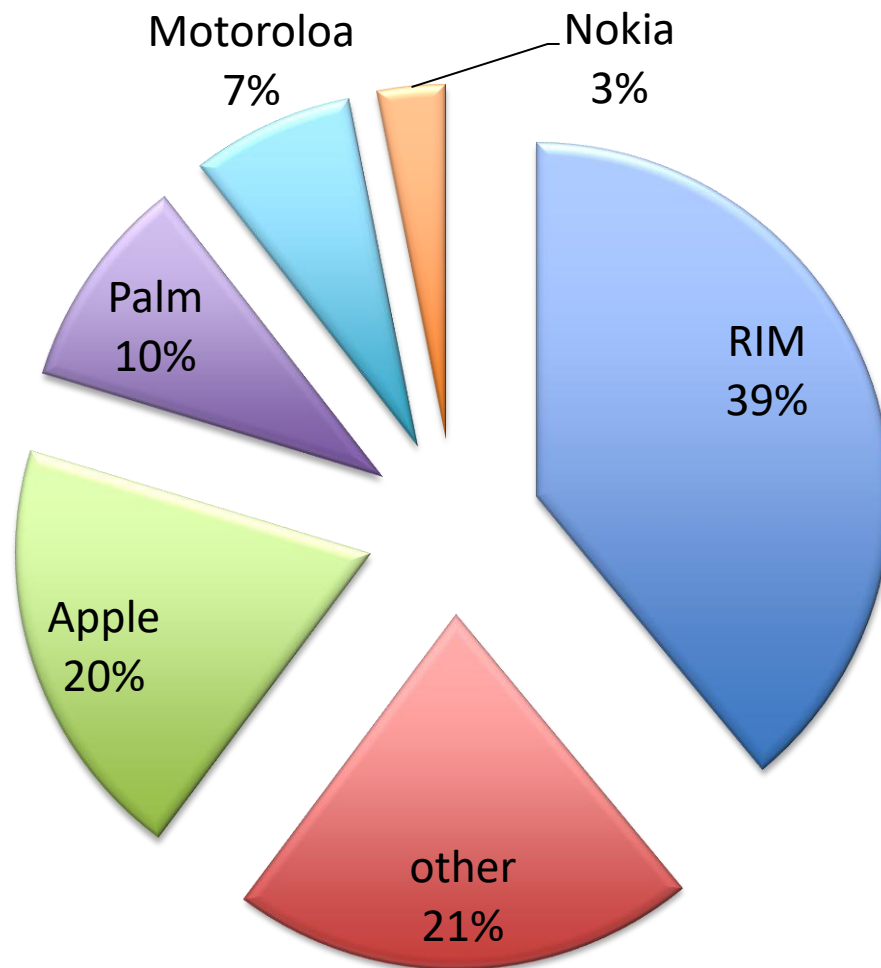
U.S. SmartPhone Marketshare

- RIM
- Appl
- Palr
- Mot
- No.
- Othe.



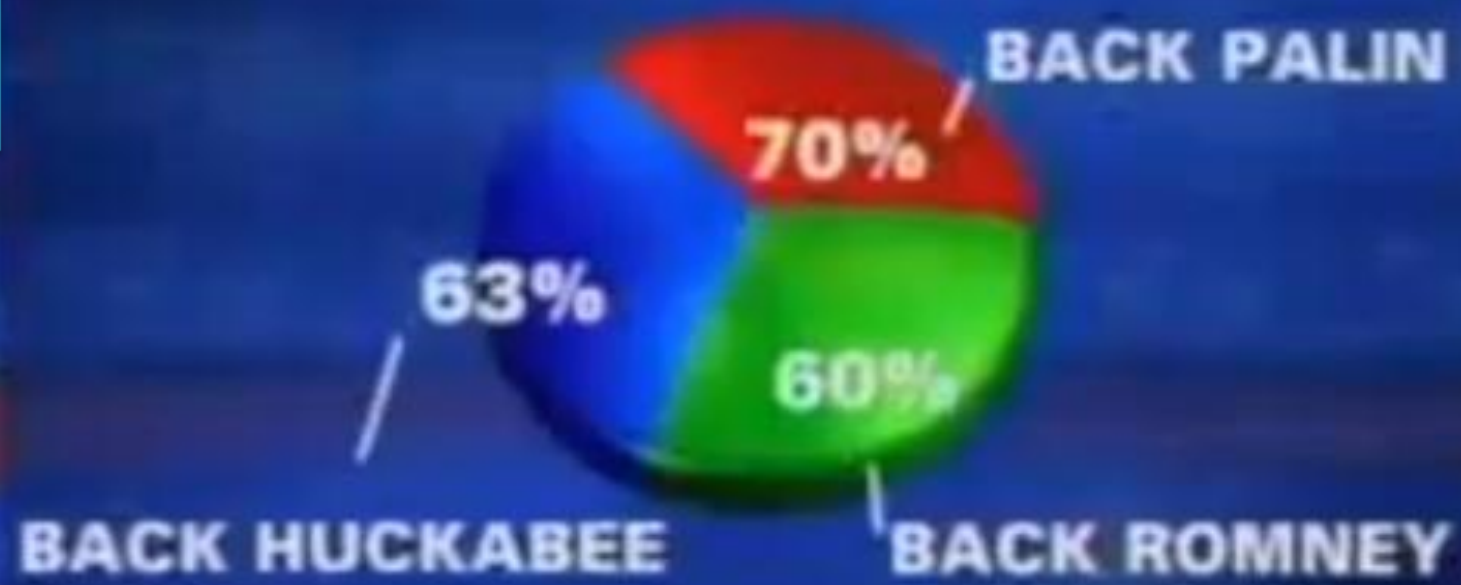
Source: Gart for '08

2008



2012 PRESIDENTIAL RUN

GOP CANDIDATES



SOURCE: OPINIONS

DYNAMIC

<https://youtu.be/-rbyhj8uTT8>

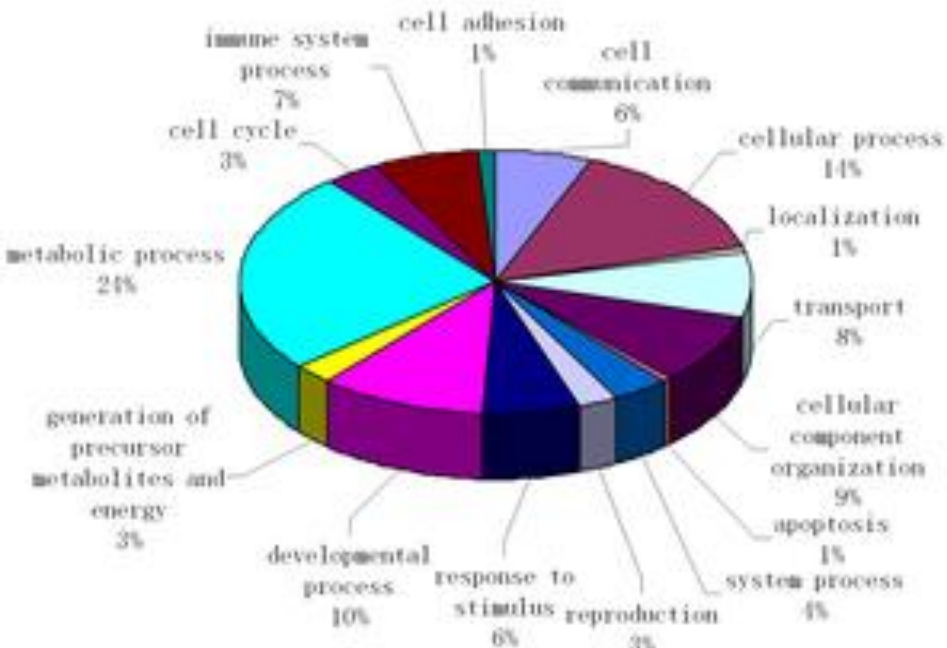
Proteomics Approaches for Identification of Tumor Relevant Protein Targets in Pulmonary Squamous Cell Carcinoma by 2D-DIGE-MS

