ISHI WORKSHOP
September 23, 2019
Palms Springs, CA

INTERNATIONAL SYMPOSIUM
ON HUMAN IDENTIFICATION
PALM SPRINGS, CA | SEPT. 23-26, 2019

Keys to Evaluating Published Data and Summarizing Your Validation Studies

John M. Butler, PhD

Charlotte J. Word, PhD

Acknowledgments and Disclaimer

Planned Workshop Schedule

Time	Topic	Presenter(s)
8:30am (10 minutes)	Introductions and Goals for Workshop	Charlotte & John
8:40am (40 minutes)	Reading the Literature and Experimental Design Using the Scientific Method	John
9:20am (40 minutes)	Critically Reviewing Published Data & Validation Studies	Charlotte
10:00am (15 minutes)	BREAK	
10:15am (30 minutes)	Writing Up Results and the Publication Process	John
10:45am (30 minutes)	Examples (hands on exercises and discussions)	Charlotte & John
11:15am (15 minutes)	Q&A	Charlotte & John
11:30am	Conclude Workshop	

Introductions and Goals for Workshop

Charlotte & John

Workshop Description

Validation study summaries and published research studies play a critical role in informing the forensic science testing and legal communities about various experiments performed, data generated and conclusions derived from the studies. These studies may impact the way testing is performed, or the evaluation and/or interpretation of information gained from testing of evidence samples in a crime laboratory. The reader of the studies needs to critically evaluate the experimental design, materials and methods used, data obtained and the conclusions presented to appropriately gauge the usefulness and value of the study.
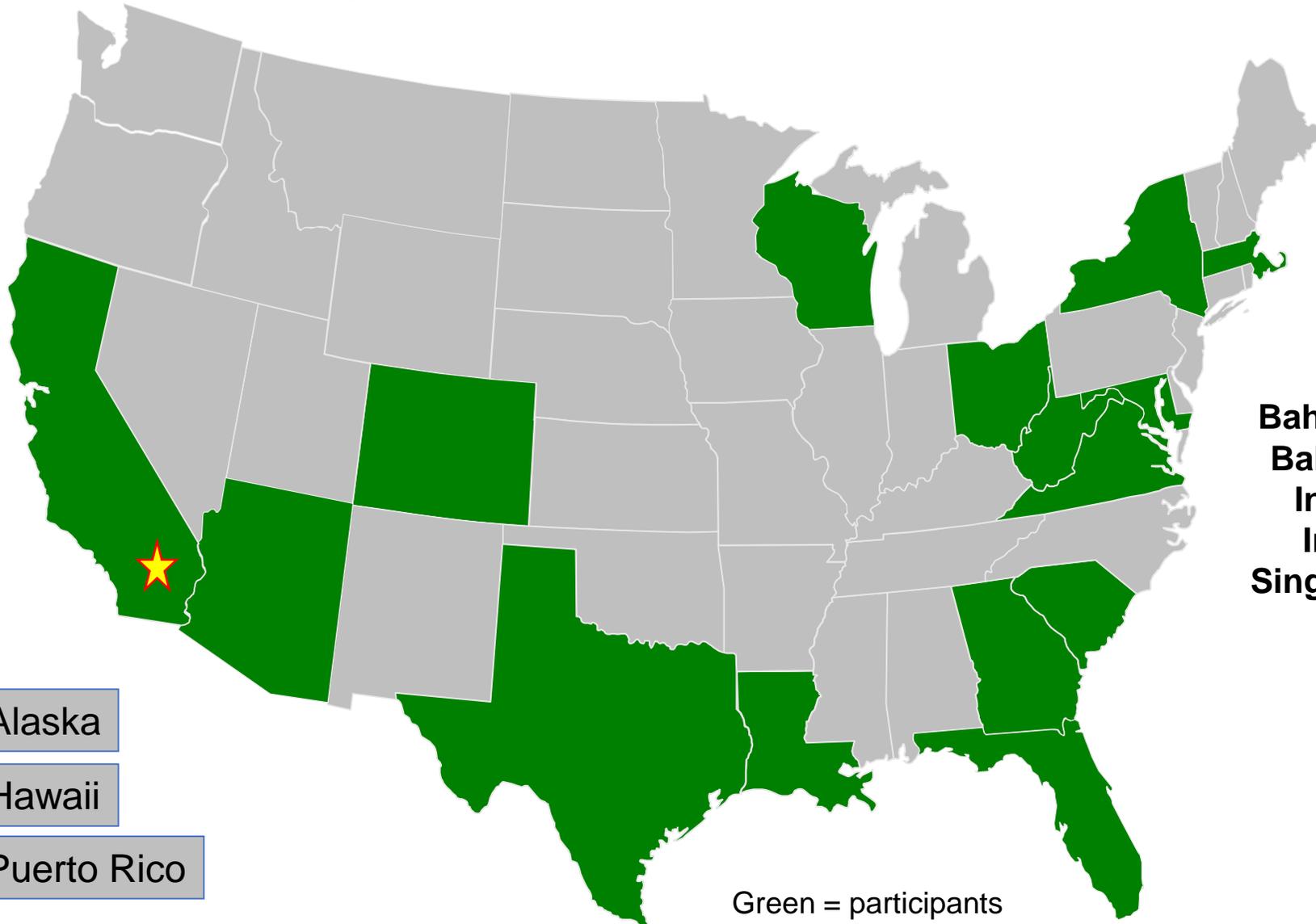
Learning Outcomes

1. Gain skills for critiquing and evaluating summaries and published studies that may have applications for forensic DNA testing

2. Learn how the scientific method applies to studies in forensic sciences, and in particular, DNA testing

3. Get hands on experience for finding the relevant information from papers and evaluating what information is missing

4. Discuss how the studies may or may not impact casework samples and data

5. Acquire information that will aid in the writing of summaries of validations studies and manuscripts to be submitted for publication

Intended Audience: Analysts, technical leaders, students, attorneys, judges, consultants, academics. No prior knowledge required but an understanding of the DNA testing process would be helpful.

ISHI 2019 Workshop Attendees
15 states and 5 other countries

44 registered + 2 presenters
(as of 8/21/2019)

In addition to state and local
forensic laboratory analysts,
we have representatives from:

ANDE
Bode Technology
DFSC (USACIL)
Florida International University
Identilab
LevitasBio
NYC Legal Aid Society
Promega Corporation
QIAGEN
ThermoFisher Scientific

Bahamas
Bahrain
India
Iraq
Singapore

Alaska

Hawaii

Puerto Rico

Green = participants
Gray = no attendees

Background and Qualification of Presenters

- **John M. Butler**:
  - Author of five textbooks (2001, 2005, 2010, 2012, 2015) and >170 research articles
  - Associate editor of *Forensic Science International: Genetics* (2006-2019)
  - Member of *Journal of Forensic Sciences* editorial board (2010-present)
  - Peer-reviewer on hundreds of articles over the past 25 years
  - Has written on and conducted workshops covering the topic of validation

- **Charlotte J. Word**:
  - Author of a number of peer-reviewed and other articles
  - Member of *Journal of Forensic Sciences* editorial board (2004 – present), *FSIG* - guest
  - Conducted thousands of technical reviews while at Cellmark Diagnostics (1990 – 2005) and as consultant; consulted on many hundreds of forensic DNA cases over the past 30 years
  - Prepared numerous validation summaries while at Cellmark Diagnostics and as a consultant
  - Member of number of committees writing recommendations and standards

Types of Data Evaluation You May Conduct

1. **Reading a published article to understand its contents and conclusions** as part of your training and continuing education (assisting yourself)

    - Review of validation studies in your own laboratory as part of training

2. **Technical or administrative review of casework** performed by someone else in your laboratory (assisting your laboratory and report users)

3. **Contributing to the peer-review process** as a reviewer for a scientific journal like the *Journal of Forensic Sciences* or *Forensic Science International: Genetics* (assisting the larger scientific community)

    - Review of validation studies from other laboratories as part of the auditing process and/or in designing validation or research studies in your own laboratory

Are There Specific Things You Are Interested in Learning in This Workshop?

