Writing in the Sciences

Unit 5: The original manuscript

One more tip on making writing easier…

- Break your writing task into small and realistic goals.
  - Examples:
    - My goal is to write 400 words today.
    - My goal is to write the first two paragraphs of the discussion section today.

Recommended order for writing an original manuscript

1. Tables and Figures
2. Results
3. Methods
4. Introduction
5. Discussion
6. Abstract

Good references

- Clinical Chemistry Guide to Scientific Writing: http://www.aacc.org/publications/clin_chem/ccgsw/Pages/default.aspx#
- Mimi Zeiger. *Essentials of Writing Biomedical Research Papers*, McGraw Hill Professional

Writing in the Sciences

Unit 5.1: Tables and Figures

Tables and Figures are the foundation of your story!

Editors, reviewers, and readers may look first (and maybe only) at titles, abstracts, and tables and figures!

Figures and tables should stand alone and tell a complete story. The reader should not need to refer back to the main text.

Tables and Figures are the story!

"An article about computational science in a scientific publication isn't the scholarship itself, it's merely advertising of the scholarship. The actual scholarship is the complete software development environment and the complete set of instructions which generated the figures."—Jon Claerbout, Stanford

Tips on Tables and Figures

- Use the fewest figures and tables needed to tell the story.
- Do not present the same data in both a figure and a table.

Tables vs. Figures

- Figures
  - Visual impact
  - Show trends and patterns
  - Tell a quick story
  - Tell the whole story
  - Highlight a particular result
- Tables
  - Give precise values
  - Display many values/variables

Table Title

- Identify the specific topic or point of the table.
- Use the same key terms in the table title, the column headings, and the text of the paper
- Keep it brief!
- Example: “Descriptive characteristics of the two treatment groups, means ± SD or N (%)”

Table Footnotes

- **Use superscript symbols to identify footnotes, according to journal guidelines;**
  - A standard series is: *, †,‡,¶,#,**,††, etc.
- **Use footnotes to explain statistically significant differences**
  - E.g., *p<.01 vs. control by ANOVA
- **Use footnotes to explain experimental details or abbreviations**
  - E.g., EDI is the Eating Disorder Inventory (reference)
  - Amenorrhea was defined as 0-3 periods per year

Table Formats

Model your tables from already published tables! Don't re-invent the wheel!!

- **Follow journal guidelines RE:**
  - Roman or Arabic numbers
  - centered or flush left table number, title, column, headings, and data
  - capital letters and italics
  - the placement of footnotes
  - the type of footnote symbols
- **Most journals use three horizontal lines: one above the column headings, one below the column headings, and one below the data**

Example table:

Three horizontal lines

Table 1. Descriptive characteristics of the study groups, means ± SD or N (%).

Characteristic	Bad Witches	Good Witches
N	13	12
Age (yrs)	45 ± 5	36 ± 6*
Female	11 (85%)	10 (83%)
BMI (kg/m^2)	21 ± 6	23 ± 3
Systolic BP (mmHg)	140 ± 10	120 ± 9*
Exercise (min/day)	30 ± 20	60 ± 30*
Employment status		
Unemployed	4 (31%)	0 (0%)
Part time	3 (23%)	4 (33%)
Full time	6 (46%)	8 (66%)
Smoker (yes/no)	6 (50%)	0 (0%)*

*p<.05, ttest or Fisher's exact test, as appropriate.

Example table:

Table 1. Descriptive characteristics of the study groups, means ± SD or N (%).

Characteristic	Bad Witches	Good Witches
N	13	12
Age (yrs)	45 ± 5	36 ± 6*
Female	11 (85%)	10 (83%)
BMI (kg/m^2)	21 ± 6	23 ± 3
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Exercise (min/day)	30 ± 20	60 ± 30*
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Smoker (yes/no)	6 (50%)	0 (0%)*

*p<.05, ttest or Fisher's exact test, as appropriate.

What not to do!

Remove grid lines!

Table 1. Descriptive characteristics of the study groups, means ± SD or N (%).

Characteristic	Bad Witches	Good Witches
N	13	12
Age (yrs)	45 ± 5	36 ± 6*
Female	11 (85%)	10 (83%)
BMI (kg/m^2)	21 ± 6	23 ± 3
Systolic BP (mmHg)	140 ± 10	120 ± 9*
Exercise (min/day)	30 ± 20	60 ± 30*
Employment status		
Unemployed	4 (31%)	0 (0%)
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Full time	6 (46%)	8 (66%)
Smoker (yes/no)	6 (50%)	0 (0%)*

*p<.05, ttest or Fisher's exact test, as appropriate.

What not to do!

Make sure everything lines up and looks professional!

Table 1. Descriptive characteristics of the study groups, means ± SD or N (%).

Characteristic	Bad Witches	Good Witches
N	13	12
age (yrs)	45 ± 5	36 ± 6*
female	11 (85%)	10 (83%)
BMI (kg/m^2)	21 ± 6	23 ± 3
Systolic BP (mmHg)	140 ± 10	120 ± 9*
Exercise (min/day)	30 ± 20	60 ± 30*
Employment status		
Unemployed	4 (31%)	0 (0%)
Part time	3 (23%)	4 (33%)
Full time	6 (46%)	8 (66%)
Smoker (yes/no)	6 (50%)	0 (0%)*

*p<.05, ttest or Fisher's exact test, as appropriate.

What not to do!

Use a reasonable number of significant figures.

Table 1. Descriptive characteristics of the study groups, means ± SD or N (%).

Characteristic	Bad Witches	Good Witches
N	13	12
Age (yrs)	45.076 ± 5.032	36.007 ± 6.032*
Female	11 (85%)	10 (83%)
BMI (kg/m^2)	21.223 ± 6.332	23.331 ± 3.333
Systolic BP (mmHg)	140.23 ± 10.23	120.23 ± 9.23*
Exercise (min/day)	30.244 ± 20.345	60.123 ± 30.32*
Employment status		
Unemployed	4 (31%)	0 (0%)
Part time	3 (23%)	4 (33%)
Full time	6 (46%)	8 (66%)
Smoker (yes/no)	6 (50%)	0 (0%)*

*p<.05, ttest or Fisher's exact test, as appropriate.

What not to do!

Give units!

Table 1. Descriptive characteristics of the study groups, means ± SD or N (%).

Characteristic	Bad Witches	Good Witches
N	13	12
age	45 ± 5	36 ± 6*
female	11 (85%)	10 (83%)
BMI	21 ± 6	23 ± 3
Systolic BP	140 ± 10	120 ± 9*
Exercise	30 ± 20	60 ± 30*
Employment status		
Unemployed	4 (31%)	0 (0%)
Part time	3 (23%)	4 (33%)
Full time	6 (46%)	8 (66%)
Smoking	6 (50%)	0 (0%)*

*p<.05, ttest or Fisher's exact test, as appropriate.

What not to do!

Omit unnecessary columns!

Table 1. Descriptive characteristics overall and by gro (%), and p-values for the comparison between the groups.

Characteristic	Overall	Bad Witches	Good Witches	P-value
N	25	13	12	n/a
Age (yrs)	41 ± 6	45 ± 5	36 ± 6	0.0005
Female	21 (84%)	11 (85%)	10 (83%)	0.80
BMI (kg/m^2)	22 ± 5	21 ± 6	23 ± 3	0.31
Systolic BP (mmHg)	131 ± 12	140 ± 10	120 ± 9	0.0001
Exercise (min/d)	45 ± 40	30 ± 20	60 ± 30	0.0069
Employment status				
Unemployed	4 (16%)	4 (31%)	0 (0%)	0.17
Part time	7 (28%)	3 (23%)	4 (33%)	
Full time	14 (56%)	6 (46%)	8 (66%)	
Smoker (yes/no)	6 (24%)	6 (50%)	0 (0%)	0.01

Types of Figures

1. Primary evidence
    - electron micrographs, gels, photographs, pathology slides, X-rays, etc.
    - indicates data quality
    - "Seeing is believing"
2. Graphs
    - line graphs, bar graphs, scatter plots, histograms, boxplots, etc.
3. Drawings and diagrams
    - illustrate an experimental set-up or work-flow
    - indicate flow of participants
    - illustrate cause and effect relationships or cycles
    - give a hypothetical model
    - represent microscopic particles or microorganisms as cartoons

Figure Legends

**Allows the figure to stand alone.

May contain:

1. Brief title
2. Essential experimental details
3. Definitions of symbols or line/bar patterns
4. Explanation of panels (A,B,C,D, etc.)
5. Statistical information (tests used, p-values)

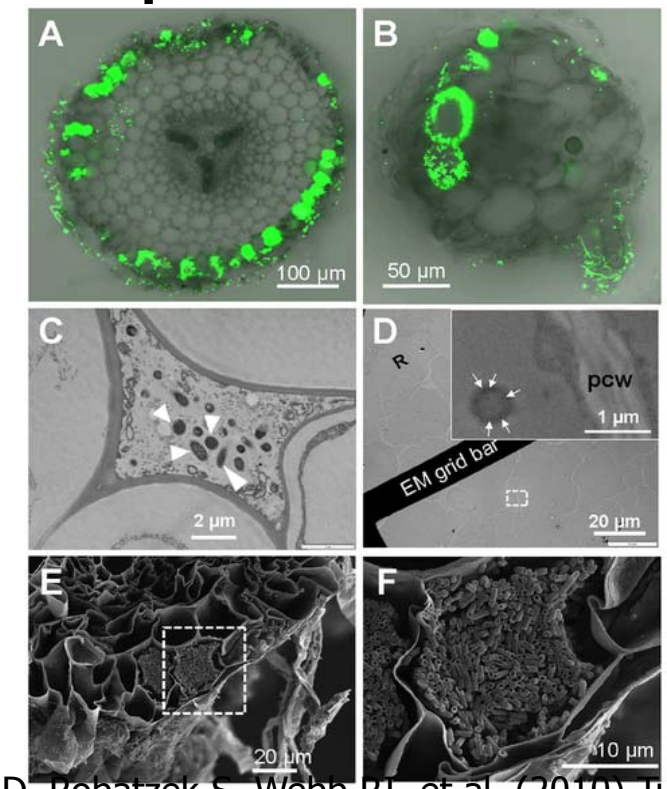
Example Legend

- Figure 2. **Root transverse sections and electron micrographs of tomato and Arabidopsis show GFP E. coli in the apoplast and inside root cells**. E. coli was detected inside tomato roots (A, C and D, E and F) and Arabidopsis roots (B). (A and B) Fluorescent images of transverse sectioned roots taken by CLSM. (C and D) Images taken by a transmission electron microscope. White triangles in (C) indicate E. coli cell present in apoplast. (D) Roots were probed with immunogold-labeled anti-GFP revealing E. coli in root cortex cells. Sub-image in (D) is a detail of dash-white square box. Gold labeling is marked with white arrows. Rhizodermis cell (R) and plant cell wall (pcw) is indicated. (F) is a detail image of (E) showing plant cells containing E. coli, and both images were taken by SEM.

- Paungfoo-Lonhienne C, Rentsch D, Robatzek S, Webb RI, et al. (2010) Turning the Table: Plants Consume Microbes as a Source of Nutrients. PLoS ONE 5(7): e11915. doi:10.1371/journal.pone.0011915

Primary Evidence

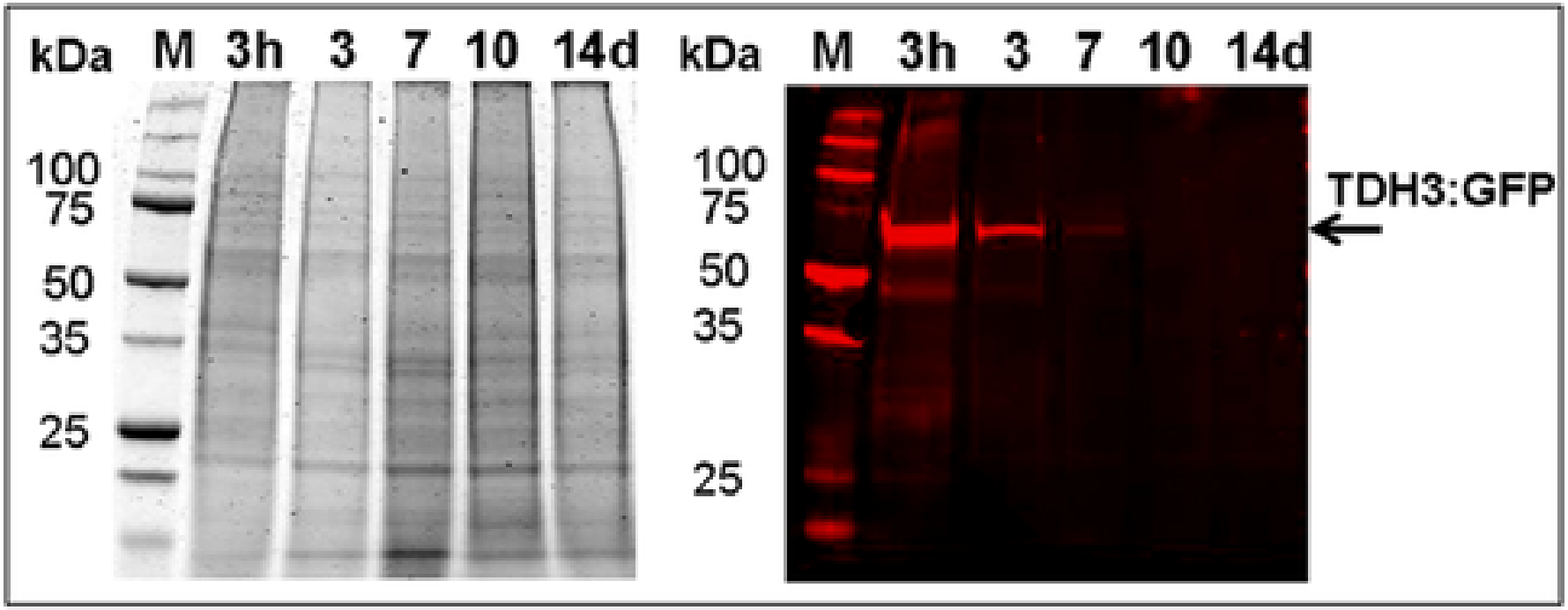
- **Figure 2. Root transverse sections and electron micrographs of tomato and Arabidopsis show GFPE. coli in the apoplast and inside root cells.**



Paungfoo-Lonhienne C, Rentsch D, Robatzek S, Webb RI, et al. (2010) Turning the Table: Plants Consume Microbes as a Source of Nutrients. PLoS ONE 5(7): e11915. doi:10.1371/journal.pone.0011915
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0011915