2014

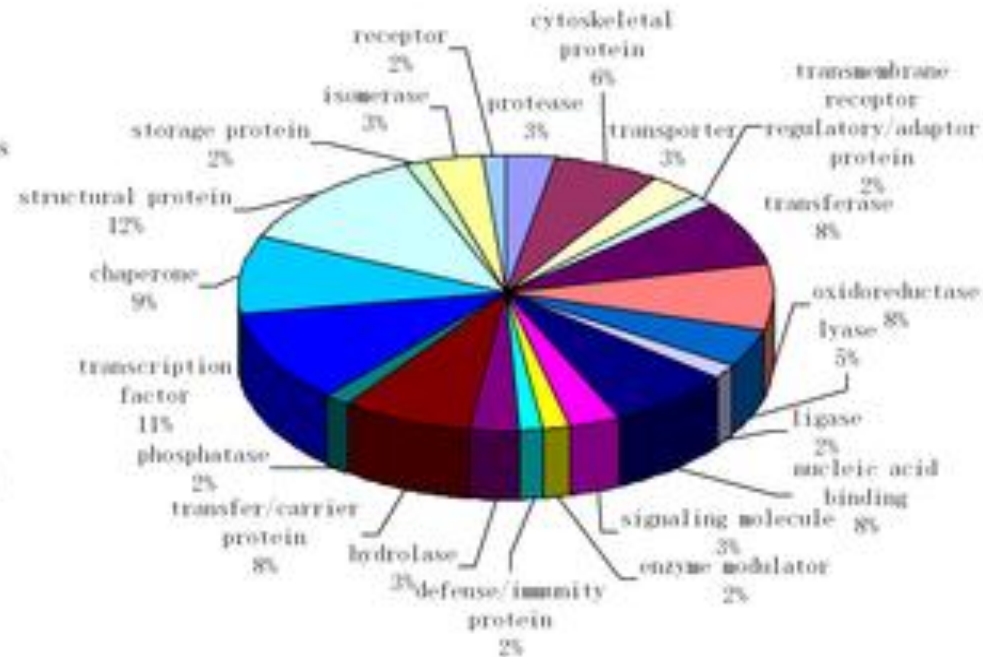
Hao Lihong¹*, Gong Linlin¹*, Guo Yiping¹, Song Yang¹, Qi Xiaoyu¹, Guan Zhuzhu¹, Yang Xiaohan¹, Zhou Xin¹, Xue Liyan², Shao Shujuan^{1*}

¹ Key Laboratory of Proteomics, Dalian Medical University, Dalian, Liaoning Province, P.R. China, ² Department of Pathology, Cancer Institute and Hospital, Chinese Academy of Medical Sciences (CAMS) and Peking Union Medical College (PUMC), Beijing, P.R. China

Biological Process



Protein Class



A

B

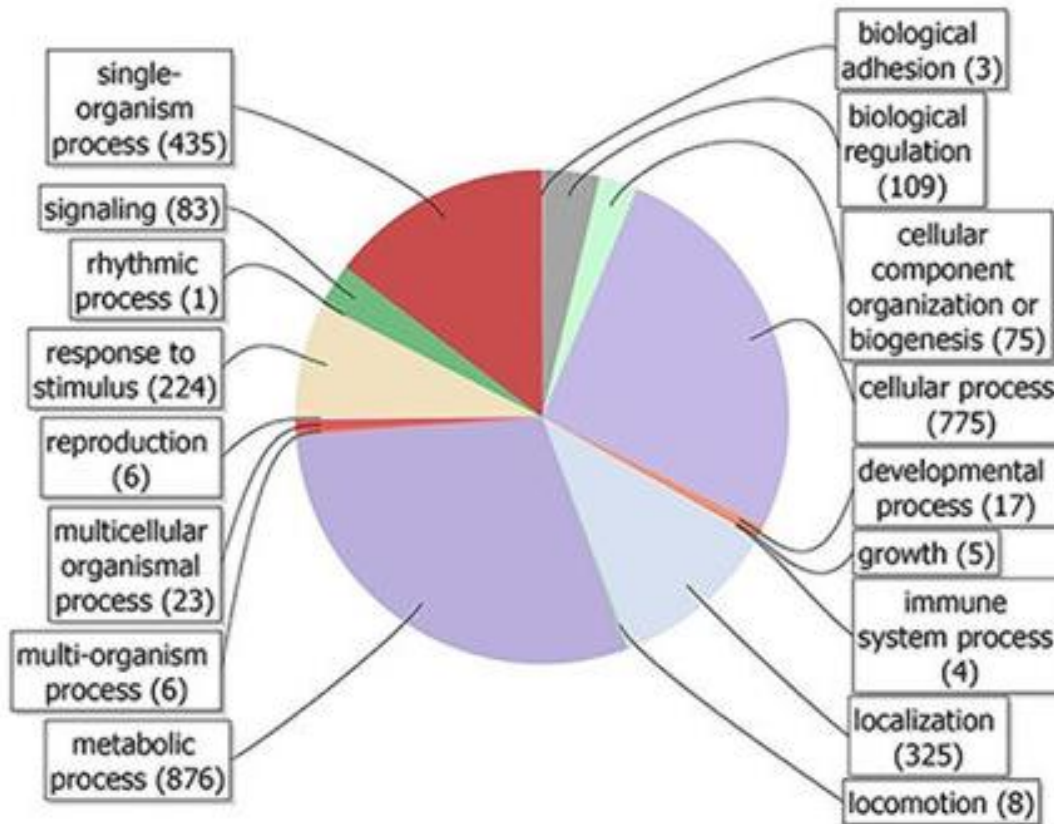
OPEN Functional interaction of nicotinic acetylcholine receptors and Na⁺/K⁺ ATPase from *Locusta migratoria manilensis* (Meyen)

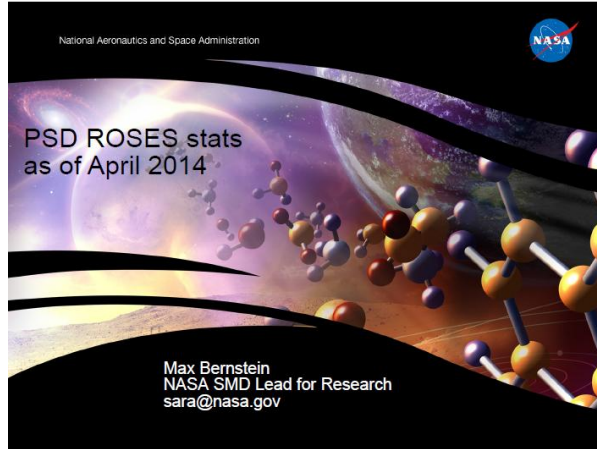
SUBJECT AREAS:
UGAND-GATED ION CHANNELS
ION CHANNELS IN THE NERVOUS SYSTEM

Received
2 September 2014
Accepted
28 January 2015
Published
6 March 2015

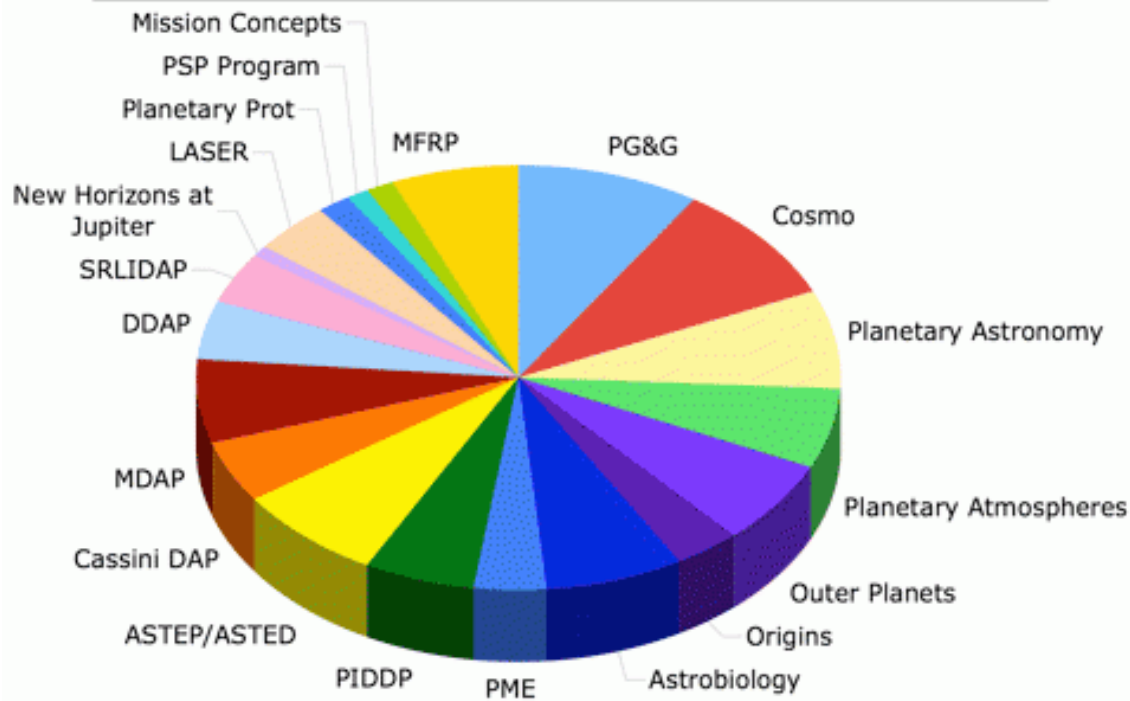
Haibo Bao^{1,2}, Huahua Sun¹, Youxin Xiao², Yixi Zhang^{1,2}, Xin Wang¹, Xiaoyong Xu², Zewen Liu¹, Jichao Fang² & Zhong Li²

¹Key Laboratory of Integrated Management of Crop Diseases and Pests (Ministry of Education), College of Plant Protection, Nanjing Agricultural University, Weigang 1, Nanjing 210095, China, ²Shanghai Key Laboratory of Chemical Biology, School of Pharmacy, East China University of Science and Technology, Meilong Road 130, Shanghai 200237, China, ³Institute of Plant Protection, Jiangsu Academy of Agricultural Sciences, St. Zhongling 50, Nanjing 210014, China.