- Learning how others think about writing up validations and making them useful

- See other perspectives on how validation is done

- How read a scientific paper critically

- Understanding limitations in studies

- Ability to compare different articles

- Pinpointing what is important in a validation study (to assist in training)

- Standardization among the community about validation studies

- More guidance on publishing validation studies (have lost the art of publishing validation studies)

- How to write a final casework report

Reading the Literature and Experimental Design Using the Scientific Method

John

Society is Often Trying to Make Sense of Science
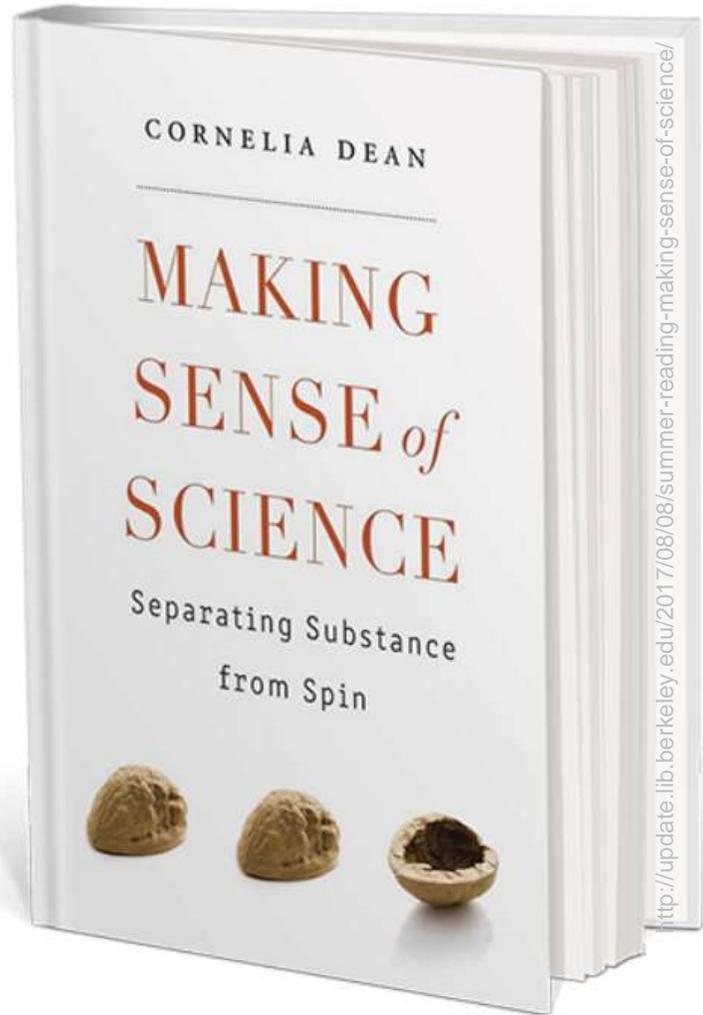
New York Times science editor Cornelia Dean writes that **we live in "a world in which researchers gather data; politicians, business executives, or activists spin it; journalists misinterpret or hype it, and the rest of us don't get it.** Whoever has the most money, the juiciest allegation, or the most outrageous claim speaks with the loudest voice. The internet, newspapers, the airwaves, the public discourse generally are all too often brimming with junk science, corrupt science, pseudoscience, and nonscience."

(Cornelia Dean, 2017 book *Making Sense of Science: Separating Substance from Spin*, p. 3)

Important Topic Being Discussed by the General Scientific Community

- **Reproducibility** means obtaining consistent results using the **same input data, code, computational steps, and conditions**.

- **Replicability** means obtaining consistent results across studies aimed at answering the same scientific questions **using different data**.

See https://youtu.be/Y6hhJvIZhls

"Responsibility begins with researchers, who should take care to explain the uncertainty inherent in [your] results and describe methods and data in a clear way."

https://www.nap.edu/catalog/25303/reproducibility-and-replicability-in-science#resources

New National Academy of Sciences Report on Reproducibility and Replicability in Science (2019)

Reproducibility and Replicability in Science
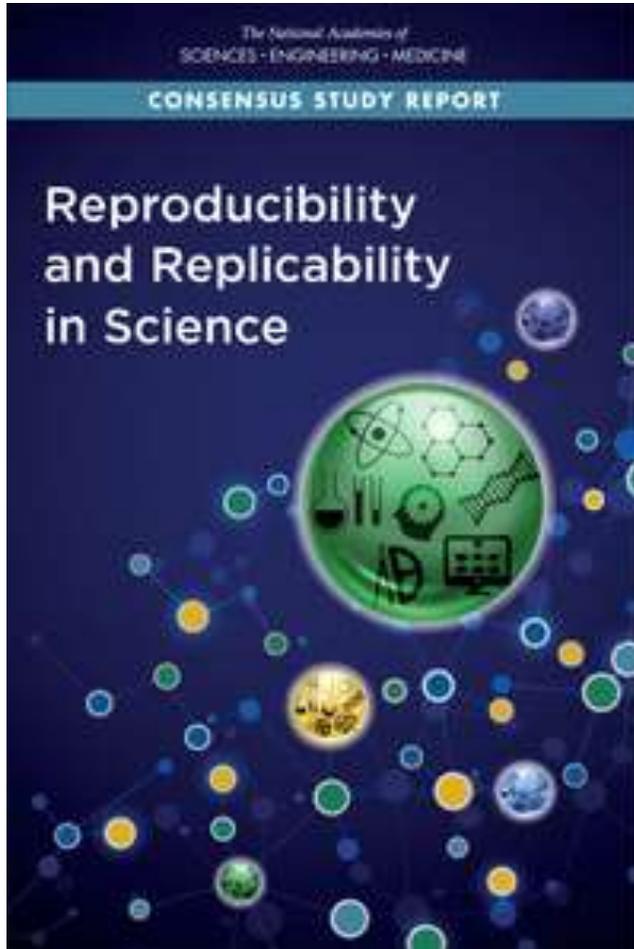
- **Recommendation 6-1**: All researchers should **include a clear, specific, and complete description of how the reported result was reached**. Different areas of study or types of inquiry may require different kinds of information.

- **Recommendation 7-1**: Scientists should take care to **avoid overstating the implications of their research** and also exercise caution in their review of press releases, especially when the results bear directly on matters of keen public interest and possible action.

- **Recommendation 7-3**: Anyone making personal or policy decisions based on scientific evidence should **be wary of making a serious decision based on the results, no matter how promising, of a single study**. Similarly, no one should take a new, single contrary study as refutation of scientific conclusions supported by multiple lines of previous evidence.

Why Read the Literature?

- Reading the relevant literature is crucial to developing expertise in a scientific field

- You must keep reading to be familiar with advances that are regularly being made

- **Your writing improves the more you read**
  - Being widely read in your field helps you prepare **relevant reference** lists and **insightful introductions** to your submitted manuscripts *or in your internal validation summaries*

- **Your ability to review other's work will improve**…
  - Being widely read in your field helps you be better able to critique different papers and to design better experiments (e.g., you can go back to well-designed studies for examples)
  - *Remember that just because something is published does not mean that it is necessarily the "best" work or completely relevant to what you may be doing*

Perspective on Requirements for Being a Forensic Science Expert

"It is a clear expectation of the courts that expert evidence is presented by people who are indeed experts in their field. This necessitates **an up to date knowledge of developments in the relevant field**, which in turn necessitates **access to scientific literature** and **sufficient time** to ensure that each expert has the current relevant knowledge that they need."