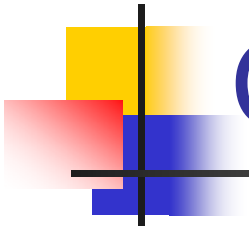
PLoS one

Primary Evidence



Paungfoo-Lonhienne C, Rentsch D, Robatzek S, Webb RI, et al. (2010) Turning the Table: Plants Consume Microbes as a Source of Nutrients. PLoS ONE 5(7): e11915. doi:10.1371/journal.pone.0011915
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0011915

PLoS one



Graphs

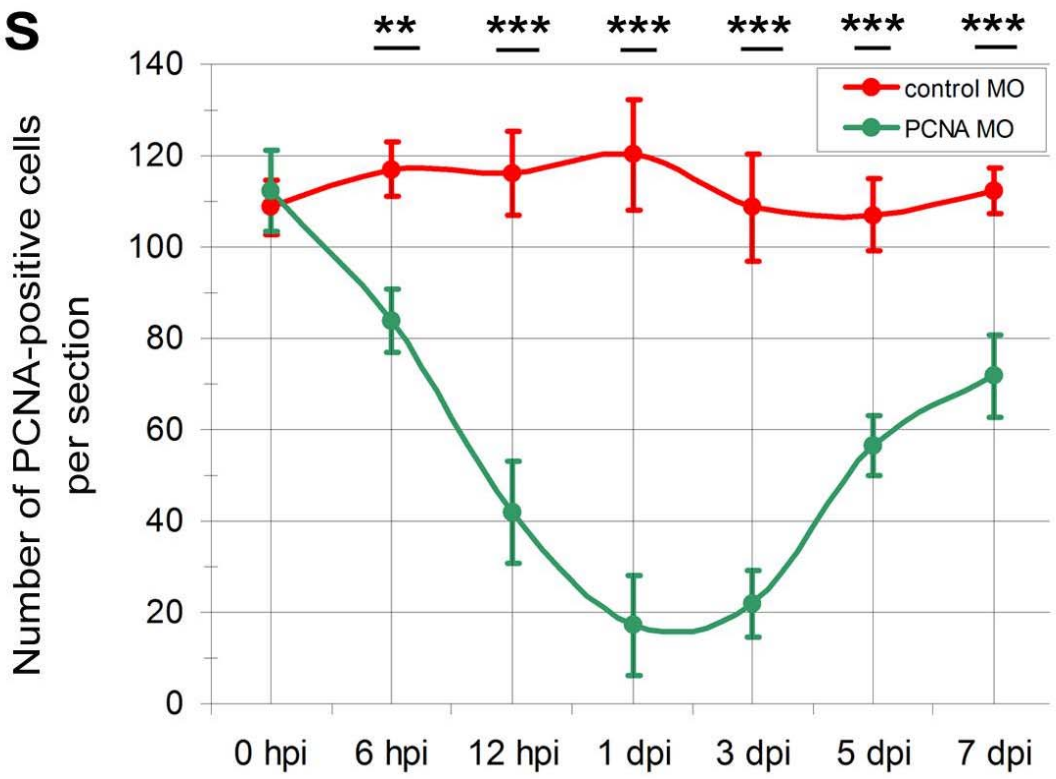
- line graphs
- scatter plots
- bar graphs
- individual-value bar graphs
- histograms
- box plots
- survival curves

Line Graphs

*Used to show trends over time, age, or dose

(can display group means or individuals)

Line graph



Kizil C, Brand M (2011) Cerebroventricular Microinjection (CVMI) into Adult Zebrafish Brain Is an Efficient Misexpression Method for Forebrain Ventricular Cells. PLoS ONE 6(11): e27395. doi:10.1371/journal.pone.0027395
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0027395

PLoS one

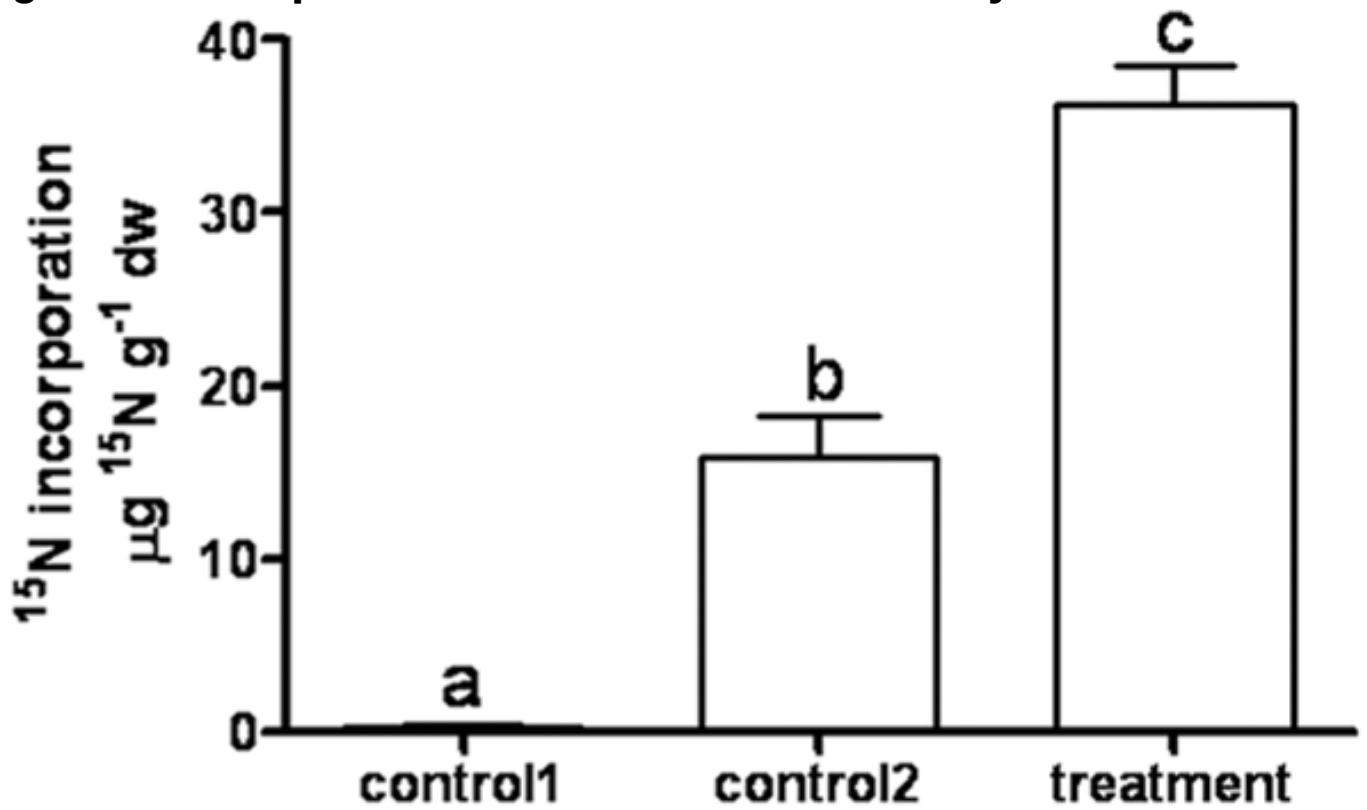
Bar Graphs

*Used to compare groups at one time point

*Tells a quick visual story

Bar graph

- **Figure 6. Incorporation of E. coli-derived 15N by leaves of tomato plants.**

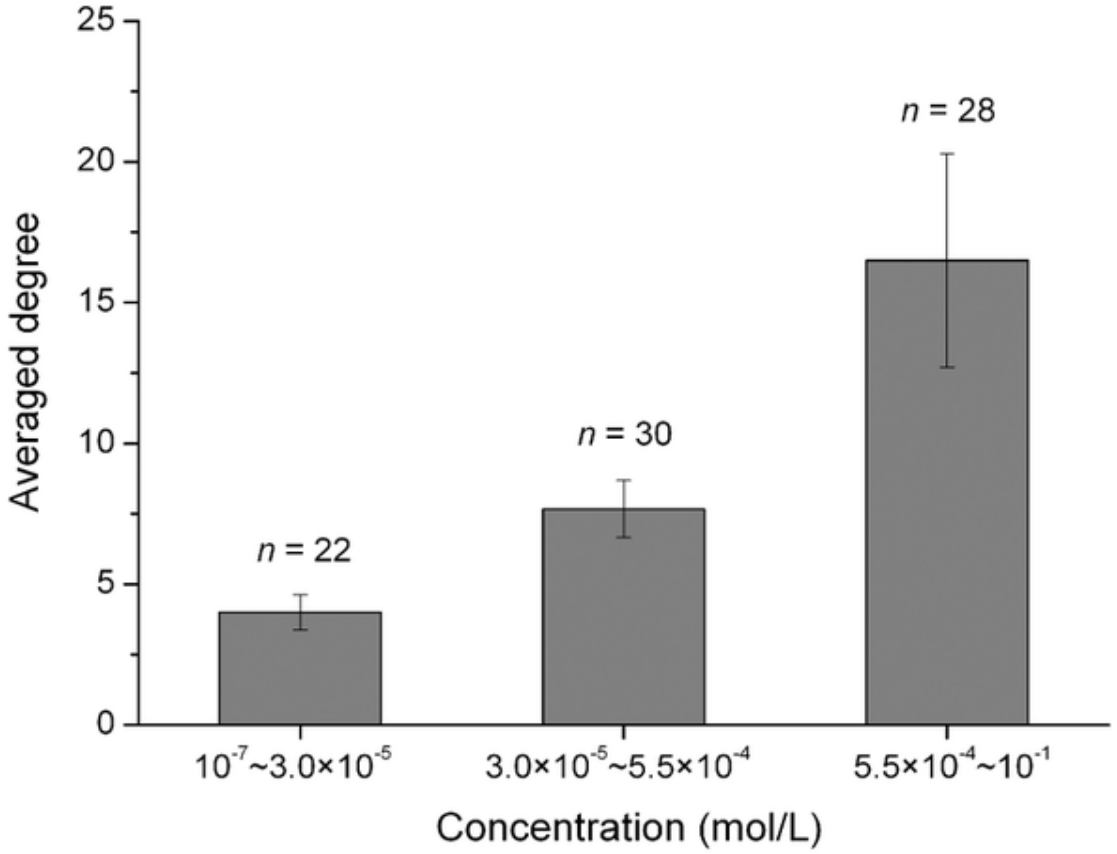


Paungfoo-Lonhienne C, Rentsch D, Robatzek S, Webb RI, et al. (2010) Turning the Table: Plants Consume Microbes as a Source of Nutrients. PLoS ONE 5(7): e11915. doi:10.1371/journal.pone.0011915

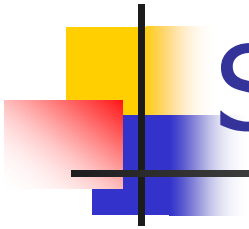
PLoS one

Bar graph

Figure 3. Degree-concentration correlation for E. coli metabolites (P<.01, Kruskal-Wallis test).



Zhu Q, Qin T, Jiang Y-Y, Ji C, et al. (2011) Chemical Basis of Metabolic Network Organization. PLoS Comput Biol 7(10): e1002214. doi:10.1371/journal.pcbi.1002214
http://www.ploscompbiol.org/article/info:doi/10.1371/journal.pcbi.1002214

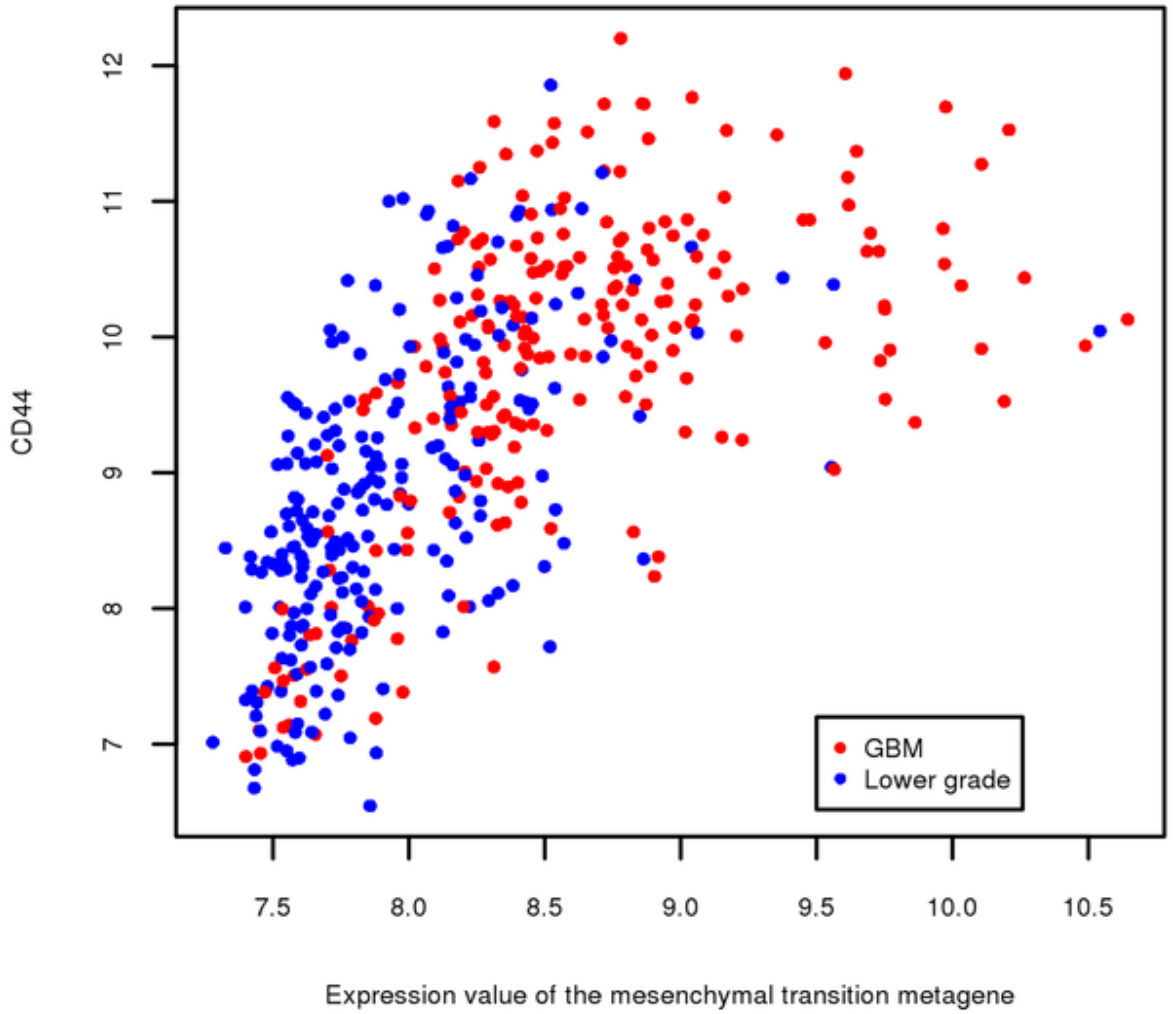


Scatter Plots

*Used to show relationships between two variables (particularly linear correlation)

*Allows reader to see individual data points=more information!