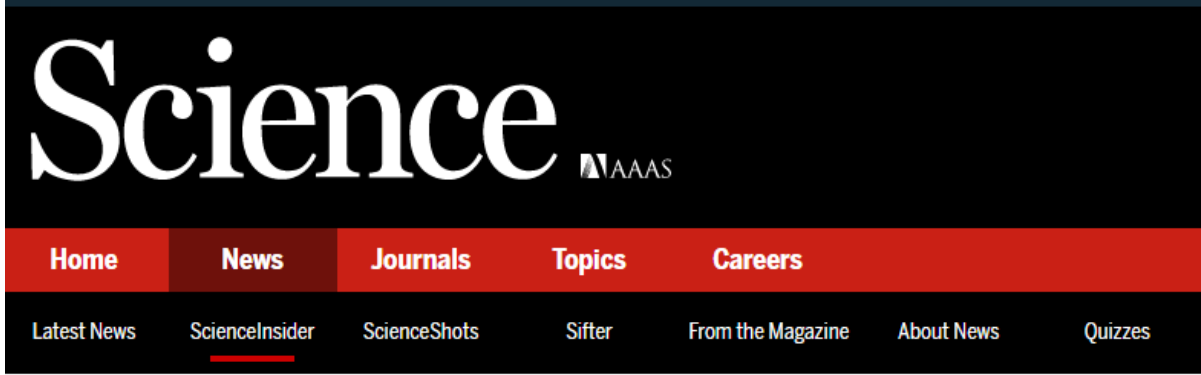


Planetary Research & Analysis FY08 Funds for ROSES 07



Total FY08 Funding \$130.5M





SHARE



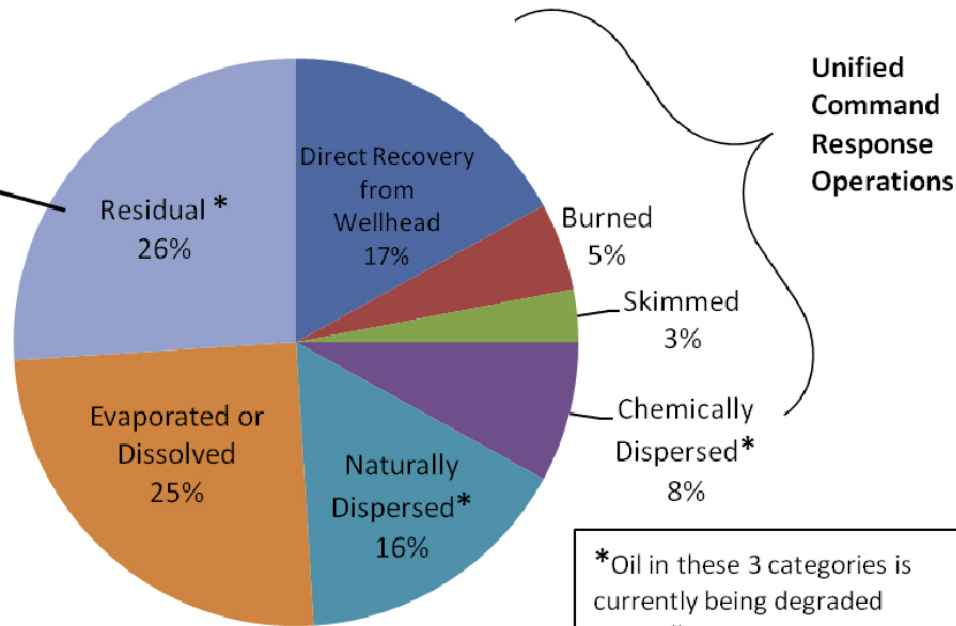
Mother Nature Having Her Way With Gulf Oil

By Richard A. Kerr | Aug. 4, 2010, 1:27 PM

Deepwater Horizon Oil Budget

Based on estimated release of 4.9m barrels of oil

Residual includes oil that is on or just below the surface as light sheen and weathered tar balls, has washed ashore or been collected from the shore, or is buried in sand and sediments.



*Oil in these 3 categories is currently being degraded naturally.



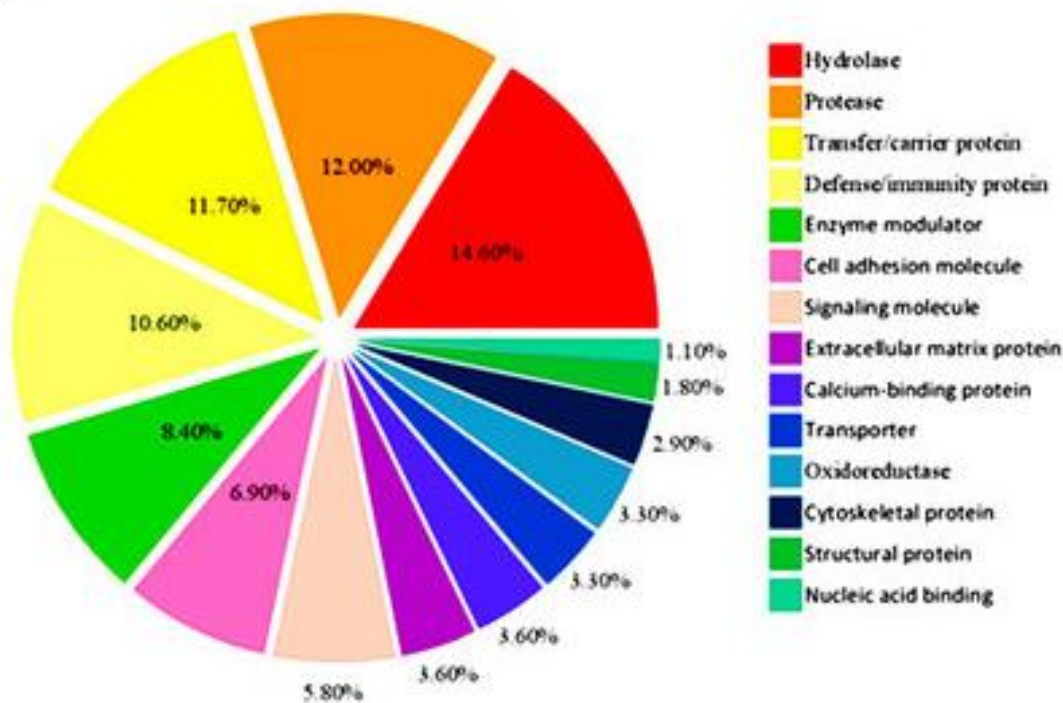
Article | OPEN

Quantitative Proteomic Analysis of Meningiomas for the Identification of Surrogate Protein Markers

Samridhi Sharma, Sandipan Ray, Aliasgar Moyyadi, Epari Sridhar & Sanjeeva Srivastava

Scientific Reports 4, Article number: 7140 (2014)
doi:10.1038/srep07140

Received: 02 June 2014
Accepted: 15 September 2014
Published online: 21 November 2014



Protein classes

SCIENTIFIC REPORTS

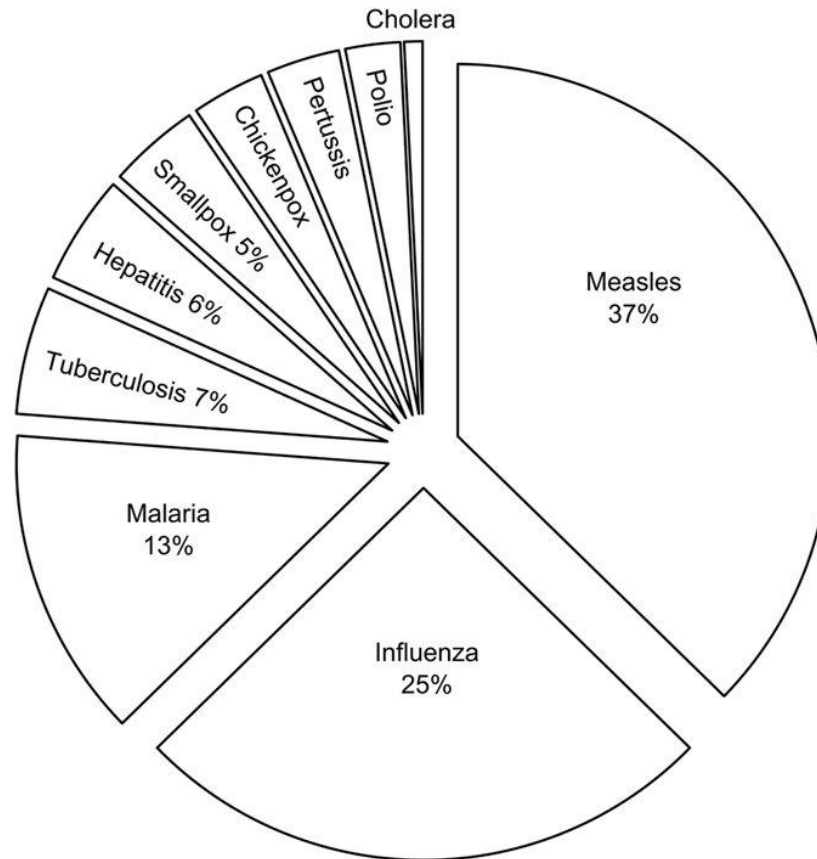
OPEN Mortality from contact-related epidemics among indigenous populations in Greater Amazonia