- **Dr. Gillian Tully,** UK Forensic Science Regulator (*Annual Report 2017,* p. 10; published 19 Jan 2018)

https://www.gov.uk/government/publications/forensic-science-regulator-annual-report-2017

Greg Matheson on Forensic Science Philosophy

"If you want to be a technician, performing tests on requests, then just focus on the policies and procedures of your laboratory. If you want to be a scientist and a professional, learn the policies and procedures, but go much further and learn the philosophy of your profession. **Understand the importance of why things are done** the way they are done, the scientific method, the viewpoint of the critiques, the issues of bias and the importance of ethics."

Forthcoming FBI DNA Quality Assurance Standards
16.1.2 (2020 version) Requirement for Literature Review

STANDARD 16.1 The laboratory shall have and follow a program to ensure technical qualifications are maintained through **participation in continuing education**.

16.1.1 …analyst(s)…shall stay abreast of topics relevant to the field of forensic DNA analysis **by attending seminars…in relevant subject areas for a minimum of eight (8) cumulative hours each calendar year**.

16.1.2 The laboratory shall have and follow a program approved by the technical leader for the annual review of scientific literature that documents the analysts' **ongoing reading of scientific literature.**

16.1.2.1 The laboratory shall maintain or have physical or electronic access to a collection of current books, reviewed journals, or other literature applicable to DNA analysis.

Challenges the Forensic DNA Community Faces with Continuing Education

- **QAS requirement for continuing education are only a start**
  - Minimum of eight (8) hours per year for seminars and one (1) or more articles to read will not cover much ground
  - **How does anyone know if you learned anything since there is no assessment of what was learned?**
  - **For example, which articles are essential for you to understand to be an expert in DNA mixture interpretation?**

- **Rapid and continuous evolution of the field**
  - New STR kits, new CE instruments, new software, new potential approaches for analysis (e.g., NGS) and interpretation (e.g., probabilistic genotyping software)
  - **There are lots of articles to chose from based on interest or need…**

- **Numerous articles are being published each year**
  - **Which articles should you choose to study?**

My Early Experience with Data Review of Capillary Electrophoresis (CE) Publications

- Summarized CE studies for my PhD dissertation
  - Drawn from **687 articles** collected as part of my research
  - It took a week to enter the data from **123 studies** into a 16-page spreadsheet

Found that many studies did not have all of the desired information needed to fully characterize all aspects of their results

Reference	Sample	Conditions: Capillary, Buffer, Additives, Voltage	Detection	Speed	Resolution
[639] Oto	(CA)$_n$ repeats PCR products	Bio-Rad BioFocus 3000 CE, 36cm(__) x 50 µm i.d. PA coated 30 °C Bio-Rad PCR Product Analysis Buffer™ HD:1s @ 414 kPa; CV: 222 V/cm (8kV)	UV 260nm	⊖→⊕ 11 min to 300bp	CA repeats ??
[640] Righetti	pBR322 HaeIII	Waters Quanta 4000E CE, 37cm(__) x 100 µm i.d. AAEE coated __ °C 89mM Tris-borate, 2mM EDTA, pH 8.3, 6% short-chain PAA EK:6s @ 100 V/cm (3.7kV); CV: 100 V/cm (3.7kV)	UV 254nm	⊖→⊕ 60+ min	184/192 split 8 bp
[646] Karger	φX174 HaeIII pBR322 MspI pBR322HaeIII 100 bp ladder 123 bp ladder 1 kbp ladder	Homebuilt CE, 50cm(40) x 75µm i.d. PA coated __ °C 89mM Tris-borate, 1mM EDTA, pH __, 6% LPA EK:5s @ 100 V/cm; CV: 300 V/cm (15kV) Dyes examined: EB, TO, POPO-3, EtHD, TOTO-3 examined sequence dependent migration behavior	UV 260nm	⊖→⊕ 37 min	271/281 split <5 bp ??
[647] Bocek	φX174 HaeIII restiction digests of bacteriophages	Homebuilt CE, 61cm(50) x 100µm i.d. LPA coated 30 °C 89mM Tris-borate, 2.5mM EDTA, 2% SeaPrep agarose EK:8s @ 10kV; CV: 10kV (164 V/cm)	UV 260nm	⊖→⊕ 45 min	271/281 split ~10 bp
[648] Oto	73 & 325 bp PCR products	BioRad BioFocus 3000 CE, 36cm(__) x 50µm i.d. LPA coated 30 °C 267mM Tris-borate, 1mM EDTA, pH 8.3, BioRad polymer additives HD:__s @ __psi/sec; CV: 222 V/cm	UV 260nm	⊖→⊕ 10 min	??
[649] Bocek	φX174 HaeIII	BioRad BioFocus 3000 CE, 54cm(50) x 100µm i.d. LPA coated 30 °C 89mM Tris-borate, 2.5mM EDTA, 2% SeaPrep agarose HD:__s @ 20psi or EK:8s @ 7kV; CV: 10kV (295 V/cm)	UV 260nm	⊖→⊕ 38 min	271/281 split 10 bp
[650] Evans	φX174 HaeIII thymocytes ladder fragments	Beckman P/ACE 2050 CE, 57cm(50) x 75µm i.d. uncoated 25 °C 50mM KH$_2$PO$_4$, 0.5mM EDTA, pH 5.0, 400 nM YO-PRO-1, 0.5% HEC (Aldrich); HD:90s @ 0.5psi; CV: 10kV (175 V/cm)	LIF 488:520	⊖→⊕ 30 min	271/281 split 10 bp
[652] Mathies	φX174 HaeIII TH01 alleles	Capillary Array Microchip, 1-3.5cm x 50µm channels 0.75% HEC (125,000 MW), 1.0 µM TO (9%T LPA, 7M urea for TH01) EK:__s @ __kV; CV: up to 250 V/cm	LIF 488:530	⊖→⊕ 2-5 min >20s	271/281 split 10 bp 9.3/10 split

The "IMRAD" Format to Scientific Articles

- **I**ntroduction – what question is being studied?

- **M**ethods (& Materials) – how study was performed?

- **R**esults – what were the findings in the study?

- **A**nd

- **D**iscussion – what do these findings mean?

- **The first scientific journals appeared in 1665** but early articles were descriptive in nature

- The IMRAD approach began to be used in the mid-20th century to focus articles and to make indexing and reviewing easier

- **IMRAD was formally defined in 1979** by the American National Standards Institute (ANSI Z39.16-1979) "American National Standard for the Preparation of Scientific Papers for Written or Oral Presentation"

From Day, R.A. (1998). *How to Write & Publish a Scientific Paper, 5th edition*. Oryx Press: Phoenix, Arizona.

How to Write a Report or Scientific Publication

From the National Information Standards Organization

ANSI/NISO Z39.18-2005 (R2010)
ISSN: 1041-5653

Scientific and Technical Reports – Preparation, Presentation, and Preservation

Abstract: This Standard outlines the elements, organization, and design of scientific and technical reports, including guidance for uniform presentation of front and back matter, text, and visual and tabular matter in print and digital formats, as well as recommendations for multimedia reports.

An American National Standard
Developed by the
National Information Standards Organization

Approved: July 27, 2005
by the
American National Standards Institute
Reaffirmed May 13, 2010

Published by the National Information Standards Organization
Baltimore, MD

Abstract: This Standard outlines the elements, organization, and design of scientific and technical reports, including guidance for uniform presentation of front and back matter, text, and visual and tabular matter in print and digital formats, as well as recommendations for multimedia reports.