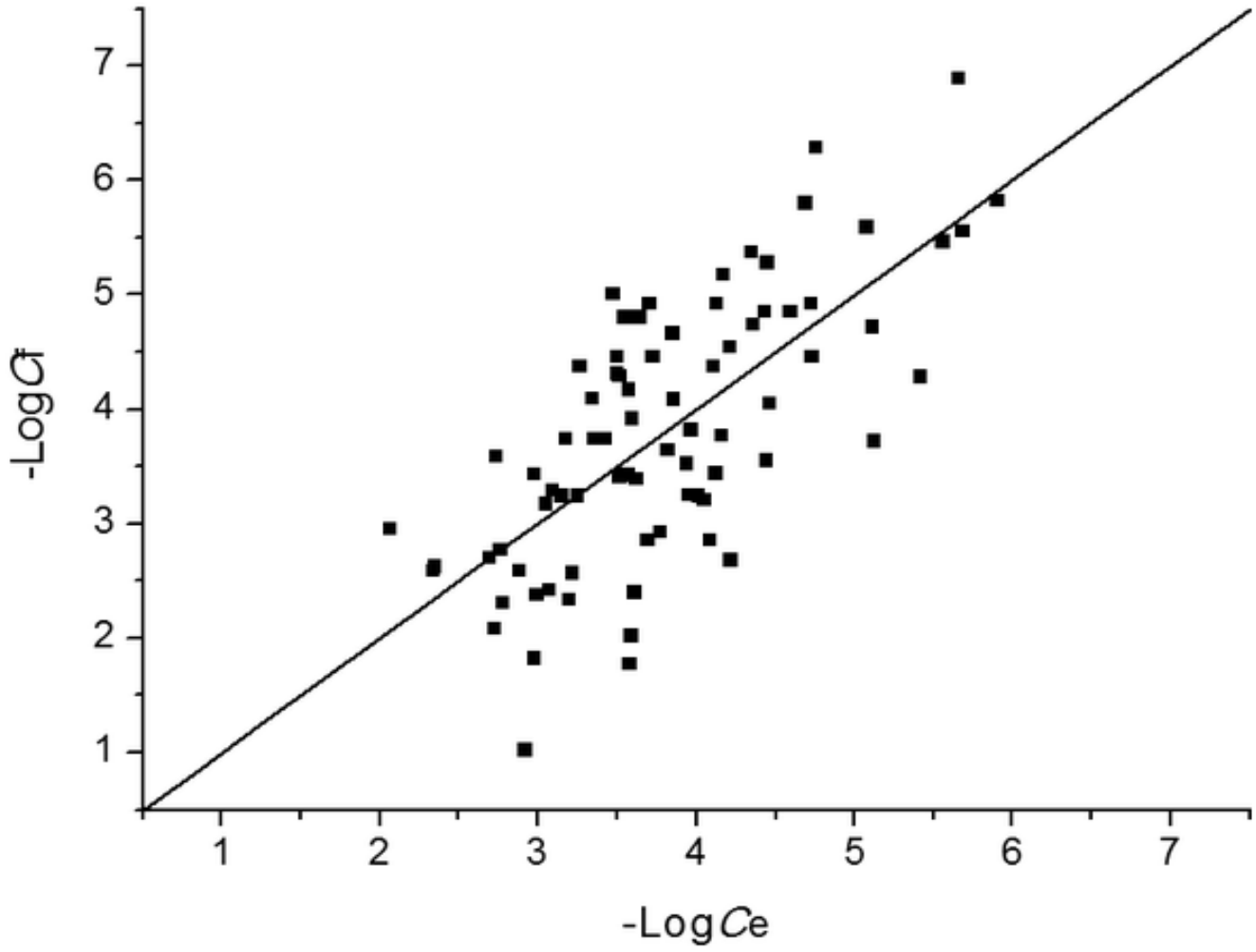
Figure 4. Scatter plot for the expression levels of CD44 vs. the mesenchymal transition metagene.



Cheng W-Y, Kandel JJ, Yamashiro DJ, Canoll P, et al. (2012) A Multi-Cancer Mesenchymal Transition Gene Expression Signature Is Associated with Prolonged Time to Recurrence in Glioblastoma. PLoS ONE 7(4): e34705. doi:10.1371/journal.pone.0034705
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0034705

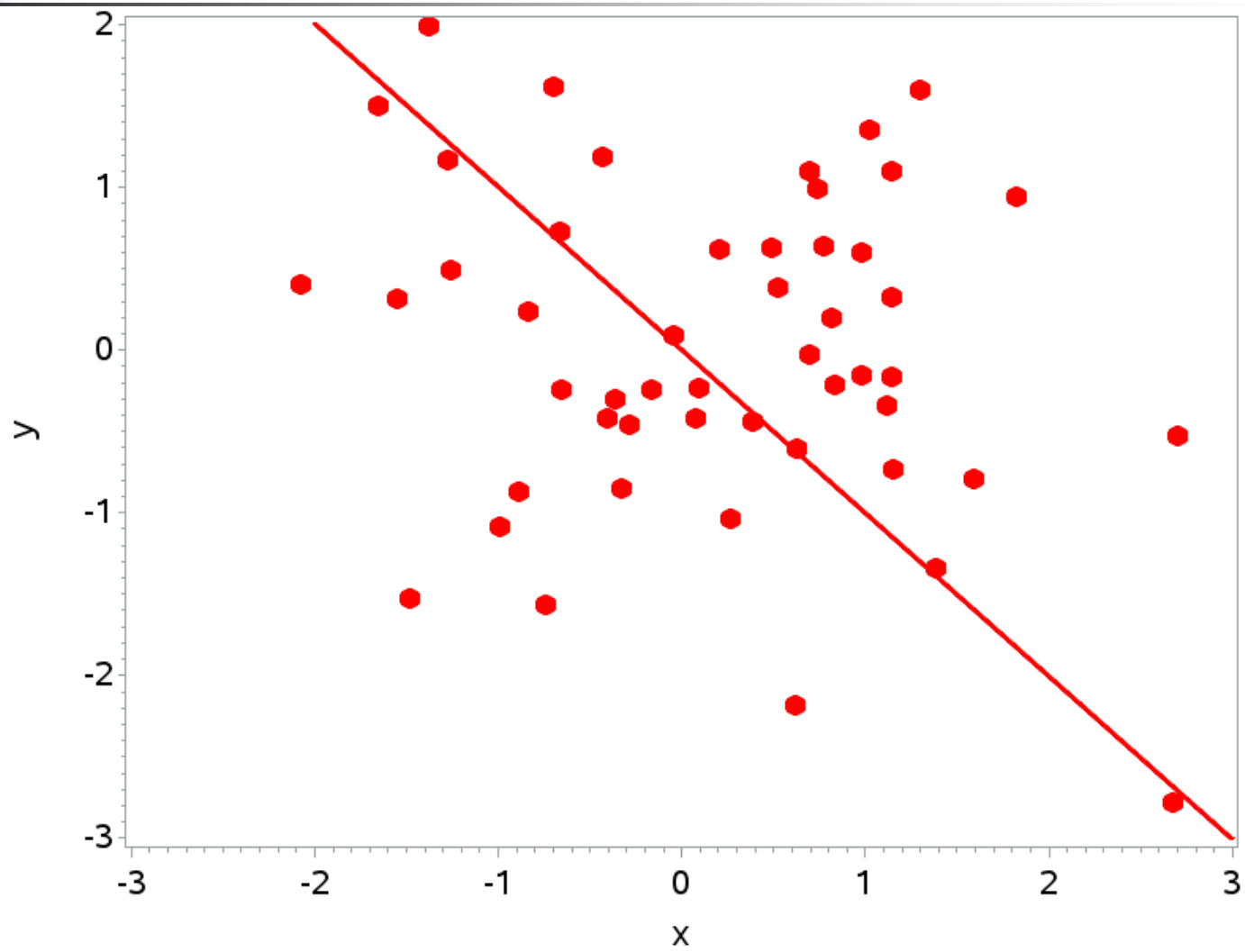
PLoS one

Figure 4. Theoretical fitting of E. coli metabolite concentrations by chemical properties.

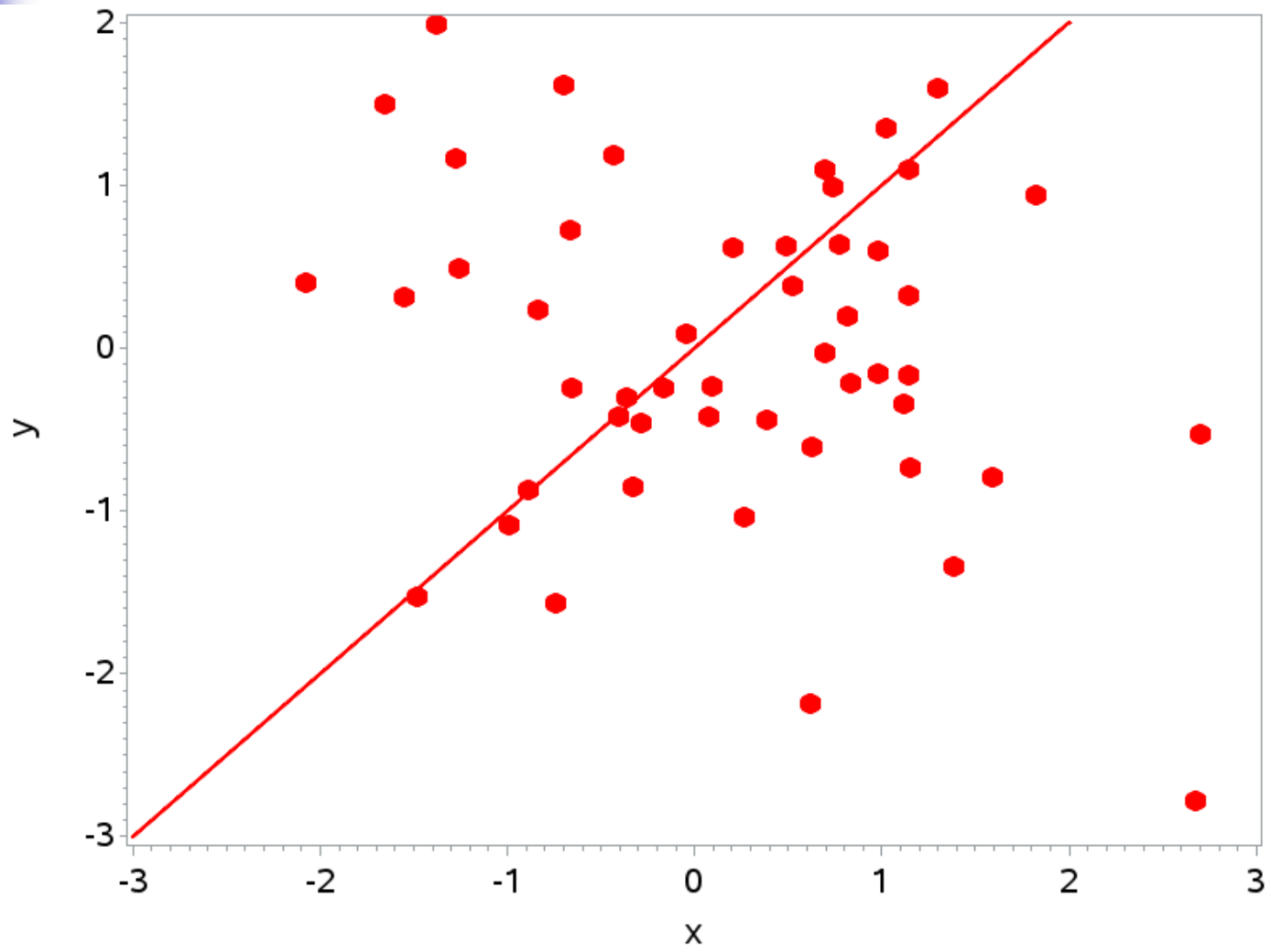


Zhu Q, Qin T, Jiang Y-Y, Ji C, et al. (2011) Chemical Basis of Metabolic Network Organization. PLoS Comput Biol 7(10): e1002214. doi:10.1371/journal.pcbi.1002214
http://www.ploscompbiol.org/article/info:doi/10.1371/journal.pcbi.1002214

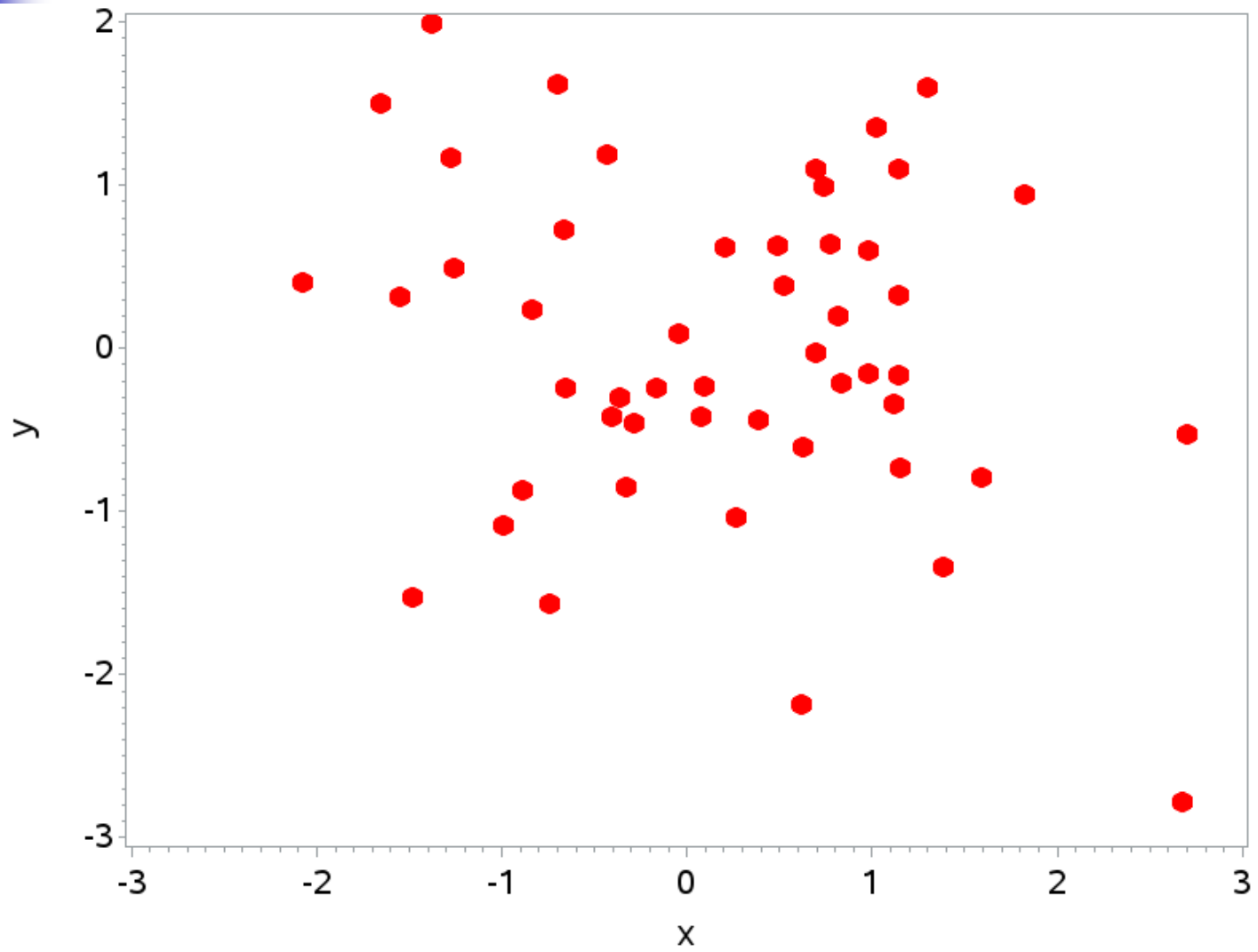
Lines can draw your eye!