Received: 08 April 2015

Accepted: 13 August 2015

Published: 10 September 2015

Robert S. Walker¹, Lisa Sattenspiel¹ & Kim R. Hill²



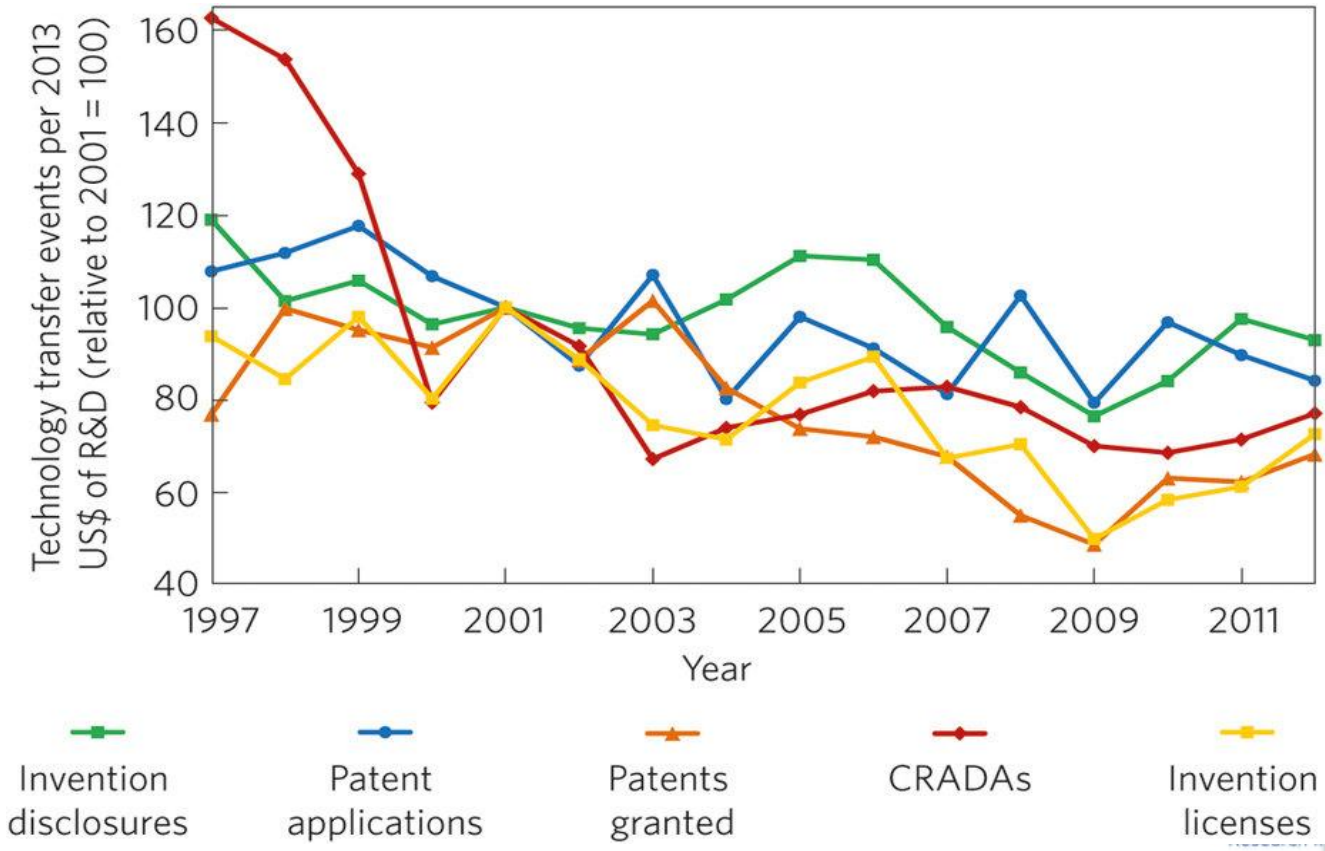
Line CHART



Perspective
The pressing energy innovation challenge of the US National Laboratories

Laura Diaz Anadon, Gabriel Chan, Amitai Y. Bin-Nun & Venkatesh Narayanamurti

Nature Energy 1, Article number: 16117 (2016)
doi:10.1038/nenergy.2016.117
Download Citation
Received: 08 April 2016
Accepted: 12 July 2016
Published online: 12 September 2016





Altmetric: 515

Views: 13,657

Citations: 11

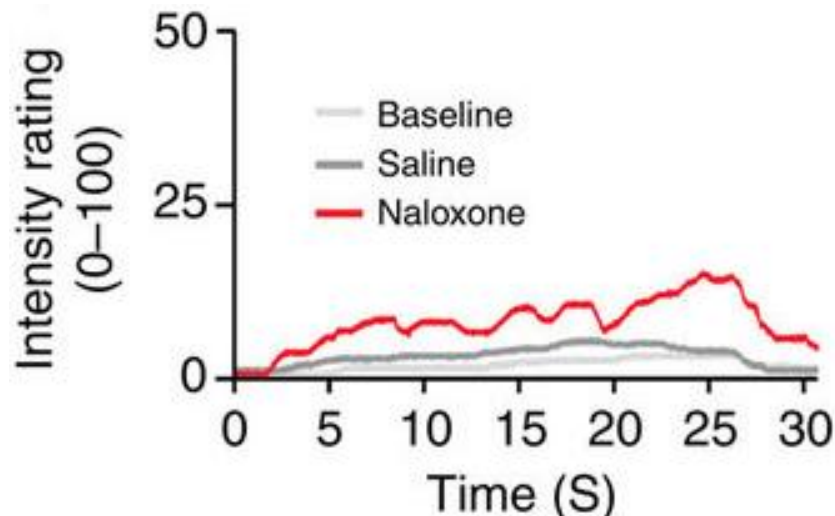
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Endogenous opioids contribute to insensitivity to pain in humans and mice lacking sodium channel $Na_v1.7$

Michael S. Minett, Vanessa Pereira, Shafaq Sikandar, Ayako Matsuyama, Stéphane Lolignier, Alexandros H. Kanellopoulos, Flavia Mancini, Gian D. Iannetti, Yury D. Bogdanov, Sonia Santana-Varela, Queensta Millet, Giorgios Baskozos, Raymond MacAllister, James J. Cox, Jing Zhao & John N. Wood

Nature Communications 6,
Article number: 8967 (2015)
doi:10.1038/ncomms9967

Received: 26 May 2015
Accepted: 21 October 2015
Published online: 04 December 2015



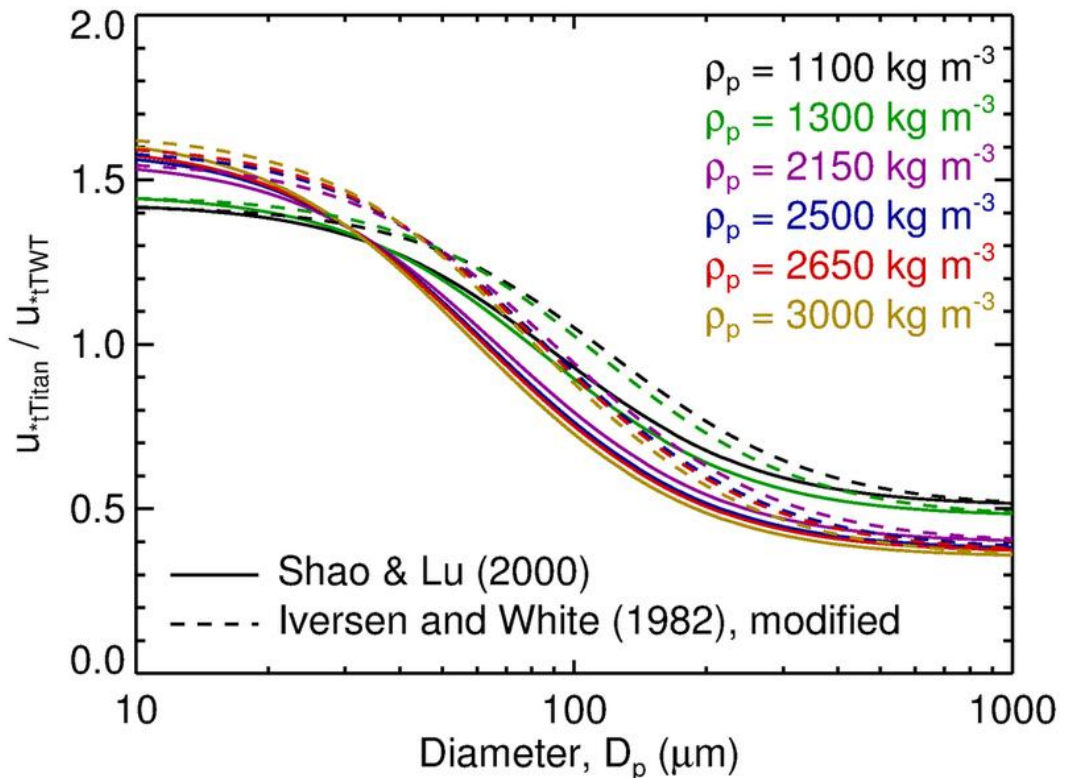
NATURE | LETTER 🔗 📄
日本語要約

Higher-than-predicted saltation threshold wind speeds on Titan

Devon M. Burr, Nathan T. Bridges, John R. Marshall, James K. Smith, Bruce R. White & Joshua P. Emery