"Its purpose is to foster uniformity in reports for ease of information retrieval while permitting diversity in presentation based on the rapidly changing environment driven by the growing digital environment."

https://groups.niso.org/apps/group_public/download.php/12038/Z39_18_2005_R2010.pdf (96-page document)

How to Read a Scientific Article

John Butler's perspective and <u>not</u> a formal standard!

- Skim the article first
  - Start with title and abstract (may consider authors as well)
  - Scan tables, figures and figure captions

- Examine results and conclusions
  - Do the data presented support the statements made?

- Do not worry about trying to comprehend the entire article at first
  - Most articles will be skimmed rather than read from start to finish
  - **Many articles are never read in detail**

- **Highlight key points and make notes on the paper** itself so you can go back to them later to refresh your memory

An Example of a Recent Article…

Contents lists available at ScienceDirect

Forensic Science International: Genetics
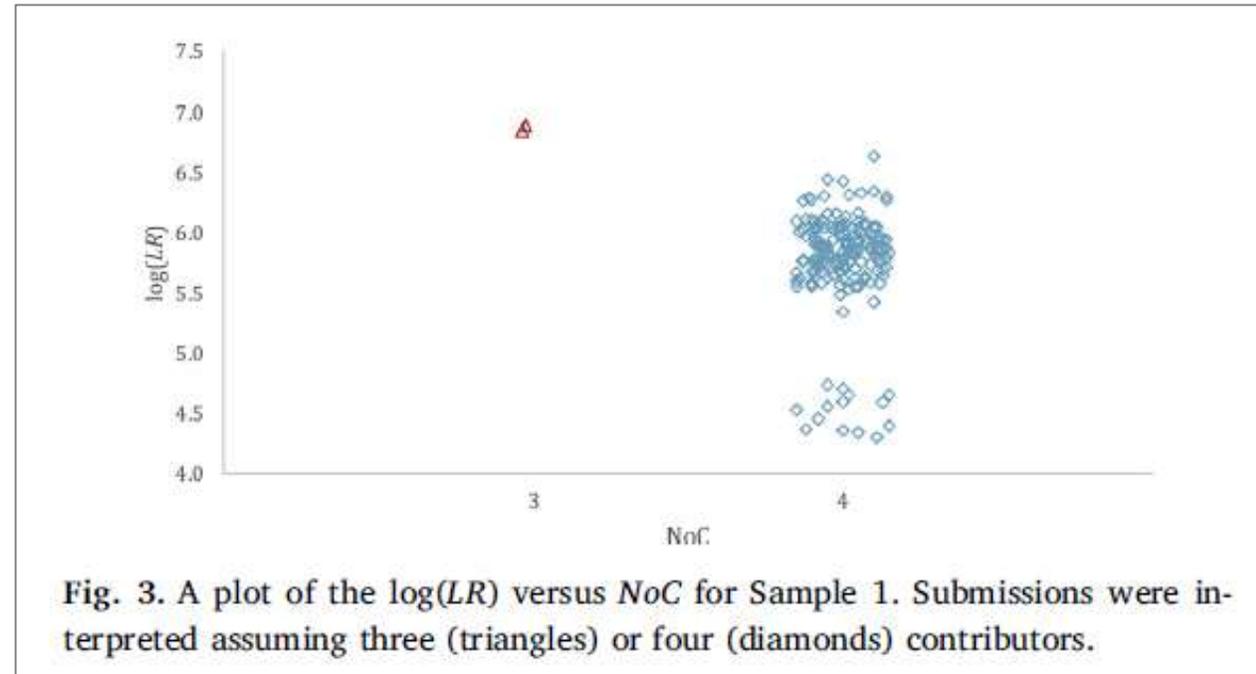
journal homepage: www.elsevier.com/locate/fsigen

Research paper

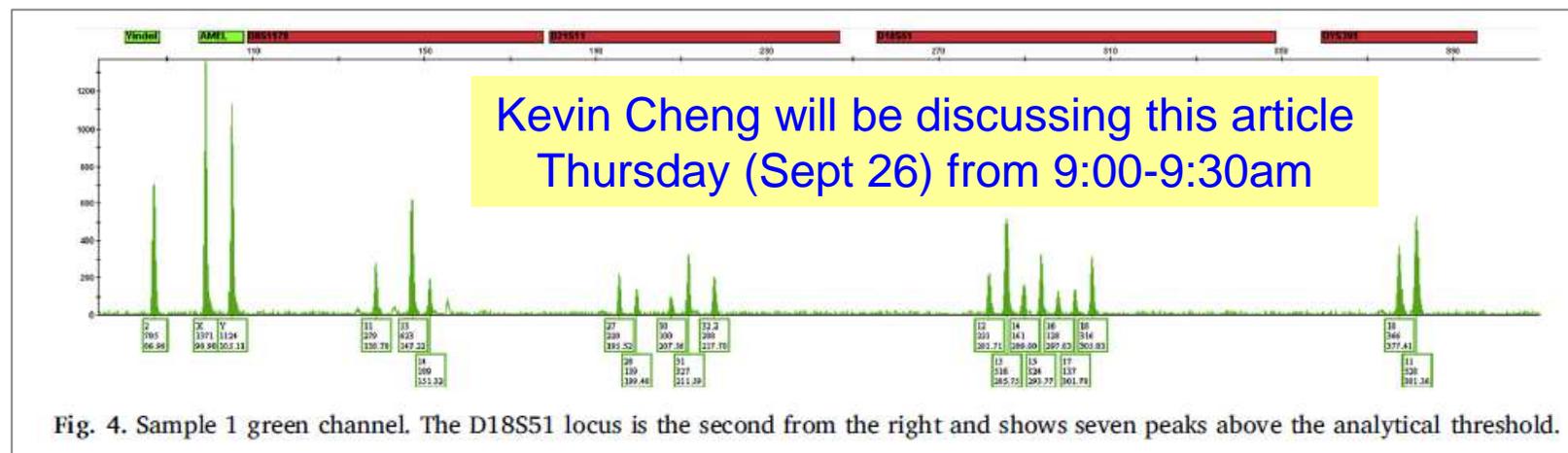### STRmix™ collaborative exercise on DNA mixture interpretation

Jo-Anne Bright[a,*], Kevin Cheng[a], Zane Kerr[a], Catherine McGovern[a], Hannah Kelly[a], Tamyra R. Moretti[b], Michael A. Smith[b], Frederick R. Bieber[c], Bruce Budowle[d], Michael D. Coble[d], Rashed Alghafri[e], Paul Stafford Allen[f], Amy Barber[g], Vickie Beamer[h], Christina Buettner[i], Melanie Russell[j], Christian Gehrig[k], Tacha Hicks[l], Jessica Charak[m], Kate Cheong-Wing[n], Anne Ciecko[o], Christie T. Davis[p], Michael Donley[q], Natalie Pedersen[r], Bill Gartside[s], Dominic Granger[t], Erin Grammer[x], Ma[...], Eugene Lien[D], Emil[...], Alyse Yacovone-Ma[...], Gary Shutler[M], Kate Stevenson[n], April R. Stonehouse[N], Lindsey Smith[O], Julie Murakami[P], Eric Halsing[Q], Darren Wright[R], Leigh Clark[S], Duncan A. Taylor[T,U], John Buckleton[a,V]

[a] Institute of Environmental Science and Research Limited, Private Bag 92021, Auckland, 1142 New Zealand

174 participants from 42 laboratories
(349 interpretations submitted across two samples)

Fig. 3. A plot of the log(*LR*) versus *NoC* for Sample 1. Submissions were interpreted assuming three (triangles) or four (diamonds) contributors.

Abstract: An intra- and inter-laboratory study using the probabilistic genotyping (PG) software STRmix™ is reported. Two complex mixtures from the PROVEDIt set, analysed on an Applied Biosystems™ 3500 Series Genetic Analyzer, were selected. 174 participants responded. …

Kevin Cheng will be discussing this article
Thursday (Sept 26) from 9:00-9:30am

Fig. 4. Sample 1 green channel. The D18S51 locus is the second from the right and shows seven peaks above the analytical threshold.