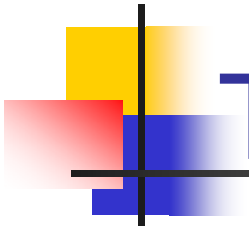


Lines can draw your eye!



Lines can draw your eye!

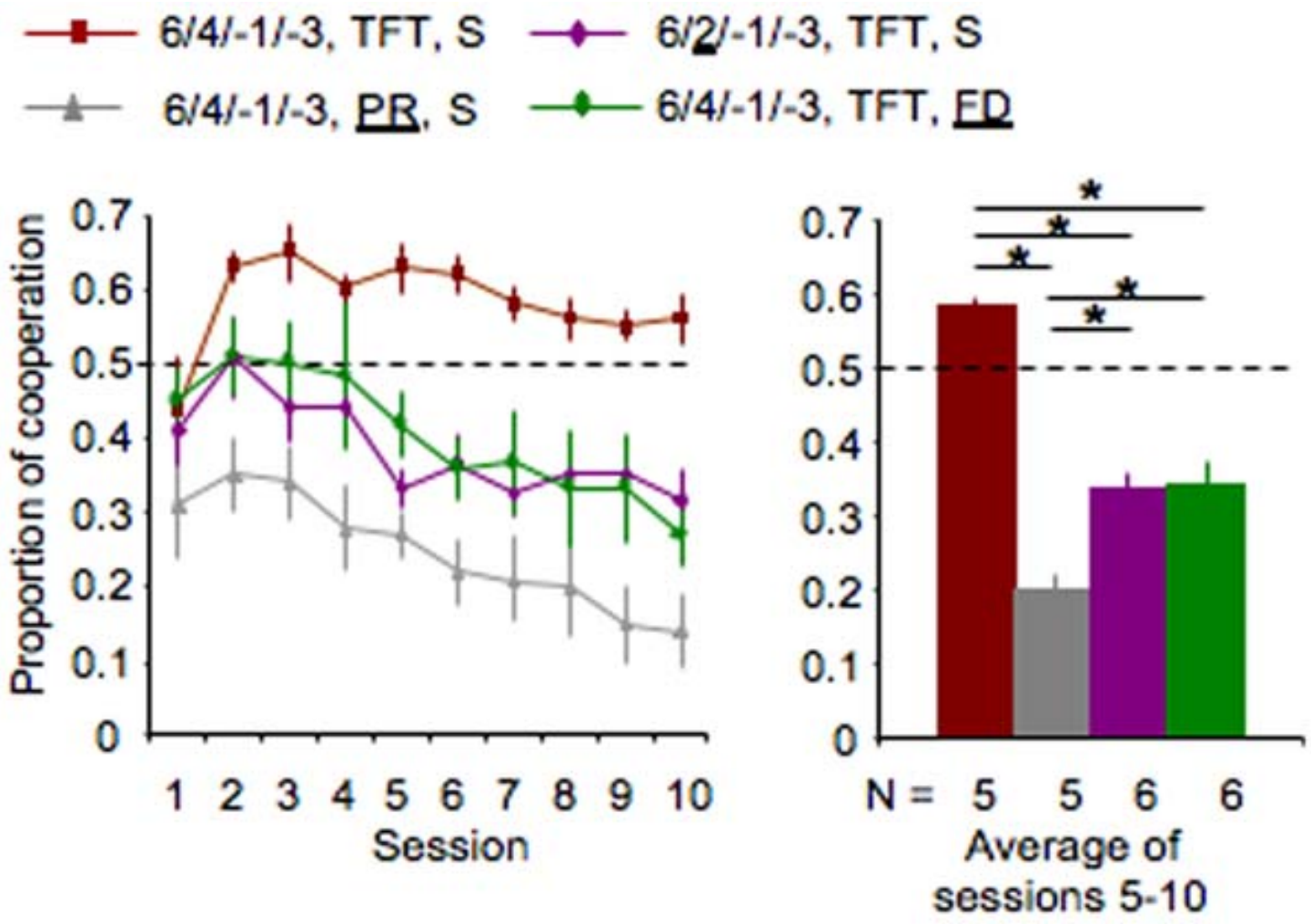




Tips for Graphs

- Tell a quick visual story
- Keep it simple!
- Make it easy to distinguish groups (e.g., triangles vs. circles vs. squares is not easy!)
- If it's too complex, maybe it belongs in a table

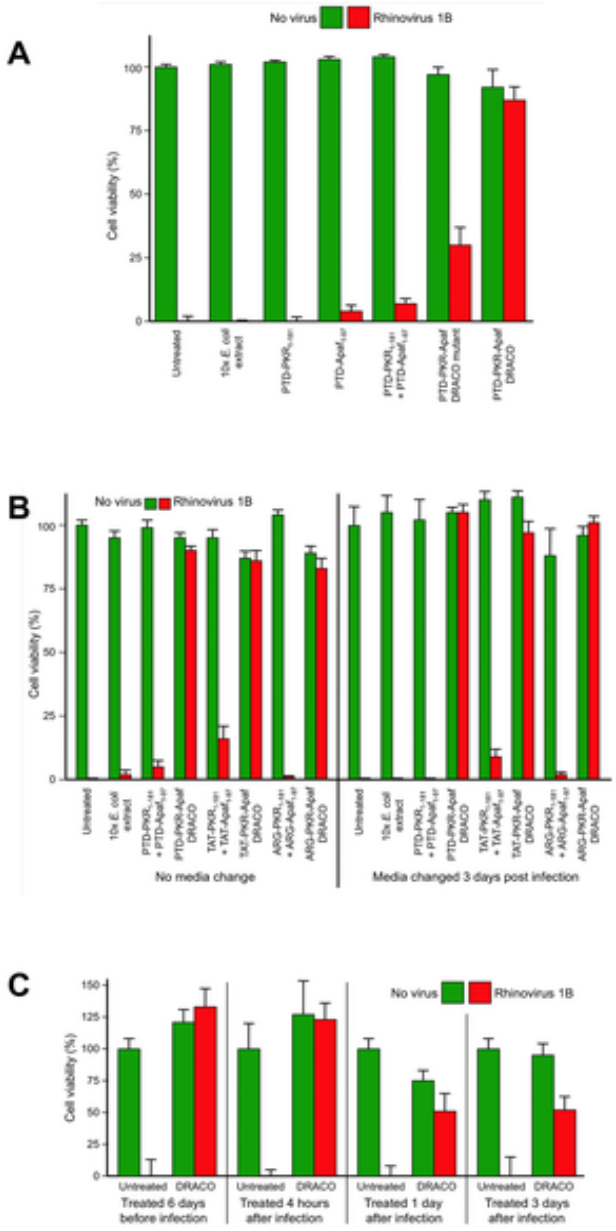
Figure 5. Cooperation levels vary with the different iPD games.



Viana DS, Gordo I, Sucena É, Moita MAP (2010) Cognitive and Motivational Requirements for the Emergence of Cooperation in a Rat Social Game. PLoS ONE 5(1): e8483. doi:10.1371/journal.pone.0008483
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0008483

PLoS one

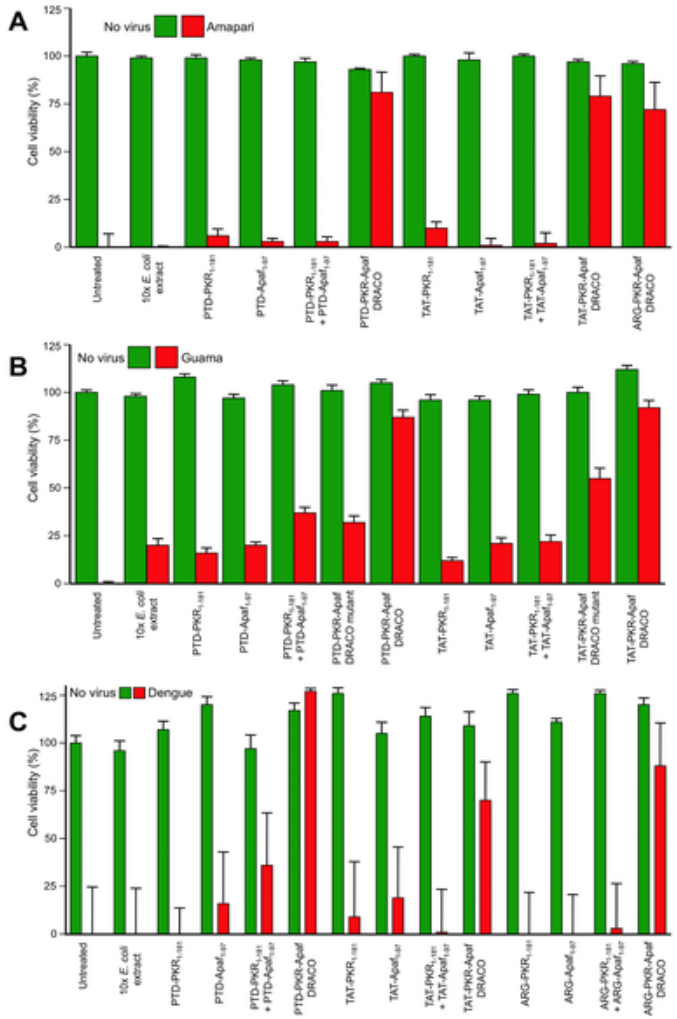
Figure 4. DRACOs were effective against rhinovirus 1B in NHLF cells.



Rider TH, Zook CE, Boettcher TL, Wick ST, et al. (2011) Broad-Spectrum Antiviral Therapeutics. PLoS ONE 6(7): e22572. doi:10.1371/journal.pone.0022572
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0022572

PLoS one

Figure 8. DRACOs were effective against arenaviruses, bunyaviruses, and flaviviruses.



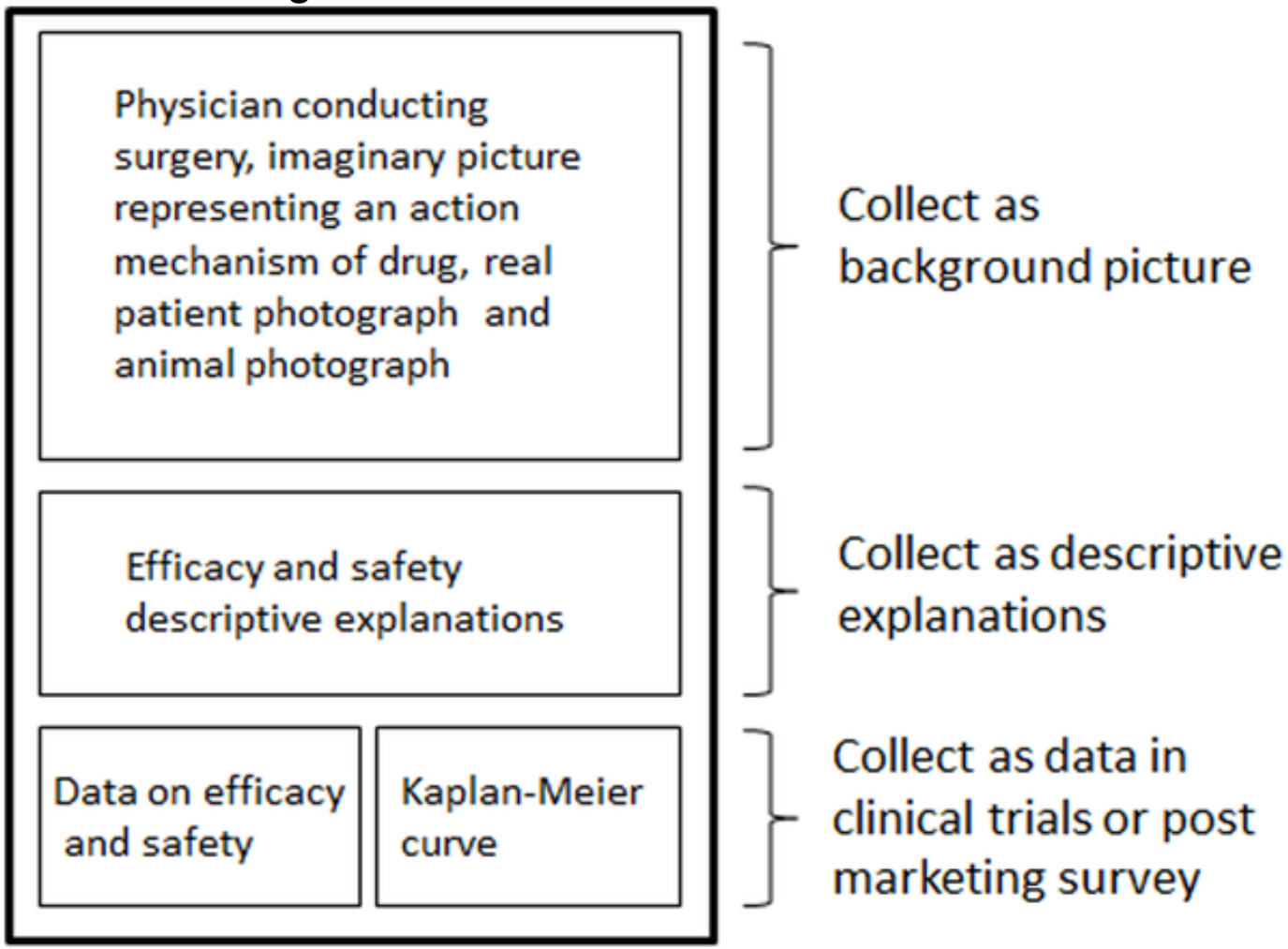
Rider TH, Zook CE, Boettcher TL, Wick ST, et al. (2011) Broad-Spectrum Antiviral Therapeutics. PLoS ONE 6(7): e22572. doi:10.1371/journal.pone.0022572
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0022572