Affiliations | Contributions | Corresponding author

Nature 517, 60–63 (01 January 2015) | doi:10.1038/nature14088
Received 07 April 2014 | Accepted 17 November 2014 | Published online 08 December 2014

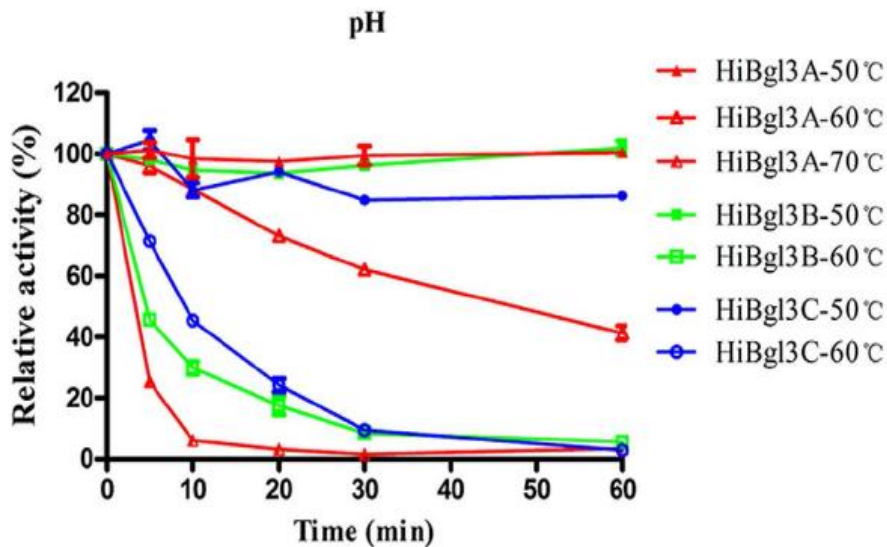


SCIENTIFIC REPORTS

OPEN Functional diversity of family 3 β -glucosidases from thermophilic cellulolytic fungus *Humicola insolens* Y1

Received: 16 October 2015
Accepted: 09 May 2016
Published: 08 June 2016

Wei Xia^{1,2*}, Yingguo Bai^{2*}, Ying Cui², Xinxin Xu³, Lichun Qian¹, Pengjun Shi², Wei Zhang³, Huiying Luo², Xiuhan Zhan¹ & Bin Yao²



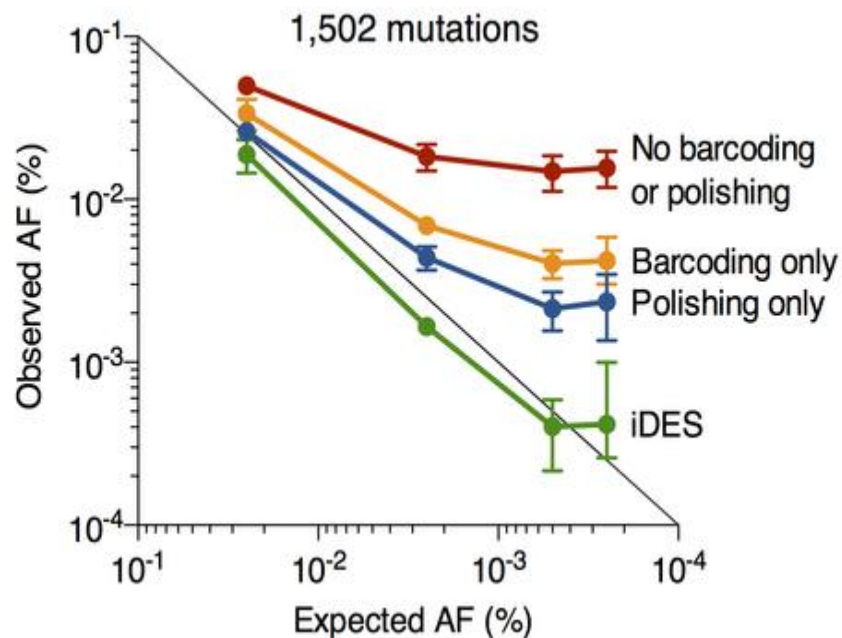
Integrated digital error suppression for improved detection of circulating tumor DNA

Aaron M Newman, Alexander F Lovejoy, Daniel M Klass, David M Kurtz, Jacob J Chabon, Florian Scherer, Henning Stehr, Chih Long Liu, Scott V Bratman, Carmen Say, Li Zhou, Justin N Carter, Robert B West, George W Sledge Jr, Joseph B Shrager, Billy W Loo Jr, Joel W Neal, Heather A Wakelee, Maximilian Diehn & Ash A Alizadeh

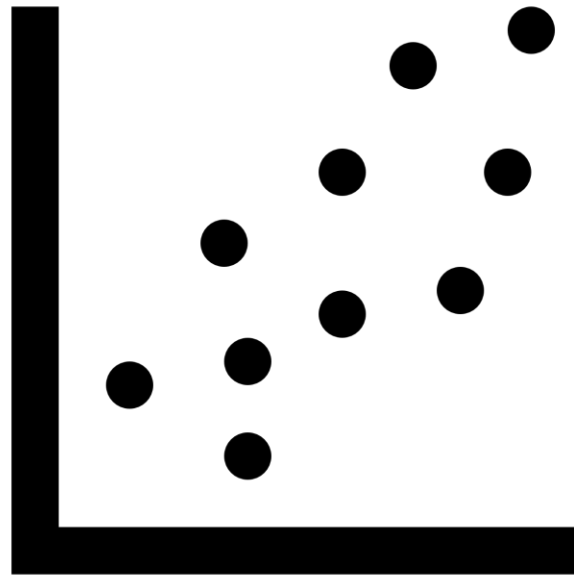
Affiliations | Contributions | Corresponding authors

Nature Biotechnology 34, 547–555 (2016) | doi:10.1038/nbt.3520

Received 02 October 2015 | Accepted 26 February 2016 | Published online 28 March 2016



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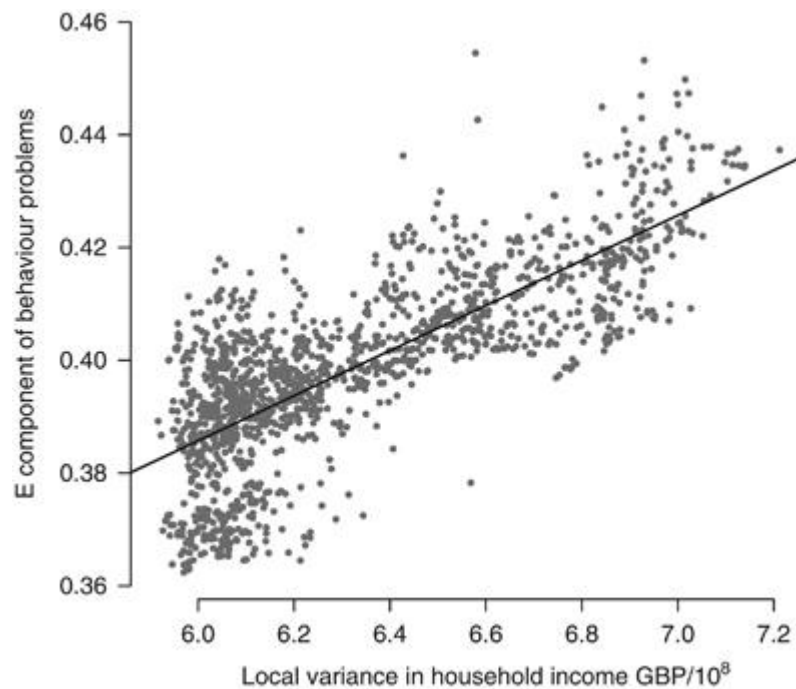
Molecular Psychiatry (2012) 17, 867–874; doi:10.1038/mp.2012.68; published online 12 June 2012