Bright et al. (2019) STRmix collaborative exercise on DNA mixture interpretation. *Forensic Sci. Int. Genet.* 40:1-8

Read Print or Electronic Format?

- **I prefer articles in print format to read them** because I like to mark meaningful passages and make notes in the margins for future use

- I do download and store articles electronically as pdf files (often for future printing purposes)
  - I typically name my files with the following format: **First Author's Last Name / Publication Date / Journal / Title or Brief Description** (e.g., "Butler 2006 J Forensic Sci – genetics and genomics of STR markers.pdf")

Different Types of Articles

- Original research articles

- Review articles

- Short communications (termed "technical notes" in *JFS*)

- Book reviews

- Case studies (termed "case reports" in *JFS*)

- Opinion or commentary

- Letters to the Editor
  - typically correcting or commenting on a previous publication

- With *FSI Genetics*: Forensic population genetics (original paper, short communication, or correspondence)

Different journals can have different categories and/or required structures for manuscript submission

https://www.elsevier.com/journals/forensic-science-international-genetics/1872-4973/guide-for-authors

Some Thoughts on Experimental Design

- **Purpose and Scope:** Consider the question you are asking and decide what you are going to evaluate

- **Parameters:** Consider carefully the parameters you would like to study and how you can isolate the variables you are trying to examine

- **Coverage:** Explore the "factor space" needed (e.g., to understand the limitations of a method, you will need to go the "edges" and beyond)

- **Replication**: Repeatability (under similar conditions) and reproducibility (under different conditions) need to be understood

Writing the Materials and Methods Section

- Describe experimental details with enough information so that someone else could replicate your measurements and interpretation if desired
  - List the city and country the first time a manufacturer's product is named
  - List software programs used and statistical tests employed for calculations
  - List any variations from manufacturer's protocol
  - Cite institutional review board approval (if applicable)

- Significant figures with numerical results reported
  - Relates to population allele frequencies and DNA quantitation values
  - For example, using "15.125 pg" is not appropriate as this number of significant figures implies a level of certainty that does not exist

Critically Reviewing Published Data & Validation Studies

Charlotte

Validation Summaries & Published Studies

- What is the purpose?
  - Memorialize the work done, results obtained & conclusions
  - Provide information to others
  - Other
- Key for:
  - Training & Education
  - Designing other validation and research studies
  - Critical resource
  - Audits
  - Success

Purpose of Validation Summaries & Published Studies for Forensic Laboratory

- Basis for development of laboratory SOPs
  - Define what to do and how to do it
  - Provide support/justification for decision processes and policies
- Define limitations of the tests
  - What not to do, where not to go
- Foundation for your testing and reporting, and testimony
- Good studies lead to high confidence in your data

New Standards

- ANSI/ASB Standard 020, *Standard for Validation Studies of DNA Mixtures, and Development and Verification of a Laboratory's Mixture Interpretation Protocol, First Edition, 2018* (http://www.asbstandardsboard.org/published-documents/dna-published-documents/)

- ANSI/ASB Standard 040, *Standard for Forensic DNA Interpretation and Comparison Protocols, First Edition, 2019* (in final review process – to be published soon)

- ANSI/ASB Standard 018, *Validation Standards for Probabilistic Genotyping Systems, First Edition, 2019* (in final review process – to be published soon)

Critical Information Needed

- What is the question being asked?
  - Abstract and Introduction
- What was done? How was it done?
  - Materials and Methods
    - Sufficient for you to repeat the experiment
- What data were collected and how evaluated?
  - Results
- What does it all mean?
  - Conclusions

Critiquing the Write-up

Did the study answer the question asked?

- Experimental design appropriate to address the question
  - What are its flaws or limitations?
  - What does the study not address?
- Proper samples used and controls done
  - Only one variable changed at a time
  - Sufficient number of samples
- Proper data collected and appropriately evaluated
  - Presented in a useful way

Critiquing the Write-up

- Conclusions appropriate for the data obtained
  - Overstated, understated, correct vs. incorrect
  - Alternative conclusions
  - Missed the point – data actually supports something else

- References sufficient
  - Only cite own work

EXERCISE: What Information Is Needed in the Materials and Methods Section?

- Samples
- Extraction
- Quantitation
- Amplification
- Electrophoresis
- Data Analysis
- Data Collected
- Evaluation of data (e.g., statistical)

Examine each area as a full group or as smaller groups with individual topics

Consider: What information will be sufficient for someone else to repeat the study?

EXERCISE: What Information Is Needed in the Materials and Methods Section?

Samples

- How old are the samples?
- Casework sample or known
- Biological source
- Substrate (what is it on?)
- Volume of sample
- How it was created?
- Environmental conditions of the sample (e.g., frozen)
- How many samples?

Extraction

- What specific method was used? (volumes, solution concentrations)
- Manual or robotic (instrumentation)
- Temperatures, times, etc.
- What kit and company source
- Volume obtained
- Could do replicates?

Consider: What information will be sufficient for someone else to repeat the study?

EXERCISE: What Information Is Needed in the Materials and Methods Section?

Quantitation

- What method, kit, instrument, software
- Volume (half or full)
- Standards used
- Range examined
- Replicates (how close are the replicates?)
- Uncertainty (admit when you are not confident)
- Inhibitors (were they examined?)
- The target in the quantitation assay

Amplification

- Kit
- Instrument
- Amount of DNA amplified
- Reaction volume
- Cycle number
- Cycling parameters

Consider: What information will be sufficient for someone else to repeat the study?

EXERCISE: What Information Is Needed in the Materials and Methods Section?

Electrophoresis

- Injection time and voltage
- Instrument
- Spatial/spectral calibration, etc.
- Sample preparation
- Volume of ILS, formamide, etc.
- Age of polymer?
- Number of runs on the capillary (maintenance of equipment may not be the same)
- Age of the amplicon? Storage?

Data Analysis

- Software version number
- Analytical and stochastic threshold
- Stutter filters used or not
- Decisions on artifacts
- Binary or probabilistic analysis

Consider: What information will be sufficient for someone else to repeat the study?

EXERCISE: What Information Is Needed in the Materials and Methods Section?

Data Collected

- Decided with experimental design

- Output

Evaluation of Data (statistical)

- Taking an average of the data?

- Were there any outliers that may have been removed?

Consider: What information will be sufficient for someone else to repeat the study?

Comparison of Three Extraction Protocols -

We want to compare Extraction Protocols 1, 2 and 3.

What does "compare" mean?

What questions are we asking in this study?

What variables are we considering?

What data do we need to collect?

How evaluate?

Comparison of Three Extraction Protocols -

Samples were prepared on cotton cloth. A 5 mm square cutting was placed into the extraction buffer for each of the three respective extraction procedures and incubated per the manufacturer's recommendation. Extraction was performed…..

What additional information do you need to repeat this part of the study?

Comparison of Three Extraction Protocols -

The samples were extracted using Protocol 1, Protocol 2 and Protocol 3. (Describes each of the extraction protocols – solutions, incubation, spins). Two μl of each sample was quantitated using Quantitation Kit A.

Quantitation (concentration) values:

Protocol 1 – 20 ng/μl
Protocol 2 – 5 ng/μl
Protocol 3 – 1 ng/μl

Protocol 1 is 4x better than 2 and 20 x better than 3 – right?

Comparison of Two Amplification Kits

What questions are we asking in this study?

What variables are we considering?

What data do we need to collect?

How evaluate?