PLoS one

Diagrams and Drawings

- illustrate an experimental set-up or work-flow
- indicate flow of participants
- illustrate cause and effect relationships or cycles
- give a hypothetical model
- represent microscopic particles or microorganisms as cartoons

- **Figure 1. Example of the content of a typical print advertisement for a pharmaceutical drug and the data collection method.**



Yonemori K, Hirakawa A, Ando M, Hirata T, et al. (2012) Content Analysis of Oncology-Related Pharmaceutical Advertising in a Peer-Reviewed Medical Journal. PLoS ONE 7(8): e44393. doi:10.1371/journal.pone.0044393
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0044393

PLoS one

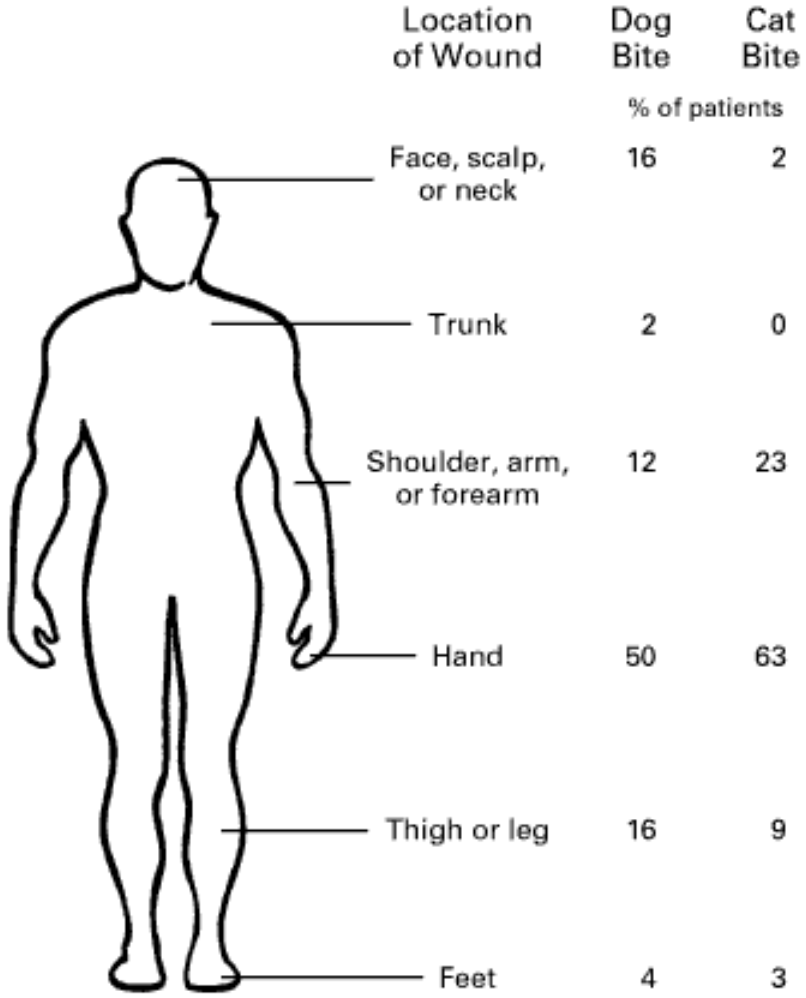
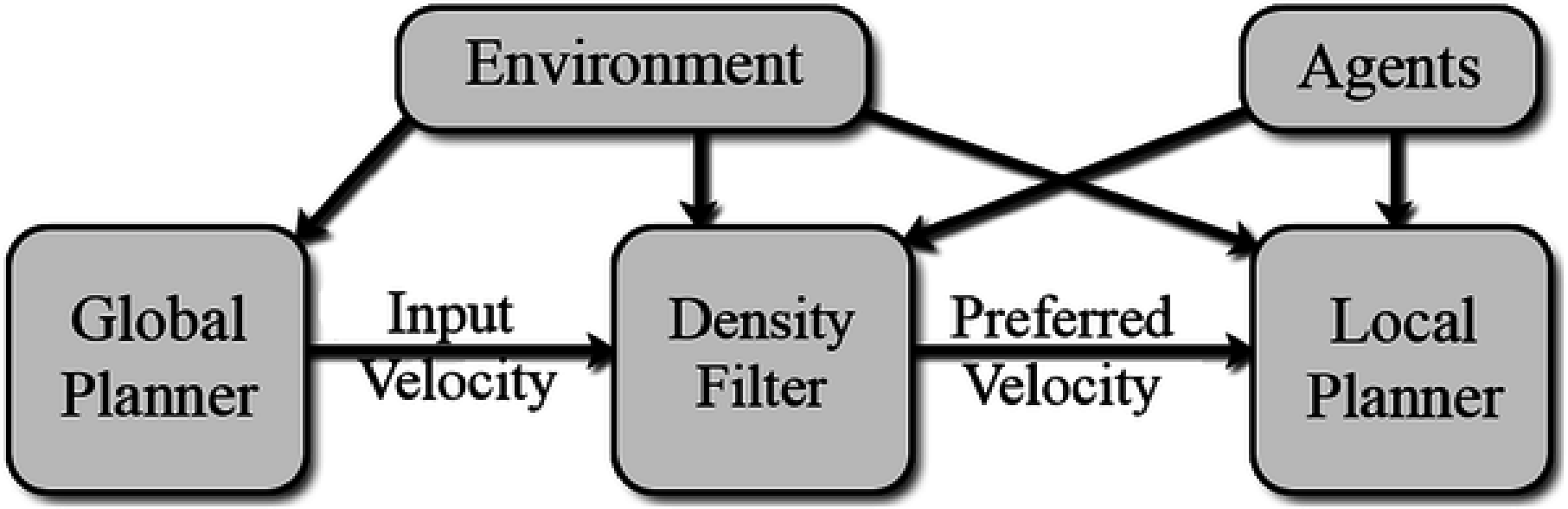


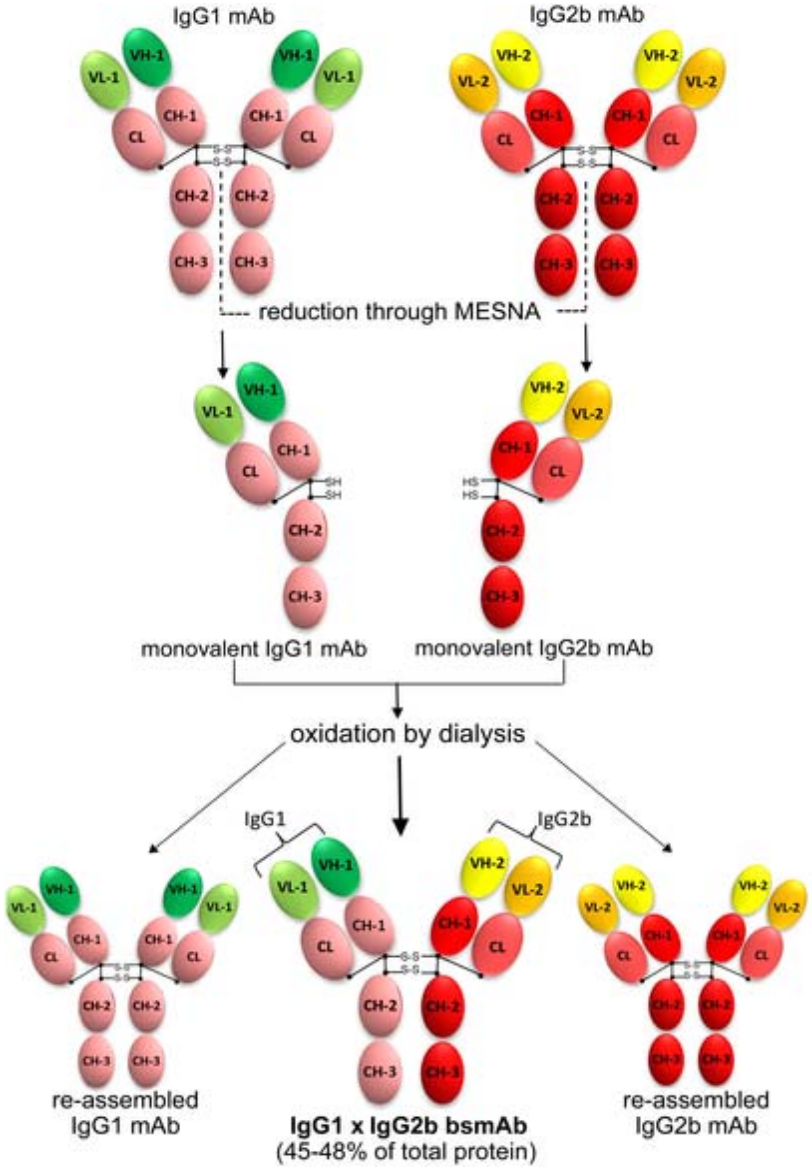
Figure 1. Location of Wound Infections in 50 Patients Bitten by Dogs and 57 Patients Bitten by Cats.

Reprinted with permission from: *NEJM* Talan et al. 340 (2): 85;January 14, 1999

Fig 2. System Architecture.



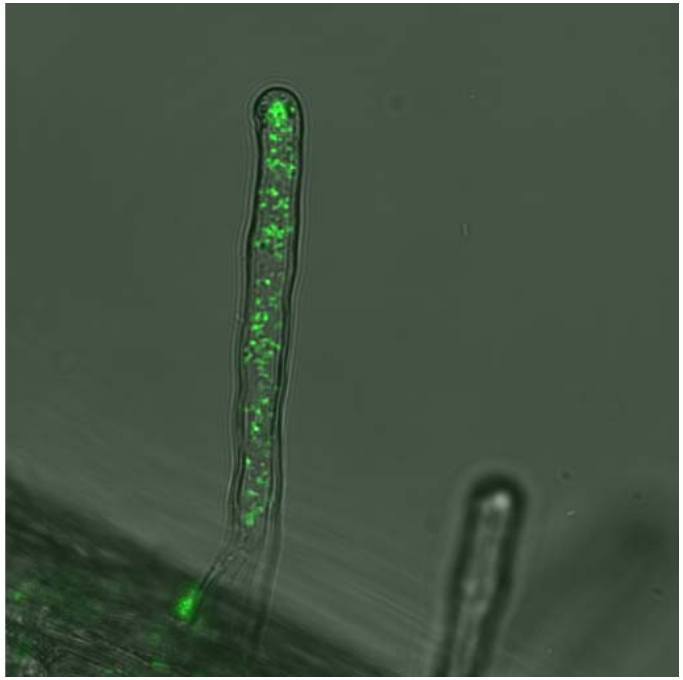
Narang S, Best A, Curtis S, Manocha D (2015) Generating Pedestrian Trajectories Consistent with the Fundamental Diagram Based on Physiological and Psychological Factors. PLOS ONE 10(4): e0117856. doi:10.1371/journal.pone.0117856
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0117856



Zito A, Bromuro C, Mandili G, Chiani P, Horenstein AL, et al. (2016) A Murine, Bispecific Monoclonal Antibody Simultaneously Recognizing β-Glucan and MP65 Determinants in Candida Species. PLOS ONE 11(2): e0148714. doi:10.1371/journal.pone.0148714
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0148714

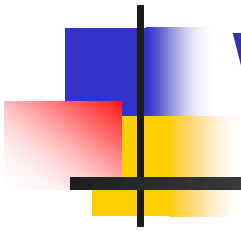
Besides tables and figures… Movies!

- Allowed as supplemental material.



Paungfoo-Lonhienne C, Rentsch D, Robatzek S, Webb RI, et al. (2010) Turning the Table: Plants Consume Microbes as a Source of Nutrients. PLoS ONE 5(7): e11915. doi:10.1371/journal.pone.0011915
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0011915

PLoS one



Writing in the Sciences

Unit 5.2: Results

Results ≠ Raw Data

- The results section should:
  - *Summarize* what the data show
    - Point out simple relationships
    - Describe big-picture trends
    - Cite figures or tables that present supporting data
  - Avoid simply repeating the numbers that are already available in tables and figures.

Examples

"Over the course of treatment, topiramate was significantly more effective than placebo at improving drinking outcomes on drinks per day, drinks per drinking day, percentage of heavy drinking days, percentage of days abstinent, and log plasma -glutamyl transferase ratio (Table 3)."

"The total suicide rate for Australian men and women did not change between 1991 and 2000 because marked decreases in older men and women (Table 1) were offset by increases in younger adults, especially younger men.[7]"

Arch Intern Med. 2008;168(11):1188-1199;
BMJ. 2003 May 10; 326(7397): 1008.

Hypothetical Example

Table 1. Descriptive characteristics of the study groups, means ± SD or N (%).

Characteristic	Bad Witches	Good Witches
N	13	12
Age (yrs)	45 ± 5	36 ± 6*
Female	11 (85%)	10 (83%)
BMI (kg/m²)	21 ± 6	23 ± 3
Systolic BP (mmHg)	140 ± 10	120 ± 9*
Exercise (min/day)	30 ± 20	60 ± 30*
Employment status		
Unemployed	4 (31%)	0 (0%)
Part time	3 (23%)	4 (33%)
Full time	6 (46%)	8 (66%)
Smoker (yes/no)	6 (50%)	0 (0%)*

*p<.05, ttest or Fisher's exact test, as appropriate.

The characteristics of the bad witches and the good witches are shown in Table 1. There was a significant difference in age between the groups. The mean age of the bad witches was 45 ± 5; and the mean age of the good witches was 36 ± 6. There was no significant difference in gender between the groups, with the bad witches having 85% females and the good witches having 83% females. BMI was not significantly different between the groups, which both had normal BMIs. Systolic blood pressure and exercise were significantly different. The bad witches had a mean blood pressure of 140 ± 10, whereas the good witches had a mean blood pressure of 120 ± 9. Estimated daily exercise was higher in the good witches (60 ± 30) than the bad witches (30 ± 20). Employment was not significantly different between the two groups…

Edited version…

Original:

The characteristics of the bad witches and the good witches are shown in Table 1. There was a significant difference in age between the groups. The mean age of the bad witches was 45 ± 5; and the mean age of the good witches was 36 ± 6. There was no significant difference in gender between the groups, with the bad witches having 85% females and the good witches having 83% females. BMI was not significantly different between the groups, which both had normal BMIs. Systolic blood pressure and exercise were significantly different. The bad witches had a mean blood pressure of 140 ± 10, whereas the good witches had a mean blood pressure of 120 ± 9. Estimated daily exercise was higher in the good witches (60 ± 30) than the bad witches (30 ± 20). Employment was not significantly different between the two groups…

Revised:

The witches were, on average, lean and predominantly female (Table 1). Bad witches were significantly older, had higher blood pressures, exercised less, and were more likely to smoke than good witches. More bad witches were unemployed, but this difference did not reach statistical significance.