Visual analysis of geocoded twin data puts nature and nurture on the map

OPENO S P Davis^{1,2,3}, C M A Haworth¹, C M Lewis¹ and R Plomin¹¹King's College London, MRC Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, London, UK²The Wellcome Trust Centre for Human Genetics, University of Oxford, Oxford, UK³European Bioinformatics Institute, Wellcome Trust Genome Campus, Hinxton, UKCorrespondence: Dr OSP Davis, King's College London, MRC Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, De Crespigny Park, London SE5 8AF, UK. E-mail: Oliver.Davis@kcl.ac.uk

Received 7 November 2011; Revised 5 March 2012; Accepted 9 April 2012

Advance online publication 12 June 2012



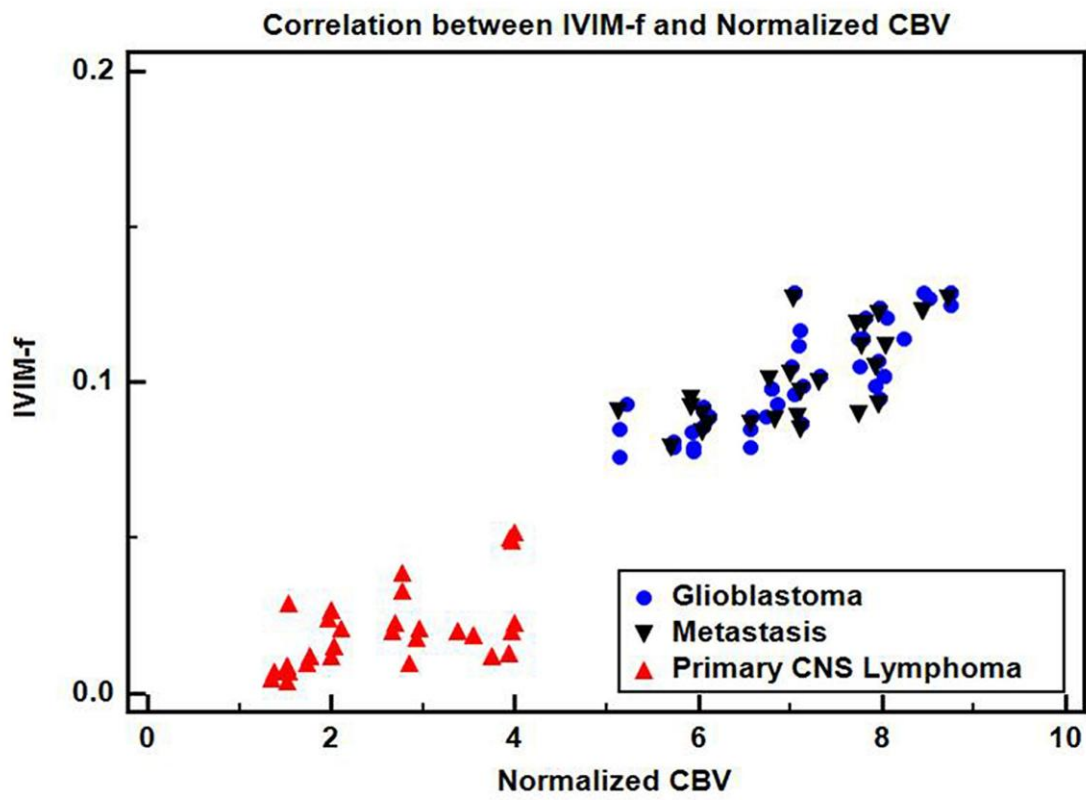
OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Comparison of Apparent Diffusion Coefficient and Intravoxel Incoherent Motion for Differentiating among Glioblastoma, Metastasis, and Lymphoma Focusing on Diffusion-Related Parameter


Woo Hyun Shim, Ho Sung Kim, Choong-Gon Choi, Sang Joon Kim

Published: July 30, 2015 • <http://dx.doi.org/10.1371/journal.pone.0134761>



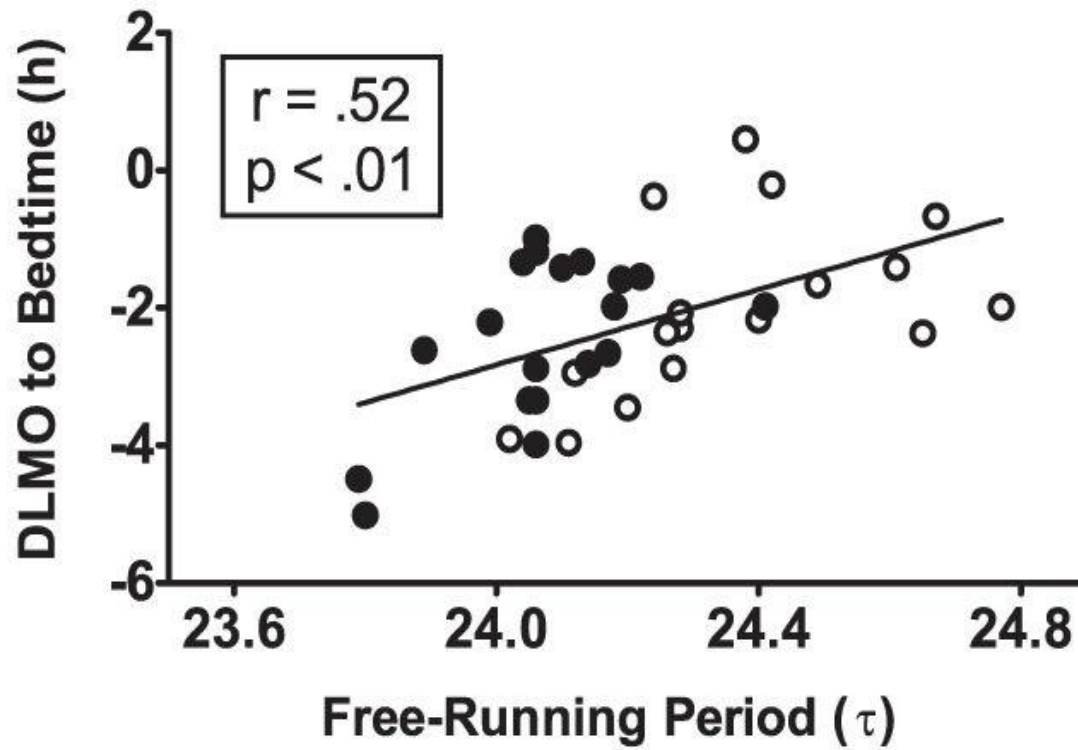
Article | OPEN

Circadian rhythm phase shifts and endogenous free-running circadian period differ between African-Americans and European-Americans

Charmaine I. Eastman , Christina Suh, Victoria A. Tomaka & Stephanie J. Crowley

Scientific Reports 5, Article number: 8381 (2015)
doi:10.1038/srep08381

Received: 08 September 2014
Accepted: 19 January 2015
Published online: 11 February 2015



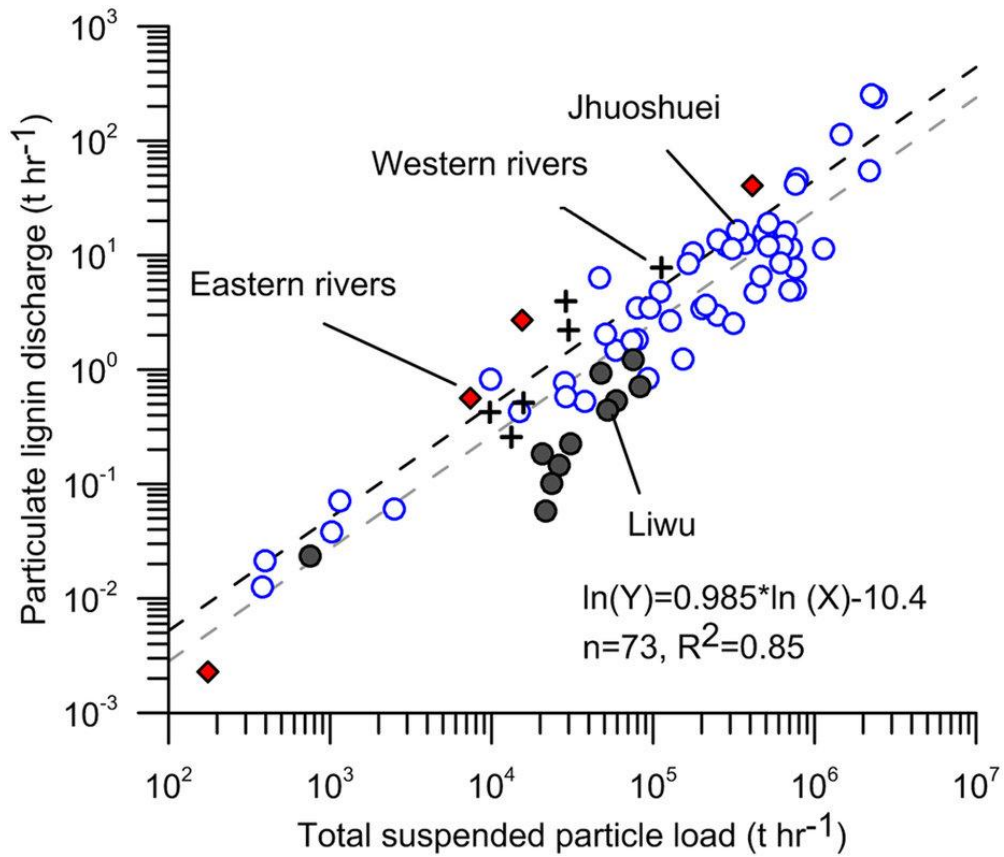
Article | OPEN

Importance of Oceanian small mountainous rivers (SMRs) in global land-to-ocean output of lignin and modern biospheric carbon