Comparison of Two Amplification Kits

The DNA was amplified 10 times in replicate with Amplification Kit X and Amplification Kit Z and electrophoresed on a 3130xl Genetic Analyzer according to manufacturer's recommendations.

What additional information do you need to repeat this part of the study? Evaluate the data?

Comparison of Two Amplification Kits

Laboratories 1 and 2 tested Amplification Kit X. Lab 1 decided on an input amplification value of 0.75 ng and Lab 2 decided on an input amplification value of 1.5 ng.

What differences in the test design/procedures could account for the two different decisions?

Comparison of Three Extraction Protocols

Blood (or semen or saliva) was collected from three men. 10 µl was spotted onto cotton cloth 100 times for each male. 5 mm cuttings for male 1 were placed into each of 25 tubes containing extraction buffer 1. Similarly, 5 mm cuttings for male 2 were placed into each of 25 tubes containing extraction buffer 2 and 5 mm cuttings for male 3 were placed into extraction buffer 3. The samples were incubated….

Writing Up Results and the Publication Process
(if you submit your work to a scientific journal)

John

Why You Need to Write Up Your Work

- Peer-review usually generates higher-quality information (but the quality control is not perfect)

- Talks are not held to the same standard as a written publication (that has been peer-reviewed)

- A written publication is also accessible to those who did not attend a presentation and is archived for future scientists to read

Why Publish Scientific Articles?

- **To spread information and share new knowledge with others**
- To gain recognition, success and prestige for the authors and their institutions
- To win promotion to higher positions, job security, and tenure within academia
- To enhance chances of obtaining grants and research funding
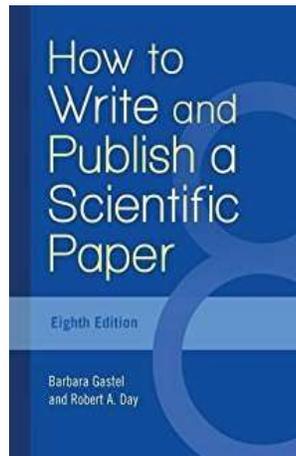- To gain priority for making a discovery

Value of Studying this Topic

Gerard Piel
(1915 – 2004)
Publisher of *Scientific American* magazine

"**Without publication, science is dead.**"

How to Write and Publish a Scientific Paper

Eighth Edition

Barbara Gastel and Robert A. Day

"**A scientific experiment is not complete until the results have been published *and understood*.**"

- Robert A. Day

Think of a paper that you enjoyed reading
What are the qualities that made it worth reading?

- (responses from workshop participants…)

Who is Your Audience?
When You Write a Scientific Paper

- Other scientists
  - Your colleagues (those in the same field – e.g., forensic genetics)
  - Scientists reading outside their discipline (e.g., molecular biologists)
  - Students who are just getting started in the field
  - Non-native English speaking scientists

- In some cases, members of the general public or other stakeholders, such as journalists or lawyers

"Ecosystem" of Scientific Knowledge

A Question Raised or a Problem to Solve ⟹ **Research Conducted** ⟹ Results Written Up & Published
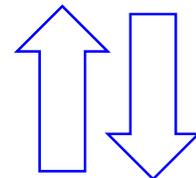
Information Resources Available

Google Scholar or PubMed

Web of Science or Other Database

Non-Indexed Journals

Crucial Elements in Search
1) Resources evaluated
2) Keywords utilized

A Question Raised or a Problem to Solve ⟹ *A Search is Conducted* ⟹ **Results Obtained**

How Scientific Publication Works

- Role and responsibilities of authors

- Role of journal editor

- Role of peer-reviewers

Ranking of the Value and Relevance of Scientific Writing

Lesser value

- Website blogs and opinion pieces
- Non-peer reviewed articles
  - Conference proceedings
  - Letters to the editor
  - Many review articles
- Peer-reviewed research articles – with data!
- **Highly cited scientific articles**
  - Shows support from other scientists over time
  - **Truly a measure of "scientific acceptance"**

Greater value

Thoughts on How to Write a Scientific Paper

- **Outline the ideas first** with a purpose and plan
  - Decide on scope & audience and select target journal

- Write Materials and Methods section first

- Prepare all figures & tables
  - captions should be stand-alone

- Write Results and Discussion based on data shown in figures & tables

- Write Introduction to provide context to your work

- Prepare reference list according to journal format

- **Write <u>abstract</u> last and then finalize <u>title</u>**
  - Most critical pieces since they will be the most read!

Read the "Author Guidelines", which are available from most journals!

Journal of Forensic Sciences: https://onlinelibrary.wiley.com/page/journal/15564029/homepage/forauthors.html
Forensic Sci. Int. Genet.: https://www.elsevier.com/journals/forensic-science-international-genetics/1872-4973/guide-for-authors

Guide for Authors

📄 Download Guide for Authors in PDF ⬅ **Supplied with workshop packet**

FSI Genetics
Guide to Authors

- Your Paper Your Way

INTRODUCTION

- Types of paper

- Contact details for submission

- Submission checklist

BEFORE YOU BEGIN

- Ethics in publishing

- Studies in humans and animals

- Declaration of interest

- Submission declaration and verification

- Use of inclusive language

- Author contributions

- Changes to authorship

- Copyright

- Role of the funding source

- Open access

- Submission

PREPARATION

- NEW SUBMISSIONS

- REVISED SUBMISSIONS

- Article structure

- Essential title page information

- Highlights

- Artwork

- Tables

- References

- Video

- Data visualization

- Supplementary material

- Research data

AFTER ACCEPTANCE

- Online proof correction

- Offprints

- Author orders

AUTHOR INQUIRIES

My Experience with Writing

- **Focus**
  - **Environment** – I need **a quiet place** with no interruptions in order to get into the flow of writing
  - **Time** – I need **long blocks of time** (around 6 hours has been optimal for me, which typically means late at night)

- **Perspective**
  - **Think from the readers' perspective** (this will require learning to step outside of yourself and see what you have written with fresh eyes)
  - Work on **content flow and clarity** (this will require multiple re-writes to your manuscript)
  - **Know your audience** (you should select a journal from which you have read articles previously)

1968 1972 1977 1981 1991 **1992** **2001** 2005 2010 2011 2015 2017 2019
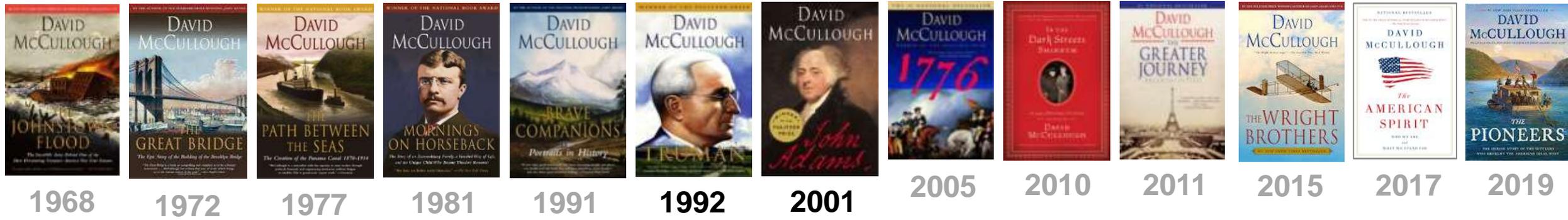
Pulitzer Prize winning books

David McCullough

"Writing is thinking. **To write well is to think clearly**. That's why it's so hard."

- David McCullough, Pulitzer Prize winner

(http://www.neh.gov/about/awards/jefferson-lecture/david-mccullough-interview)

Some Decisions to Be Made

- How to subdivide information into digestible sections?

- What information is needed in Materials and Methods to permit someone to follow and repeat your experiments?

- What should be covered in a figure or table?

- What should be supplemental material versus material in the paper itself?