Tips for writing Results

- **Break into subsections, with headings (if needed)**
- **Complement the information that is already in tables and figures**
  - **Give precise values that are not available in the figure**
  - **Report the percent change or percent difference if absolute values are given in the table**
- **Repeat / highlight only the most important numbers**

Tips for writing Results

- **Don’t forget to talk about negative and control results**
- **Reserve the term “significant” for statistically significant**
- **Reserve information about what you did for the methods section**
  - **In particular, do not discuss the rationale for statistical analyses within the Results section.**
- **Reserve comments on the meaning of your results for the discussion section**

What verb tense do I use?

***Use past tense for completed actions:**

We found that…
The average reaction time was…
Women were more likely to…
Men smoked more cigarettes than…

***Use the present tense for assertions that continue to be true, such as what the tables show, what you believe, and what the data suggest:**

Figure 1 shows…
The findings confirm…
The data suggest…
We believe that this shows…

Example: verb tense

Example:

Information was available for 7766 current cigarette smokers. Of these, 1216 (16%) were classified as hardcore smokers. Table 1 gives characteristics of all the smokers. The most striking difference was that hardcore smokers were about 10 years older on average and tended to be more dependent on tobacco. Significantly more hardcore smokers had manual occupations, lived in rented accommodation, and had completed their full time education by the age of 16 years. There was no difference by sex.

Jarvis et al. Prevalence of hardcore smoking in England, and associated attitudes and beliefs: cross sectional study *BMJ* 2003;326:1061 (17 May)

Use the active voice!

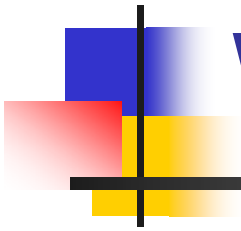
- **More lively!**
- **Since you can talk about the subjects of your experiments, “we” can be used sparingly while maintaining the active voice!**

Use the active voice!

Differences in attitudes and beliefs by level of dependence

To test whether it was appropriate to exclude a measure of cigarette dependence from our criteria for defining hardcore smoking, we compared attitudes and beliefs by dependence in hardcore and other smokers (table 4). For most items, beliefs were similar in low and high dependence hardcore smokers but strikingly different from those of other smokers. For example, almost 60% of both low and high dependency non-hardcore smokers agreed that improved health would be a major benefit from quitting whereas among hardcore smokers only 27% of low dependency and 32% of high dependency smokers agreed. Similar differentiation in beliefs by hardcore smoking status, but not dependence level, emerged for other items, especially those related to health.

Jarvis et al. Prevalence of hardcore smoking in England, and associated attitudes and beliefs: cross sectional study
***BMJ* 2003;326:1061 (17 May)**



Writing in the Sciences

Unit 5.3: Practice writing results

TABLE 2. Summary of running during pregnancy and breastfeeding.

Running during pregnancy and breastfeeding	Mean± SD or Percent (n)
Ran ever during pregnancy	77 (70.0%)
Ran during the first trimester	69 (62.7%)
Ran during the second trimester	57 (51.8%)
Ran during the third trimester	34 (30.9%)
Ran while breastfeeding*	90 (84.1%)
Time to resume running post-partum**	
<1 week	6 (5.7%)
1-2 weeks	18 (17.2%)
3-4 weeks	23 (21.9%)
5-7 weeks	26 (24.8%)
2-6 months	20 (19.1%)
>6 months	12 (11.4%)
Running during pregnancy (n=77):	
Average weekly mileage	20.3 ± 9.3
Average running intensity (percent of normal)	47.9% ± 21.0%
Sustained a running injury	3 (3.9%)

The majority of runners ran during pregnancy (70.0%, 77/110), with 62.7% running during the first trimester, 51.8% during the second trimester, and fewer than one third (30.9%) during the third trimester (Table 2). From the 77 women who ran during pregnancy, we observed the average weekly mileage during pregnancy for those who ran to be 20.3 ± 9.3 miles. Average running intensity was reported to be 47.9% ± 21.0% as a percent of non-pregnant running effort. A small number (3.9%, 3/77) reported sustaining a running injury while pregnant. About a quarter (24.8%) waited 5-7 weeks to resume running post-partum. A small fraction (5.7%) resumed running less than a week after giving birth. Some women (11.4%) waited more than six months post-partum to resume running.

Running during pregnancy and breastfeeding	or Percent (n)
Ran ever during pregnancy	77 (70.0%)
Ran during the first trimester	69 (62.7%)
Ran during the second trimester	57 (51.8%)
Ran during the third trimester	34 (30.9%)
Ran while breastfeeding*	90 (84.1%)
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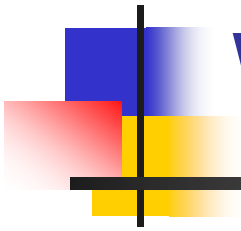


Writing in the Sciences

Unit 5.4: Methods

Methods and Materials

- Give a clear overview of what was done
- Give enough information to replicate the study (like a recipe!)
- Be complete, but make life easy for your reader!

1. Break into smaller sections with subheadings
2. Cite a reference for commonly used methods
3. Display in a flow diagram or table where possible

- You *may* use jargon and the passive voice more liberally in the methods section

Who, what, when, where, how, and why…

Table 1.

Who, what, when, where, how, and why questions to consider when writing the Methods section.

Who
Who maintained the records? Who reviewed the data? Who collected the specimens? Who enrolled the study participants? Who supplied the reagents? Who made the primary diagnosis? Who did the statistical analyses? Who reviewed the protocol for ethics approval? Who provided the funding?
What
What reagents, methods, and instruments were used? What type of study was it? What were the inclusion and exclusion criteria for enrolling study participants? What protocol was followed? What treatments were given? What endpoints were measured? What data transformation was performed? What statistical software package was used? What was the cutoff for statistical significance? What control studies were performed? What validation experiments were performed?
When
When were specimens collected? When were the analyses performed? When was the study initiated? When was the study terminated? When were the diagnoses made?
Where
Where were the records kept? Where were the specimens analyzed? Where were the study participants enrolled? Where was the study performed?
How
How were samples collected, processed, and stored? How many replicates were performed? How was the data reported? How were the study participants selected? How were patients recruited? How was the sample size determined? How were study participants assigned to groups? How was response measured? How were endpoints measured? How were control and disease groups defined?
Why
Why was a species chosen (mice vs rats)? Why was a selected analytical method chosen? Why was a selected experiment performed? Why were experiments done in a certain order?

Reprinted, with permission, from: Annesley TM. Who, what, when, where, how, and why: The ingredients in the recipe for a successful methods section. *Clinical Chemistry*. June 2010 vol. 56 no. 6, 897-901.

Materials and Methods

- **Materials**
  - **Drugs, buffers, chemicals, gases, reagents, cell lines, etc.**
- **Participants/subjects**
  - **Animals (state that the research was approved by the appropriate committee at your institution)**
  - **Humans (state that the research was approved by the appropriate committee at your institution)**
- **Experimental protocol/study design**
- **Measurements**
  - **How were the dependent and independent variables measured**
    - **Instruments (telescope, microscope, weighing scale, questionnaire, etc.)**
- **Analyses**

Make life easy for your reader!

1. Break into sub-sections with informative subheadings

Example subheadings

METHODS

- **General Approach**
- **Biosafety**
- **Isolation of Virus**
- **Serologic Analysis**
- **Pathological and Immunohistochemical Studies**
- **Molecular Analyses**

e.g., Ksiazek et al. A Novel Coronavirus Associated with Severe Acute Respiratory Syndrome
NEJM 348:1953-1966, May 15, 2003

Example subheadings

METHODS

- **Subjects and experimental protocols**
- **Hardware**
- **GPS data processing**
- **Wind**

Sachs G, Traugott J, Nesterova AP, Dell'Omo G, et al. (2012) Flying at No Mechanical Energy Cost: Disclosing the Secret of Wandering Albatrosses. PLoS ONE 7(9): e41449. doi:10.1371/journal.pone.0041449
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0041449

Example subheadings

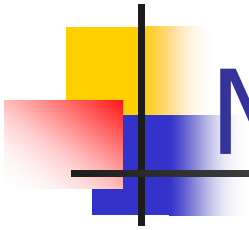
MATERIALS AND METHODS

- **Cell culture and transfections**
- **Antibodies**
- **Plasmids**
- **Recombinant virus production and infection**
- **Metabolic labeling and immunoprecipitation**
- **Immunoblotting**
- **Subcellular fractionation**
- **Electron microscopy**

The Journal of Cell Biology, Volume 161, Number 3, 521-533

Proprotein convertase cleavage liberates a fibrillogenic fragment of a resident glycoprotein to initiate melanosome biogenesis

Joanne F. Berson1, Alexander C. Theos1, Dawn C. Harper1, Danielle Tenza2, Graça Raposo2 and Michael S. Marks1



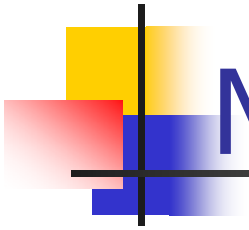
Make life easy for your reader!

2. Cite a reference for commonly used methods or previously used methods rather than explaining all the details…

Cite commonly/previously used methods

Each peptide was covalently coupled to agarose (AminoLink Kit, Pierce Chemical), and 30-to-200-ml quantities of each crude polyclonal antiserum were affinity-purified with the use of the appropriate immobilized peptide, ***as previously described.***[13]

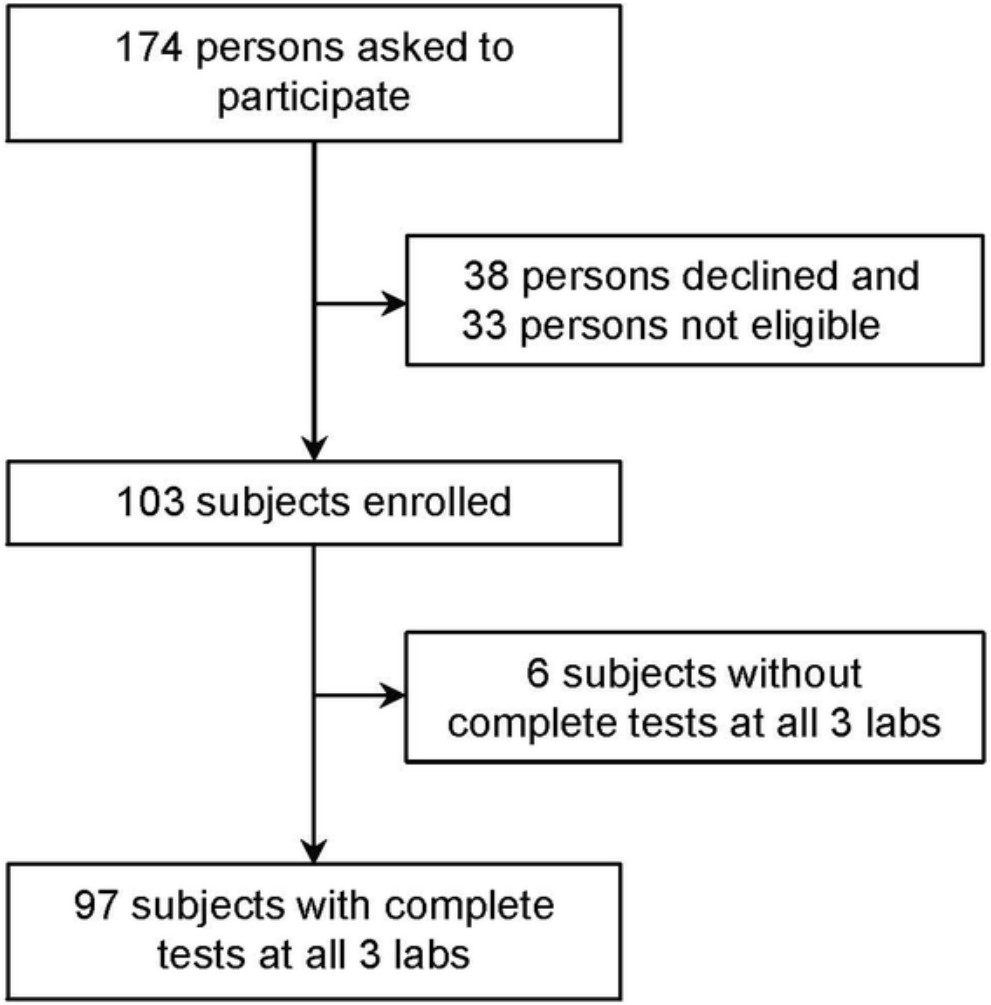
Immunoprecipitations, SDS-PAGE on 10% polyacrylamide gels, and phosphorimaging analysis were performed **as described previously** (Berson et al., 2000).



Make life easy for your reader!

3. Use flow diagrams or tables to help simplify explanations of methods!

Figure 1. Study participation diagram.



Whitworth WC, Hamilton LR, Goodwin DJ, Barrera C, et al. (2012) Within-Subject Interlaboratory Variability of QuantiFERON-TB Gold In-Tube Tests. PLoS ONE 7(9): e43790. doi:10.1371/journal.pone.0043790
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0043790

Verb tense

Report methods in past tense (“we measured”),

But use present tense to describe how data are presented in the paper (“data are summarized as means ± SD”)

It's OK to use passive voice (or even to use a combination)!

Passive:

E.g., Oral temperatures were measured.

Emphasizes the method or variable.

Active:

E.g., We measured oral temperatures

More lively, but sacrifices having the material/method/variable as the subject of the sentence

Requires creativity to avoid starting every sentence with We!

Passive voice and jargon are OK!

Peptides were synthesized by the Biopolymer Core Facility, Massachusetts General Hospital, Boston. Peptides representing portions of the FGF-23 precursor — [Cys70]FGF-23(51–69)amide, [Tyr185] FGF-23(186–206)amide, [Tyr223]FGF-23(206–222)amide, and [Tyr224]FGF-23(225–244)amide — were coupled to keyhole limpet hemocyanin, emulsified with complete Freund's adjuvant, and used for subcutaneous immunization of eight goats (with approximately 100 µg per animal); each…

From Jonsson et al. Fibroblast Growth Factor 23 in Oncogenic Osteomalacia and X-Linked Hypophosphatemia NEJM 348:1656-1663; April 24, 2003.

Active voice can work well too!

- We assessed the number of spam emails received in each collection phase. Detailed analysis was undertaken of spam received in April 2014, June 2014, and April 2015. The investigators rated their spam invitations as being of no, low, medium, or high relevance to their academic careers. We determined the number of duplicate spam invitations. When possible, we recorded the publisher for journal invitations and organising body for conference invitations. Finally, we conducted a qualitative analysis, focusing on memorable spam.