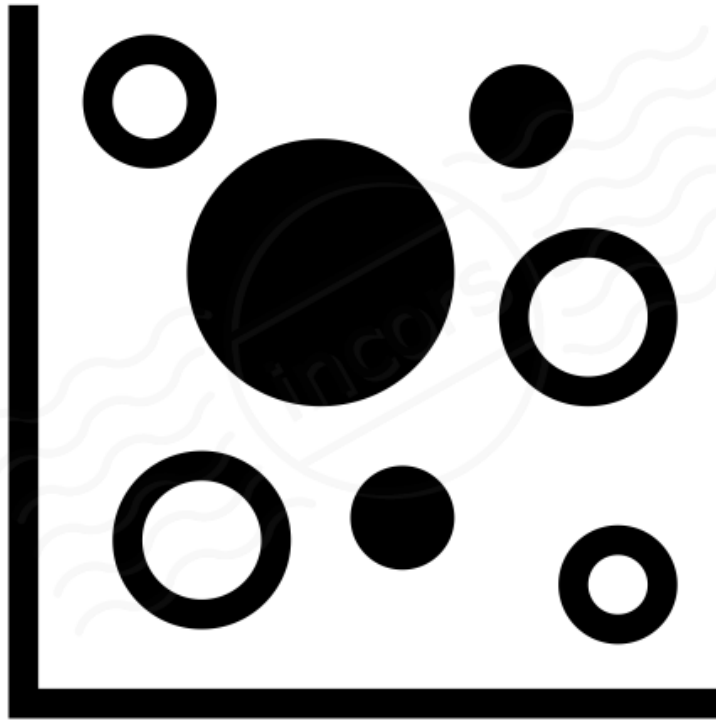
Hongyan Bao, Tsung-Yu Lee, Ji-Chuan Huang, Xiaojuan Feng, Minhan Dai & Shuh-Ji Kao

Scientific Reports 5, Article number: 16217 (2015)
doi:10.1038/srep16217

Received: 24 June 2015
Accepted: 09 October 2015
Published online: 20 November 2015



Bubble CHART



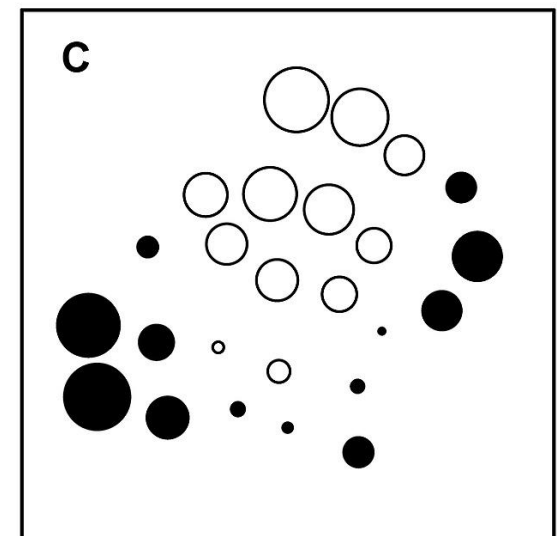
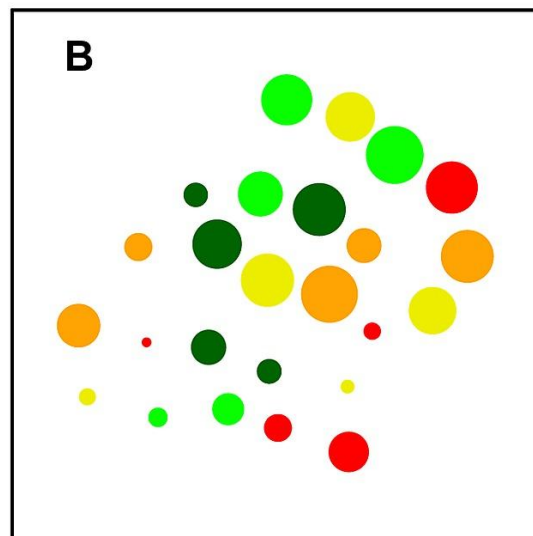
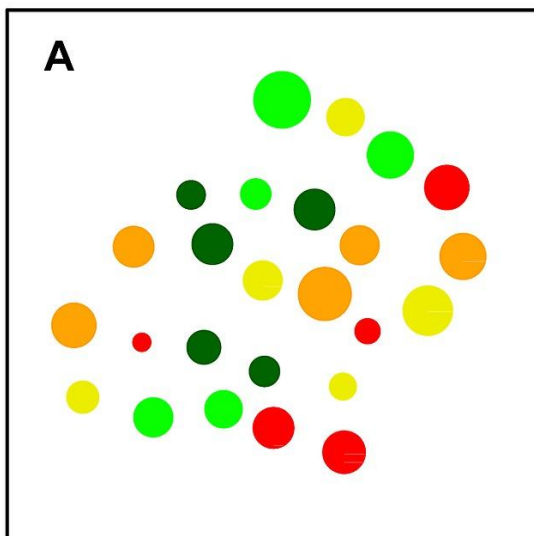
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RESEARCH ARTICLE

Optimising Bait for Pitfall Trapping of Amazonian Dung Beetles (Coleoptera: Scarabaeinae)

Charles J. Marsh , Julio Louzada, Wallace Beiroz, Robert M. Ewers

Published: August 30, 2013 • <http://dx.doi.org/10.1371/journal.pone.0073147>



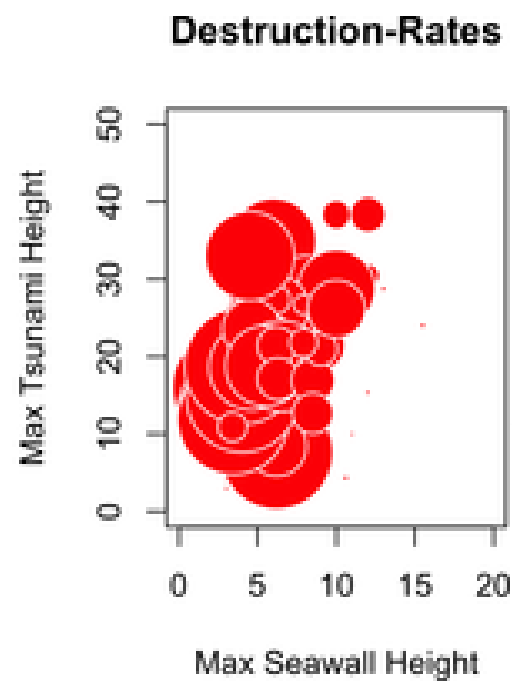
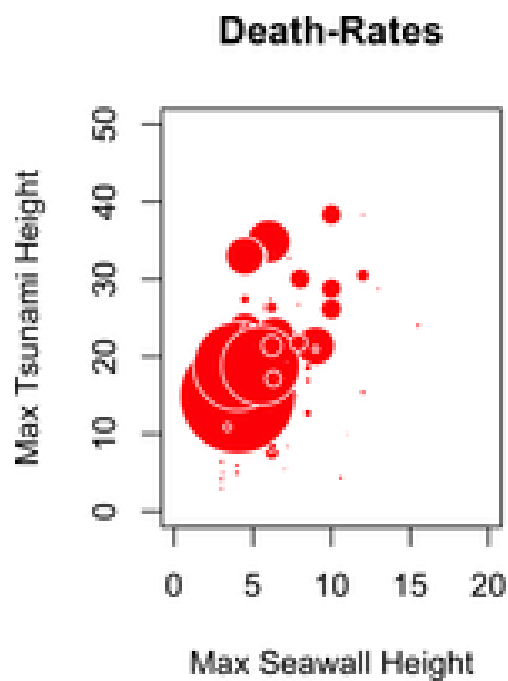
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RESEARCH ARTICLE

Statistical Analysis of the Effectiveness of Seawalls and Coastal Forests in Mitigating Tsunami Impacts in Iwate and Miyagi Prefectures