Thoughts on Creating Appropriate Titles

- Consider that **your title will be read more than anything else in your paper** – perhaps by thousands of people
  - The entire paper may not be read by anyone (except hopefully at least your coauthors!)

- Robert Day defines a good title as containing "**the fewest possible words that adequately describe the contents of the paper**"
  - "The meaning and order of the words in the title are of importance to the potential reader who sees the title in the journal table of contents."
  - **"In designing the title, the author should ask: 'How would I look for this kind of information in an index?'"**
  - "Avoid abbreviations in the title"

Day, R.A. (1998). *How to Write & Publish a Scientific Paper, 5th edition*. Oryx Press: Phoenix, Arizona; see Chapter 4 "How to Prepare the Title"

Authorship

- **Authorship brings both credit and responsibility**
  - Can **each author** explain and defend the data and conclusions made in the article?

- Co-authors should read and agree with the final version of the article PRIOR to submission!

- The acknowledgments section exists to express appreciation for those who have contributed but not enough for authorship
  - not necessarily appropriate to include everyone in your lab
  - simple sample contribution should not guarantee authorship

For a discussion on authorship vs. contributorship, see
http://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html

- **Many journals now require the role of each listed author to be described**

Preparing **the Introduction** to a Paper

- The purpose of the introduction is **to describe the problem you are studying and some of its history** – **not to just cite previous papers from your group** (to try and improve someone's *h*-index)

- **You need to understand the history of the problem, but you do not need to share everything you know!**

"All problems have histories and the wisest route to a successful solution to nearly any problem begins with understanding its history."
- David McCullough (2017) *The American Spirit*, Simon & Schuster: New York, p. 20

Materials and Methods

- **Often the first portion of the paper written**

- Describe experimental details with enough information so that someone else could replicate your measurements if desired
  - List the city and country the first time a manufacturer's product is named
  - List software programs used and statistical tests employed for calculations
  - List any variations from manufacturer's protocol
  - Cite institutional review board approval (if applicable)

Results and Discussion

- Decide on how to tell the story of your project

- Prepare figures and tables first

- **Describe findings step-by-step in walking the reader through your data**

- Interpret your results in the discussion section in the context of other work, which may have been mentioned in the introduction
  - Sometimes a separate "Conclusions" section can be included at the end of your article

How Data Are Presented Makes a Difference

(A) t (time) = 15', T (temperature) = 32°; t = 0', T = 25°;
t = 6', T = 29°; t = 3', T = 27°; t = 12', T = 32°; t = 9', T = 31°

(B)

Time (min)	Temperature (°C)
0	25
3	27
6	29
9	31
12	32
15	32

(C)

Temperature (°C)	Time (min)
25	0
27	3
29	6
31	9
32	12
32	15

Gopen, G.D., & Swan, J.A. (1990). The science of scientific writing. *American Scientist, 78,* 550-558

Why Readers Prefer a Specific Order

Contextual information appearing in regular steps	The "new" (measured) information
Time (min)	**Temperature** (°C)
0	25
3	27
6	29
9	31
12	32
15	32

- In English, we read left to right

- Thus, we prefer **contextual information on the left** (in this example, time)

- And our brains prefer **the new information**, what we are trying to "discover" from the measurements made, **on the right** (in this example, temperature)

Gopen, G.D., & Swan, J.A. (1990). The science of scientific writing. *American Scientist, 78*, 550-558

The Same Data – but in a Figure Format

t (time) = 15', T (temperature) = 32°; t = 0', T = 25°;
t = 6', T = 29°; t = 3', T = 27°; t = 12', T = 32°; t = 9', T = 31°
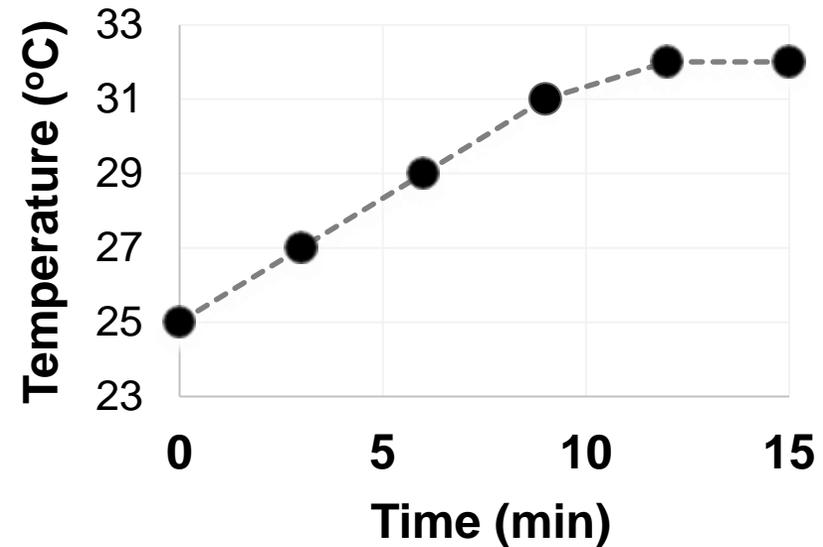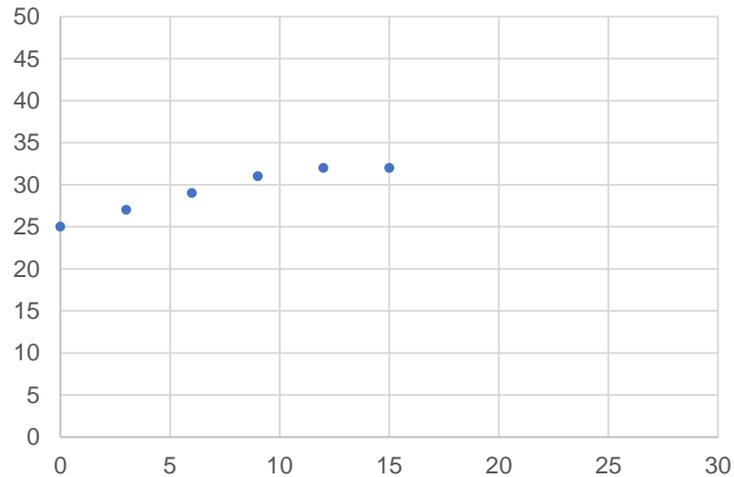
No axis labels or units (min, °C)
Small axis values
Not scaled to emphasize data
Data points are small
Grid lines can be distracting

Reference List

- Should be appropriate, relevant, and without any mistakes
  - In my opinion, your scientific abilities and reputation are connected to quality citations to appropriate references

- As an editor, I use the reference list as a gauge for the attention to detail that authors exhibit
  - If references are incomplete, have mistakes, or are in different formats, then I can lose confidence in quality of the work coming from the authors

- **Extensive self-citation suggests both a lack of humility and perhaps failure to appreciate the work of others in the field**
  - Are you really familiar with the literature if you can only cite your own work?

Acknowledgments

- Credit funding sources ($)

- Express appropriate appreciation for input of other individuals who are not coauthors but who assisted in some way
  - you can be specific with describing their contributions

- If the anonymous reviewers (and possibly editor) provided useful feedback in their initial reviews, then they may be recognized in the revised manuscript

Suggestions for Writing and Re-Writing

- Write, then read, then re-write, then read, then re-write (continue this process as needed)
  - **Dozens of drafts may be required to polishing a text into the desired document**

- **Read the text out loud as you are editing…**
  - Write as if you were presenting to a friend

- Write in short sentences where possible
  - Omit unnecessary words
  - Don't use words your audience will likely not understand. Your goal is to clearly explain your work, not sound smart.