BMJ 2016;355:i5383

Academic spam

This message was sent with high importance.

Action Items

Dear Dr. Kristin Sainani,

Greetings for the day!!
Hope you are doing well.

With support of editorial board members and organizing committee we would like welcome y
International Conference on Case Reports" during **October 16-18, 2017** at **San Francisc**

We wish if you could join as a Keynote Speaker at this grand event. ICMCR 2017 will lay a
experts across the globe to discuss on the current research work in the field of healthcare.

The main theme for this year is *"Sharing the Reason behind Patients Happiness of Well Bein*

Why to attend?
CME Approved
Accepted abstracts will be available online at the ICMCR-2017 website

Please take some time to have a look on the Conference website: https://goo.gl/hQ1qHZ

We would be pleased and honoured if you would consent to speak at this international Event.

Dear Dr. Kristin L Sainani,

Journal of Behavior Therapy and Mental Health
ISSN: 2474-9273

This 2017, may you output the best papers of your career and get the best number of citations. We sincerely hope this to be true and many more good things happen to you in this year.

With new challenges and new aspirations ahead, fueling our dreams and achieving great heights are not that impossible. Finding proper way to do things make it absolutely possible. Submitting a paper to JBTM is one such great way to present your research work to the scientific community. You can connect with the larger group of researchers, and gain recognition for yourself and your research work internationally.

With 14 days rapid review we offer time bound publishing with quality peer review. It is possible since our editors and reviewers are dedicated to their interest in the field and are always willing to make time. Moreover, we do have ample of editors and reviewers on hand pertaining to various specialties, so that none of them are overwhelmed. Attributing significant importance to the work of deserving authors in time is very much necessary in this digital era.

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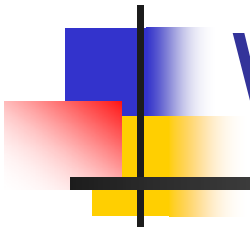


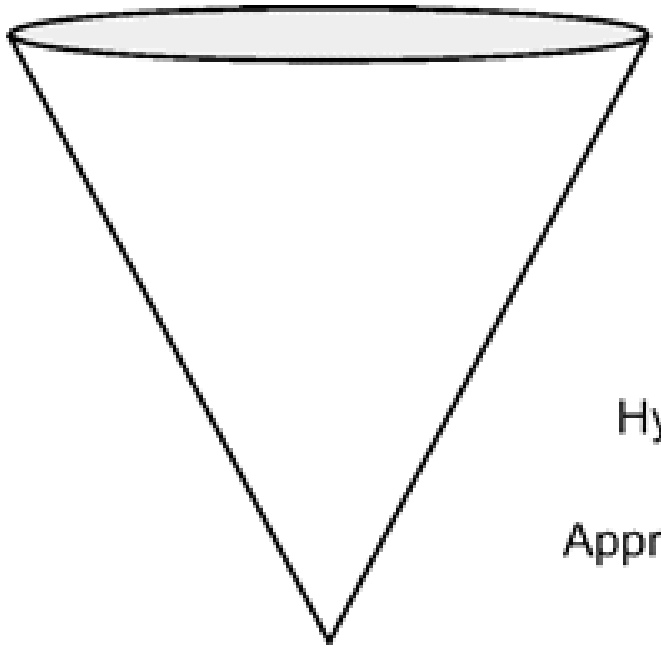
Writing in the Sciences

Unit 5.5: Introduction

Introduction

- Good News: The introduction is easier to write than you may realize!
- Follows a fairly standard format
- Typically 3 paragraphs long
  - Recommended range: 2 to 5
- It is **not** an exhaustive review of your general topic
  - should focus on the specific hypothesis/aim of your study

Introduction



Background, known information

Knowledge gap, unknown information

Hypothesis, question, purpose statement

Approach, plan of attack, proposed solution

Reproduced with permission from: Annesley TM. "It was a cold and rainy night." Set the scene with a good introduction. *Clinical Chemistry*. May 2010 56: 708-713. (Figure 1)

Introduction

1. What's known
2. What's unknown
   - limitations and gaps in previous studies
3. Your burning question/hypothesis/aim
4. Your experimental approach
5. Why your experimental approach is new and different and important (fills in the gaps)

Mimi Zeiger. *Essentials of Writing Biomedical Research Papers*, McGraw Hill Professional, 1999

Corresponds to roughly 3 paragraphs…

1. What's known

≈ Paragraph 1

2. What's unknown
   - limitations and gaps in previous studies

≈ Paragraph 2

3. Your burning question
4. Your experimental approach
5. Why your experimental approach is new and different and important (fills in the gaps)

≈ Paragraph 3

Tips for writing an Introduction

- Keep paragraphs short
- Write for a general audience
  - clear, concise, non-technical
- Take the reader step by step from what is known to what is unknown. End with your specific question.
  - Known→Unknown→Question/hypothesis
- Emphasize how your study fills in the gaps (the unknown)
- Explicitly state your research question/aim/hypothesis:
  - "We asked whether"; "Our hypothesis was"; "We tested the hypothesis that"; "Our aim/s were"
- Do not answer the research question (no results or implications).
- Summarize at a high level! Leave detailed descriptions, speculations, and criticisms of particular studies for the discussion.

Introduction, Example

- Unsolicited and unwanted (spam) electronic invitations to speak at or attend conferences, or to write for or edit journals are a burgeoning aspect of academic life. Colleagues regard such invitations with wry amusement, intense frustration, or resignation. Two of us (AG, ND) have reviewed travel grant applications from colleagues who received spam invitations to give conference presentations.
- Few studies have focused on academic spam. In the Academic Spam Study we investigated the amount, relevance, content, and suppressibility of academic spam emails.

BMJ 2016;355:i5383

Introduction, Example

The relations between excess body weight and mortality, not only from all causes but also from cardiovascular disease, are well established.[1,2,3,4,5,6] Although we have known for some time that excess weight is also an important factor in death from cancer,[7] our knowledge of the magnitude of the relation, both for all cancers and for cancers at individual sites, and the public health effect of excess weight in terms of total mortality from cancer is limited. Previous studies have consistently shown associations between adiposity and increased risk of cancers of the endometrium, kidney, gallbladder (in women), breast (in postmenopausal women), and colon (particularly in men).[8,9,10,11,12] Adenocarcinoma of the esophagus has been linked to obesity.[11,13,14] Data on cancers of the pancreas, prostate, liver, cervix, and ovary and on hematopoietic cancers are scarce or inconsistent.[7,8,9,10,11,15,16,17] The lack of consistency may be attributable to the limited number of studies (especially those with prospective cohorts), the limited range and variable categorization of overweight and obesity among studies, bias introduced by reverse causality with respect to smoking-related cancers, and possibly real differences between the effects of overweight and obesity on the incidence of cancer and on the rates of death from some cancers.[18,19]

We conducted a prospective investigation in a large cohort of U.S. men and women to determine the relations between body-mass index (the weight in kilograms divided by the square of the height in meters) and the risk of death from cancer at specific sites. This cohort has been used previously to examine the association of body-mass index and death from any cause.[5]

Eugenia E. Calle, Ph.D., Carmen Rodriguez, M.D., M.P.H., Kimberly Walker-Thurmond, B.A., and Michael J. Thun, M.D. Overweight, Obesity, and Mortality from Cancer in a Prospectively Studied Cohort of U.S. Adults. N Engl J Med 2003; 348:1625-1638.

What's known

What's unknown

The relations between excess body weight and mortality, not only from all causes but also from cardiovascular disease, are well established.[1,2,3,4,5,6] Although we have known for some time that excess weight is also an important factor in death from cancer,[7] our knowledge of the magnitude of the relation, both for all cancers and for cancers at individual sites, and the public health effect of excess weight in terms of total mortality from cancer is limited. Previous studies have consistently shown associations between adiposity and increased
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"This study will answer the question with better methods."

We conducted a prospective investigation in a large cohort of U.S. men and women to determine the relations between body-mass index (the weight in kilograms divided by the square of the height in meters) and the risk of death from cancer at specific sites. This cohort has been used previously to examine the association of body-mass index and death fro

Gaps/limitations of previous studies

Introduction Example

Exogenous estrogens prevent or substantially retard the decrease in bone mineral density (BMD) that accompanies menopause [1]. However, it is unclear whether exogenous estrogens, administered as oral contraceptives (OCs), can modify premenopausal BMD. Several studies suggest that exposure to OCs during the premenopausal years has a favorable effect on BMD [2-10], whereas other studies show no effect [11-18].

Past studies of the relationship between OC use and BMD have several limitations. Studies have focused primarily on crude measures of OC use, such as current, past and never. These categories combine diverse types of OC use and may reduce the power to detect an effect. Many studies also failed to take into account lifestyle characteristics of study participants. Finally, few studies have considered an effect of OCs on BMD in women of races other than white.

The aim of this study was to evaluate the associations of OCs with spine, hip and whole body BMD in black and white premenopausal women. Our primary hypothesis was that there would be an association between cumulative exposure to estrogen from OCs and BMD.

Osteoporos Int. **2002 Nov;13(11):893-900.**

Gaps in previous research

The lit. review

What's known

What's unknown/the research question

Exogenous estrogens prevent or substa[illegible]crease in bone mineral density (BMD) that accompanies menopause [1]. However, it is unclear whether exogenous estrogens, administered as oral contraceptives (OCs), can modify premenopausal BMD. Several studies suggest that exposure to OCs during the premenopausal years has a favorable effect on BMD [2-10], whereas other studies show no effect [11-18].

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This study

The aim of this study was to evaluate the associations of OCs with spine, hip and whole body BMD in black and white premenopausal women. Our primary hypothesis was that there would be an association between cumulative exposure to estrogen from OCs and BMD.

Writing in the Sciences

Unit 5.6: Introduction Practice

Introduction Practice Exercise

Identify sentences that give:

1. The "what's known" or background
2. The "what's unknown" or gaps and limitations
3. The aims and approach of this specific study

- Mass media in the form of television, radio and printed material are frequently used to deliver medical information to the public. Research suggests that mass media can improve public knowledge1 and potentially improve health behaviors.2 Television is one of the most important mass media sources of health information.3 4 However, concerns have been raised about the quality, completeness and accuracy of medical information covered in the news media,5 6 7 8 and television news media is no exception.7 8 The quality of information outside of the news media has not been examined.
- According to Nielsen's report, American citizens spend an average of over five hours a day watching television.9International health information programs, such as *The Dr Oz Show* and *The Doctors* have become a regular part of television broadcasting. In the 2012-13 season, *The Dr Oz Show* was consistently ranked in the top five talk shows in America with an average of 2.9 million viewers per day, while *The Doctors* had a high of 2.3 million viewers.10 11 In the 2012 Greatist report, Dr Mehmet Oz and Dr Travis Stork (one of the hosts of *The Doctors*) were both included in the top 100 health and fitness influencers.12
- Popular television talk shows such as *The Dr Oz Show* often engender skepticism and criticism from medical professionals.13 14 15 However, no research has systematically examined the content of the medical information provided on these talk shows. Our objective was to review the most popular medical talk shows on television, to (1) determine the type of recommendations and claims given and the details provided, and (2) search for and evaluate the evidence behind these recommendations.

BMJ 2014;349:g7346

Background/What's known

- **Mass media in the form of television, radio and printed material are frequently used to deliver medical information to the public. Research suggests that mass media can improve public knowledge[1] and potentially improve health behaviors.[2] Television is one of the most important mass media sources of health information.[3] [4] However, concerns have been raised about the quality, completeness and accuracy of medical information covered in the news media,[5] [6] [7] [8] and television news media is no exception.[7] [8]** The quality of information outside of the news media has not been examined.
- **According to Nielsen's report, American citizens spend an average of over five hours a day watching television.[9] International health information programs, such as *The Dr Oz Show* and *The Doctors* have become a regular part of television broadcasting. In the 2012-13 season, *The Dr Oz Show* was consistently ranked in the top five talk shows in America with an average of 2.9 million viewers per day, while *The Doctors* had a high of 2.3 million viewers.[10] [11] In the 2012 Greatist report, Dr Mehmet Oz and Dr Travis Stork (one of the hosts of *The Doctors*) were both included in the top 100 health and fitness influencers.[12]**
- **Popular television talk shows such as *The Dr Oz Show* often engender skepticism and criticism from medical professionals.[13] [14] [15]** However, no research has systematically examined the content of the medical information provided on these talk shows. Our objective was to review the most popular medical talk shows on television, to (1) determine the type of recommendations and claims given and the details provided, and (2) search for and evaluate the evidence behind these recommendations.

What's unknown

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Our Study

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Introduction Practice Exercise

- Scholarly publications are among the most important indicators of academic achievement. While the quantity of papers authored certainly matters, simple publication count is not the only important metric. The reputation of the journal in which a paper is published (often gauged using impact factors), along with the number of citations that a paper receives (i.e., other articles that reference that particular work), are together often seen as proxies for a publication's importance and influence.
- Self-citation may have a consequential impact on scholarly careers by both directly and indirectly increasing an author's citation counts. Each additional self-citation yields an additional three citations (though not necessarily to the same paper) from other scholars over a five-year period (Fowler and Aksnes 2007). Given the importance of metrics of scholarly influence in academic hiring, tenure and salary decisions, examining gender differences in citation patterns may shed light on persisting gender discrepancies in faculty hiring and promotion. More broadly, academic publishing provides an illustrative case for gender differences in evaluation metrics and workplace advancement.
- Papers authored by women receive fewer citations than do papers by men, even controlling for tenure status, institution, and journal (Larivière et al. 2013). Fewer citations to female-authored papers could be due in part to gender differences in self-citations (when an author cites his or her own previously published work). Research analyzing 12 journals in the field of international relations from 1986-2000 showed men cite their own papers more than one and a half times as often as women (Maliniak, Powers, and Walter 2013).
- To date, studies of self-citation have been few in number and confined to a limited number of disciplines and a relatively small number of papers. Here we examine gender differences in self-citations across 24 broad academic fields with hundreds of subfields and several million scholarly papers, with over a million self-citations. We further examine how the gender ratio self-citation patterns changed over time.

King MM et al. Men set their own cites high: Gender and self-citation across fields and over time, Sept 2016

What's known

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- **Papers authored by women receive fewer citations than do papers by men, even controlling for tenure status, institution, and journal (Larivière et al. 2013). Fewer citations to female-authored papers could be due in part to gender differences in self-citations (when an author cites his or her own previously published work). Research analyzing 12 journals in the field of international relations from 1986-2000 showed men cite their own papers more than one and a half times as often as women (Maliniak, Powers, and Walter 2013).**

What's unknown

- To date, studies of self-citation have been few in number and confined to a limited number of disciplines and a relatively small number of papers.