Roshanak Nateghi, Jeremy D. Bricker, Seth D. Guikema, Akane Bessho

Published: August 10, 2016 • <http://dx.doi.org/10.1371/journal.pone.0158375>



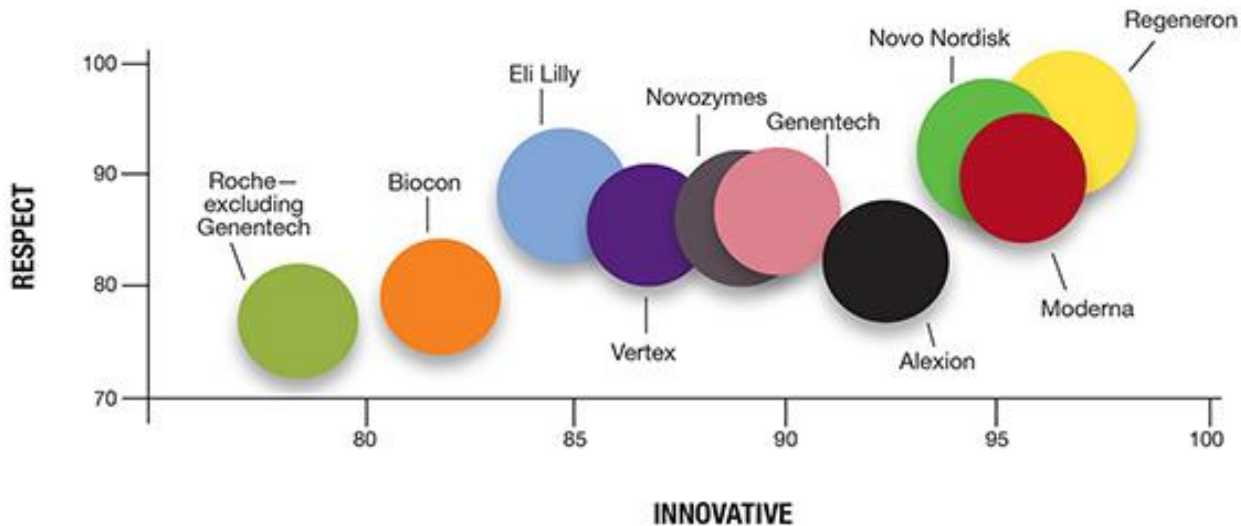


Top firms bring out creativity, growth in their scientists

By Kendall Powell | Oct. 28, 2016 , 2:00 PM

Comparison of top ten's top characteristics

Width of bubble = LOYAL EMPLOYEES



Comparison of the top 10 companies on the basis of the top three drivers (scored out of 100):

- Innovative leader in the industry (x-axis),
- Treats employees with respect (y-axis),
- Has loyal employees (bubble width).

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RESEARCH ARTICLE

Personality, Gender, and Age in the Language of Social Media: The Open-Vocabulary Approach

H. Andrew Schwartz , Johannes C. Eichstaedt, Margaret L. Kern, Lukasz Dziurzynski, Stephanie M. Ramones, Megha Agrawal, Achal Shah, Michal Kosinski, David Stillwell, Martin E. P. Seligman, Lyle H. Ungar

Published: September 25, 2013 • <http://dx.doi.org/10.1371/journal.pone.0073791>



a a a
correlation strength

relative frequency

b b b
prevalence in topic

8

there are eight
hats to wear to
produce an

optimal

visualization

Primary Investigator(s)

Data Scientist

Communication Specialist

Designer

Finance Manager

Marketing Specialist

Facilitator

Project Manager



Purpose & parameters

Prepare & explore data

Formulate conclusion

Concept Design

Construct & launch

PI(s)

Data Scientist

Communication specialist

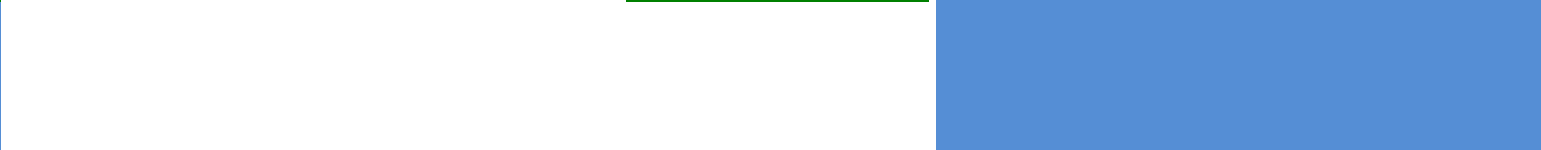
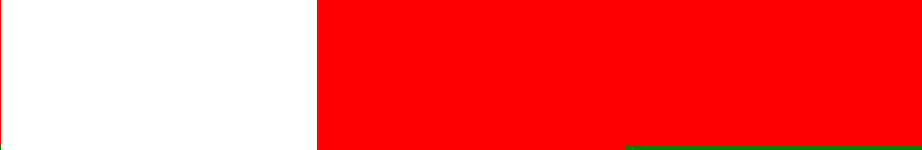
Graphic Designer

Facilitator

Marketing Specialist

Project Manager

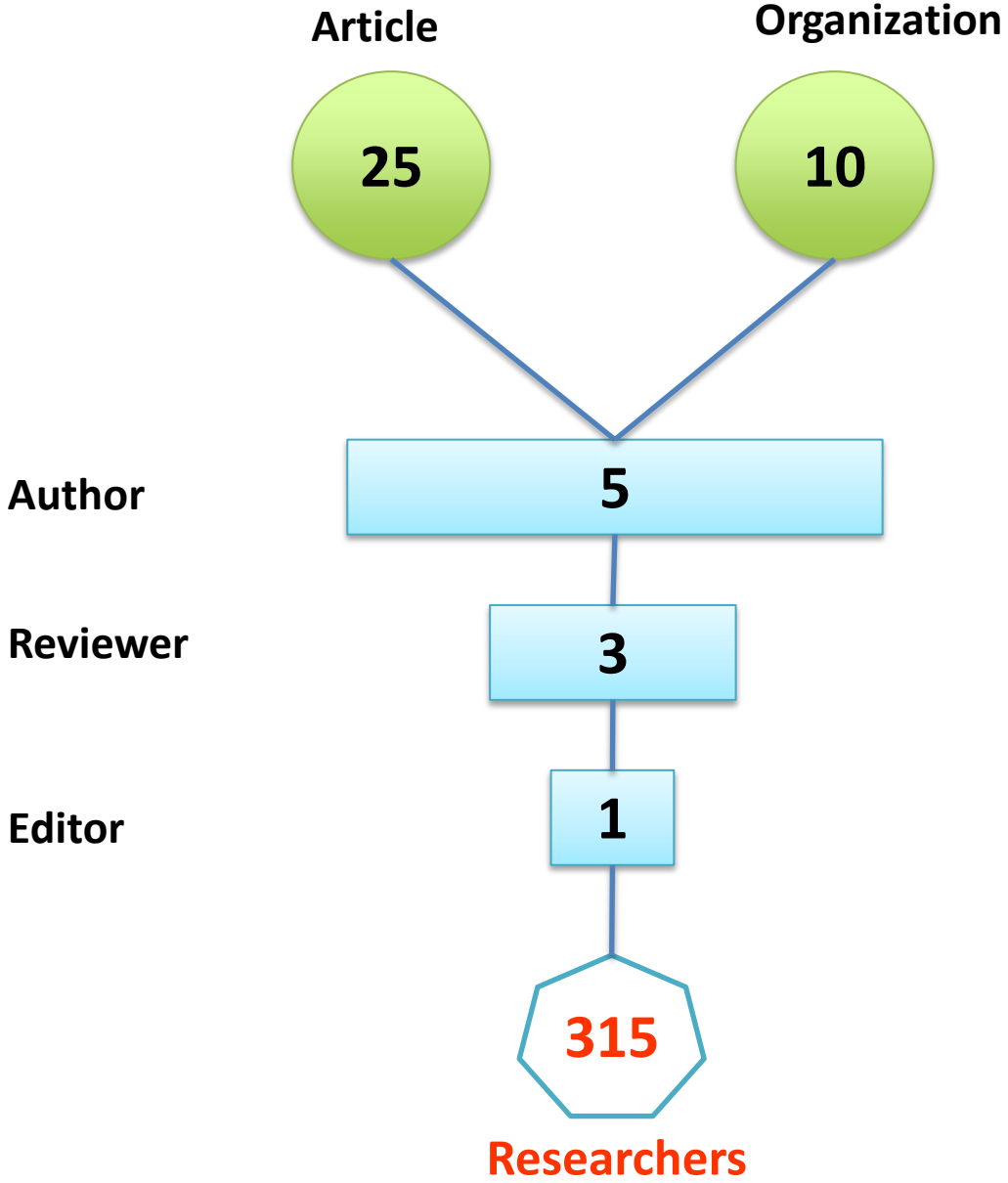
Finance Manager



Summary

- We use data visualization to analyze, to discover, to tell a story, and to teach.
- There are 7 fundamental attributes to articulate relative differences
(Positioning and length are optimal attributes)
- When you choose your chart, make it clear as much as you can!

Remarks



315 RESEARCHERS OVERLOOKED ESSENTIAL VISUALIZATIONS PRINCIPLES

Learned Today!

Workshop – Part II

- Programs to use
- Hands on examples
- Realtime visualization development





Let's keep in touch!

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moe.elgendi@gmail.com