Our study

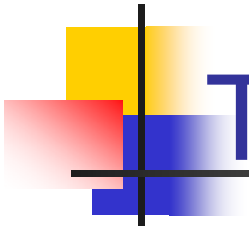
- Here we examine gender differences in self-citations across 24 broad academic fields with hundreds of subfields and several million scholarly papers, with over a million self-citations. We further examine how the gender ratio self-citation patterns changed over time.

Writing in the Sciences

Unit 5.7: Discussion

The Discussion section…

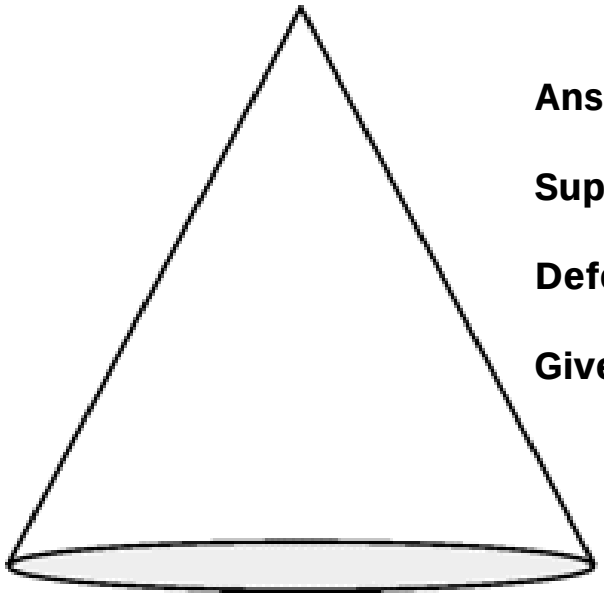
- Gives you the most freedom
- Gives you the most chance to put good writing on display
- Is the most challenging to write



The Discussion

Follow your rules for good writing!

Invert the cone!



Answer the question asked.

Support your conclusion (your data, others' data)

Defend your conclusion (anticipate criticisms)

Give the "big-picture" take-home message

I.e., what do my results mean and why should anyone care?

Key finding (answer to the question(s) asked in Intro.)	• Start with: "WE FOUND THAT…" (or something similar) • Explain what the data mean (big-picture!) • State if the findings are novel
Key secondary findings	
Context	• Give possible mechanisms or pathways • Compare your results with other people's results • Discuss how your findings support or challenge the paradigm
Strengths and limitations	• Anticipate readers' questions/criticisms • Explain why your results are robust
What's next	• Recommended confirmatory studies ("needs to be confirmed") • Point out unanswered questions and future directions
The "so what?": implicate, speculate, recommend	• Give the big-picture (human) implications of basic science findings • Tell readers why they should care
Strong conclusion	• Restate your main finding. • Give a final take-home message.

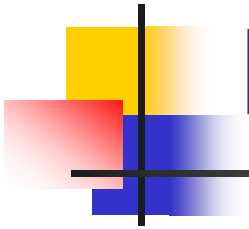
Discussion section, tips

- **Showcase good writing!**
  - **Use the active voice**
  - **Tell it like a story**
- **Start and end with the main finding**
  - **“We found that…”**
- **Don’t travel too far from your data**
  - **Focus on what your data do prove, not what you had hoped your data would prove**
- **Focus on the limitations that matter, not generic limitations**
- **Make sure your take-home message is clear and consistent**

From the Intro of the academic spam study:

- In the Academic Spam Study we investigated the amount, relevance, content, and suppressibility of academic spam emails.

BMJ 2016;355:i5383



Discussion, example

Discussion

The Academic Spam Study shows that mid-career academics in New Zealand receive on average 2.1 spam invitations each day to publish papers and attend conferences. Unsubscribing had a modest and short lived effect on the quantity of received spam. Sixteen per cent of spam invitations were duplicates, and 83% were of little or no relevance to the recipient. Some organisations send spam invitations without an unsubscribe option, or persist despite recipients requesting unsubscription

Discussion, example

Strengths and weaknesses of this study

Our study has limitations. Some invitations were removed by the institutional spam filter, so we might have underestimated the amount of spam. Our sample of researchers was too small to be representative of the academic community. New Zealand is a small, remote country that might not be targeted by academic spam distributors, even though we have held the Rugby World Cup since 2011, and the *Lord of the Rings* movies were filmed here. We received a similar number of spam invitations to colleagues in Poland and Canada who assessed journal invitations, however.[2] [3]

Discussion, example

Comparison with other studies

Published research on academic spam is limited. Some senders of spam journal invitations are bad eggs,[4] who misrepresent their locations and are usually open access publishers.[2 5] Spam invitations are often issued by predatory organisations,[2 3] the modus operandi of which threatens academic integrity.[5 6] Vigorous responses to spam invitations might generate humorous outcomes but not stop the invitations.[7] Attempts to unsubscribe from spam invitations are only moderately successful, but stringent email filtering[3] or threatening recidivist organisations with legal action[8] might stop further communications.

Discussion, example

Implications and future research

We suggest further research on academic spam:

"Nobel and prestigious colleagues,

We are enthralled by prospect of novel research focus of academic spam so we make a proposition to improve enlightenment of evidence. We wish greatly to start journal and convene scientific meeting that focus on academic spam, so illustrious colleagues can form interdisciplinary web of scientific rigour to advance knowledge. Maybe we will christen soon *Journal of Advances in Interdisciplinary Academic Spam* and launch with alacrity the First Annual International Symposium on Academic Spam (Spam-2017). Once we identify publisher and conference organiser we will email academics to join this exciting novel venture! Honourable colleagues, stay tuned!!!!!!"

Discussion, example

END OF INTRODUCTION:

We performed a study designed to test the hypothesis that severely obese subjects with a high prevalence of diabetes or the metabolic syndrome [a] would have a greater weight loss, [b] without detrimental effects on risk factors for atherosclerosis, while on a carbohydrate-restricted (low-carbohydrate) diet than on a calorie- and fat-restricted (low-fat) diet.

Samaha FF, Iqbal N, Seshadri P, et al. A low-carbohydrate as compared with a low-fat diet in severe obesity. *N Engl J Med* 2003;348:2074-2081

The Discussion

1. <u>We found that</u> severely obese subjects with a high prevalence of diabetes and the metabolic syndrome lost more weight in a six-month period on a carbohydrate-restricted diet than on a fat- and calorie-restricted diet. [answer to a]…

2. Subjects in the low-carbohydrate group had greater decreases in triglyceride levels than did subjects in the low-fat group; nondiabetic subjects on the low-carbohydrate diet had greater increases in insulin sensitivity, and subjects with diabetes on this diet had a greater improvement in glycemic control. No adverse effects on other serum lipid levels were observed.

[answer to b]…

4. Many of our subjects were taking lipid-lowering medications and hypoglycemic agents. Although enrolling these subjects introduced confounding variables, it allowed the inclusion of subjects with the obesity-related medical disorders typically encountered in clinical practice. Analyses from which these subjects were excluded still revealed greater improvements in insulin sensitivity and triglyceride levels on a carbohydrate-restricted diet than on a fat- and calorie-restricted diet. [limitations and how they were addressed]

6. The high dropout rate in our study occurred very early and affected our findings. The very early dropout of these subjects may indicate that attrition most closely reflected base-line motivation to lose weight, rather than a response to the dietary intervention itself. [limitation]

7. Taken together, our findings demonstrate that severely obese subjects with a high prevalence of diabetes and the metabolic syndrome lost more weight during six months on a carbohydrate-restricted diet than on a calorie- and fat-restricted diet. The carbohydrate-restricted diet led to greater improvements in insulin sensitivity that were independent of weight loss and a greater reduction in triglyceride levels in subjects who lost more than 5 percent of their base-line weight. **[conclusion; restate answers to a and b]** These findings must be interpreted with caution, however, since the magnitude of the overall weight loss relative to our subjects' severe obesity was small, and it is unclear whether these benefits of a carbohydrate-restricted diet extend beyond six months. Furthermore, the high dropout rate and the small overall weight loss demonstrate that dietary adherence was relatively low in both diet groups. **[big picture]** **This study proves a principle and does not provide clinical guidance; given the known benefits of fat restriction, future studies evaluating long-term cardiovascular outcomes are needed before a carbohydrate-restricted diet can be endorsed.** **[take-home message]**

Recall: self-citation paper objectives (from the intro)

- Here we examine gender differences in self-citations across 24 broad academic fields with hundreds of subfields and several million scholarly papers, with over a million self-citations. We further examine how the gender ratio self-citation patterns changed over time.

First paragraph of the Discussion: What they found

- Our study uses an unprecedentedly large dataset of 1.7 million papers across a broad range of academic fields to examine trends in self-citation by academic researchers. Examining 39.4 million author-to-author citations and over 1 million self-citations in this JSTOR database, we uncovered a number of important patterns: (1) In the last two decades, for every seven self-citations by men, women cited themselves four times (a ratio of 1.7). This ratio rose sharply in the 1960s and 1970s, evening out in the 1980s…

First paragraph of the Discussion: Secondary findings

Our study uses an unprecedentedly large dataset of 1.7 million papers across a broad range of academic fields to examine trends in self-citation by academic researchers. Examining 39.4 million author-to-author citations and over 1 million self-citations in this JSTOR database, we uncovered a number of important patterns: (1) In the last two decades, for every seven self-citations by men, women cited themselves four times (a ratio of 1.7). This ratio rose sharply in the 1960s and 1970s, evening out in the 1980s. (2) There is wide variation across fields and subfields, and we found no correlation between the proportion of women in a field and women's self-citation rates in that field. (3) Across the whole JSTOR corpus, about 9.4% of citations are self-citations, indicating that these make up an important fraction of all citations to authors' work. (4) Men and women differ by more than ten percentage points in how likely they are not to cite themselves in a given paper (68.6% for men vs. 78.8% for women).

Next few paragraphs: Context

Possible mechanisms

Why might men academics cite their own previous work more than women academics? While our data include a large number of papers and self-citations, they do not contain variables that allow us to determine the cause of the patterns we identify. However, prior research suggests several mechanisms that are consistent with our results. We review five possible mechanisms here, which may in some combination contribute to the gender self-citation gap: (1) Men may self-cite more because they evaluate their abilities more positively than women. (2) Men face fewer social sanctions for self-promotion. (3) Men specialize more in academic subfields, and specialization may encourage more self-citation. (4) Men publish more papers, particularly earlier in their career, and therefore have more work to cite. (5) Men publish different types of papers, which are the types of papers an academic may be more likely to self-cite.

Later paragraph: Limitations

Again, our data cannot reveal the mechanisms behind this temporal trend; here we present hypotheses bases on the other scholarly literature to encourage future study. Irrespective of the underlying causal mechanisms, we find statistically significant and socially important gender differences in patterns of self-citation.

Final few paragraphs: Implications

Implications

(2 additional paragraphs)

Final paragraph: Historically, women's academic contributions have been undervalued. Rossiter (1993) described the "Matilda Effect," which is the process by which women's scientific ideas are steadily downplayed or ignored and recognition systematically biased in favor of men's intellectual contributions. When interpreting the impact metrics of scholars' work, university hiring and tenure committees should be aware that women are likely to cite their own work less often. Considering other proposed measures for scientific impact that exclude self-citation (Ferrara and Romero 2013) could make evaluation processes less gender-biased and improve equity in the academic community.

What NOT to do…

Don’t start your discussion like this!

Discussion

- This meta-analysis is subject to a number of limitations. The estimates of risk for melanoma subsequent to using sunlamps/sunbeds are based on published data in a series of 10 articles over a period of 20 years. A pooled analysis of original observations taken in the 10 studies would have provided a more powerful approach …

The Discussion: verb tense

Past, when referring to study details, results, analyses, and background research:

- We found that
- Subjects may have experienced
- Miller et al. found

Present, when talking about what the data suggest:

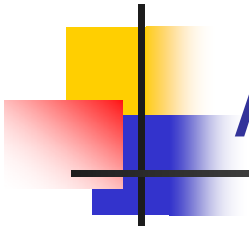
The greater weight loss suggests

The explanation for this difference is not clear.

Potential explanations include

Writing in the Sciences

Unit 5.8: Abstract



Abstract

Abstracts (*ab*=out, *trahere*=pull; "to pull out")

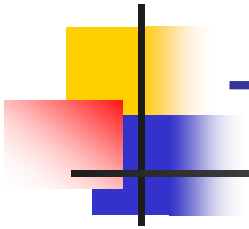
- Overview of the main story
- Gives highlights from each section of the paper
- Limited length (100-300 words, typically)

- Stands on its own
- Most often, the only part people read

Abstract

1. Background
2. Question/aim/hypothesis
   - "We asked whether," "We hypothesized that,"…etc.
3. Experiment(s)
   - Quick summary of key materials and methods
4. Results
   - Key results found
   - Minimal raw data (prefer summaries)
5. Conclusion: The answer to the question asked/take-home message
6. Implication, speculation, or recommendation

Mimi Zeiger. *Essentials of Writing Biomedical Research Papers*, McGraw Hill Professional, 1999



The Abstract

Abstracts may be structured (with subheadings) or free-form.

Example Abstract

Objectives To assess the amount, relevance, content, and suppressibility of academic electronic spam invitations to attend conferences or submit manuscripts.

Design Prospective cohort study.

Setting Email accounts of participating academics.

Participants Five intrepid academics and a great many publishers, editors, and conference organisers.

Intervention Unsubscribing from sender's distribution lists.

Main outcome measures Number of spam invitations received before, immediately after, and one year after unsubscribing from senders' distribution lists. The proportion of duplicate invitations was also assessed and the relevance of each invitation graded to the recipient's research interests. A qualitative assessment of the content of spam invitations was conducted.

Example Abstract

- **Results** At baseline, recipients received an average of 312 spam invitations each month. Unsubscribing reduced the frequency of the invitations by 39% after one month but by only 19% after one year. Overall, 16% of spam invitations were duplicates and 83% had little or no relevance to the recipients' research interests. Spam invitations were characterised by inventive language, flattery, and exuberance, and they were sometimes baffling and amusing.
- **Conclusions** Academic spam is common, repetitive, often irrelevant, and difficult to avoid or prevent.

Abstract: unstructured example

Empirical research with nonhuman primates appears to support the view that causal reasoning is a key cognitive faculty that divides humans from animals. The claim is that animals approximate causal learning using associative processes. The present results cast doubt on that conclusion. Rats made causal inferences in a basic task that taps into core features of causal reasoning without requiring complex physical knowledge. They derived predictions of the outcomes of interventions after passive observational learning of different kinds of causal models. These competencies cannot be explained by current associative theories but are consistent with causal Bayes net theories.

Science. 2006 Feb 17;311(5763):1020-2. Causal reasoning in rats. Blaisdell AP, Sawa K, Leising KJ, Waldmann MR.