See Martin W. Gregory (1992) "The infectiousness of pompous prose", *Nature* 360: 11-12

The Science of Scientific Writing
George Gopen & Judith Swan (1990)

Some Recommendations to Improve Accessibility:

1) Put grammatical subjects close to their verbs

2) Put information intended to be emphasized towards the end of a sentence (the **stress position**)

3) Place the person or thing whose "story" a sentence is telling at the beginning of the sentence (the **topic position**)

4) Provide context for the reader before sharing anything new

To provide good flow, place old information in topic positions, and place new, emphasis-worthy information in stress positions.

Gopen, G.D., & Swan, J.A. (1990). The science of scientific writing. *American Scientist, 78,* 550-558

An Example of Using These Recommendations from Gopen & Swan (1990)

Authority established

1

subject — *verb*

"The Forensic Science Service recently noted that sporadic contamination

of consumables used in DNA testing, such as the small tubes in which the

3 *topic position*   **4** *context provided*

PCR amplification is performed, can introduce extraneous DNA profiles

stress position

2

(Howitt *et al.* 2003)."

Source provided

Passage from J.M. Butler (2005) *Forensic DNA Typing, 2nd edition*, p. 153

Additional Thoughts

- Writing involves a lot of re-writing (edit, edit, edit)

- Re-read your manuscript one final time before submission (perhaps after waiting a day or two to approach it with a fresh perspective)

- **Ask others for their input** (and be willing to listen and learn from their suggestions)
  - At NIST, we have an internal review process for all manuscripts before they are submitted to a journal

Errata and Letters to the Editor

- **Mistakes happen and should be corrected to fix the scientific record**

- If you discover the mistake
  - a Letter to the Editor can be written and submitted to note the correction needed (called an "erratum"; "errata" is plural form)

- If someone else discovers your mistake or raises a concern (regarding an issue that is real or perceived), then the critic(s) may write a Letter to the Editor exposing the issue
  - Original authors being criticized are typically given an opportunity to respond
  - Be kind in responding to critics and treat them with respect even if you disagree with their position
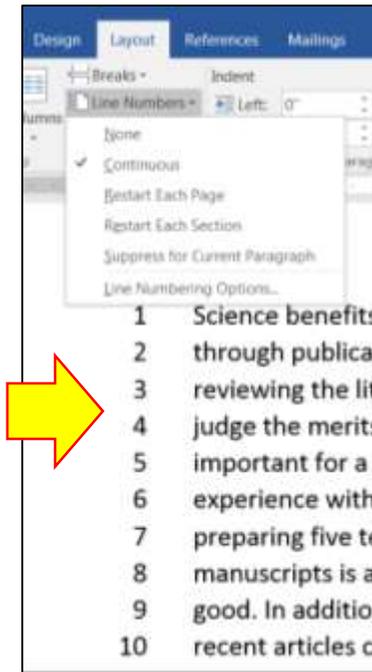
Importance of Selecting an Appropriate Journal

- Depends on your intended audience

- Speed to publication

- Impact factor of the journal

- Remember that **peer-review is not perfect**
  - If a poor quality article (or one you have a specific concern with) makes it through the process, then a letter to the editor may be an appropriate avenue to pursue further clarification or correction

- **An editor can reject an article if it is not considered appropriate for the journal's intended audience**

Manuscript Submission

- Cover letter
  - Although not always required, it helps to **introduce your article with a brief letter to the editor** briefly reviewing your work and its importance

- Suggested reviewers
  - You are welcome to **identify potential reviewers** and reviewers who may have a conflict of interest (suggest who should not review your work)

- **Do NOT co-submit** your article to another journal!
  - We have caught several authors who have done this in the past few years and have banned them from submission to both journals for a period of time

Other Items with Submissions

- Review the Journal's Guide for Authors
  - https://www.elsevier.com/journals/forensic-science-international-genetics/1872-4973/guide-for-authors

- **Include line numbers** next to the text for submitted manuscripts so that these numbers can be used for peer-review purposes

- Please **work on the English grammar** and spelling BEFORE submitting the manuscript (peer-reviewers should not be your language police)

Some Reasons Why Articles Are Rejected

- Material covered in the article is deemed **inappropriate for the journal or** **insufficiently novel** by the reviewers and/or the editor

- **Poor English language and grammar** make it challenging for the article to be understood

- One or more of the reviewers feel that **conclusions cannot be supported** by the results

- **Poor experimental design** such that results obtained are not meaningful

- **Rude responses** to reviewers and/or editors **that fail to address concerns** raised during revision

Responding to Reviews with Revisions

- Address reviewer and editor concerns point-by-point in a direct and pleasant manner
  - Your purpose is to convince the editor (and often the original reviewers) that you have carefully considered the initial concerns raised

- Provide respectful rebuttals
  - **Criticism is hard to take but is necessary to improve your work**

Potential Reasons for Delays

- Handling editor may be busy or on travel and slow in assigning potential reviewers

- Potential reviewers decide not to accept and editor has to find other reviewers

- Reviewers are busy and delay turning in their reviews (and editor may have to wait for a second or third review before making a decision)

- Once all reviews are into the editorial system, handling editor is notified but may be busy or on travel and slow in making a decision

Some Problems I Have Seen as an Editor

- All authors did not review article before submission of revision (and the corresponding author had moved to another laboratory)

- Methods were missing critical details so that experiments could not be repeated

- Misspellings and grammar mistakes

- Potential conflicts of interest not identified

Galley Proof Review

- Galley proofs are provided to authors to verify the type composition when a manuscript is laid out for publication

- **Review them carefully** – **all authors should see them** – this is your last chance to avoid appearing foolish before your article goes into print…

- **This can be a lot of work** for the first author and/or corresponding author

The Elsevier Publishing Campus

https://www.publishingcampus.elsevier.com/

Free lectures, training and advice in:

- **writing** a journal article or book,
- learning **how to conduct peer review**,
- **understanding** research and publishing **ethics**
- **preparing a successful grant application**

My Overall Summary Thoughts

`READ`

- The best preparation to write well is to **critically read a lot of papers**

`WRITE`

- **Writing well takes practice** and is one of the most valuable skills you can develop
  - Effective communication benefits scientific advancement

`REVIEW`

- **Help review** the work of other scientists
  - As an editor, I appreciate your willingness to be a reviewer when you are asked to help
  - An important way to give back to the community

Do's and Don'ts of the Review Process

Do

1) Provide clear comments to authors

2) Be consistent with comments to authors and editor

3) Provide specific references to text to support your critiques

4) Reread your review to ensure you are not too harsh

5) Treat authors of a manuscript as your equal independent of quality

Do Not

1) State in your comments to the authors your recommendation to the editor

2) Praise manuscript in authors comments and disparage it in confidential comments to editor

3) Make vague text references or opinions not supported by data

4) Send off your review without looking over it at least once

5) Talk down to authors (remember that science is a collaborative process)

Lovejoy, T.I., Revenson, T.A., France, C.R. (2011). Reviewing manuscripts for peer-reviewed journals: a primer for novice and seasoned reviewers. *Annals of Behavioral Medicine, 42,* 1-13.

2017 Review of Peer-Review

Forensic Science International 2017, 277, 66-76

Review Article

Peer review in forensic science

Kaye N. Ballantyne[a,b,*], Gary Edmond[c], Bryan Found[a,c]

[a] Office of the Chief Forensic Scientist, Victoria Police Forensic Services Department, Macleod Victoria, Australia
[b] School of Psychology and Public Health, La Trobe University, Bundoora, Victoria, Australia
[c] Program in Expertise, Evidence and Law, Faculty of Law, University of New South Wales, Kensington 2052, Australia

- **Examines different types of peer-review (editorial, scientific community, technical & administrative, verification & replication)**

- Describes how forensic practitioners should approach and use peer-review and how it should be described in expert reports and testimony

- **Key Finding**: "While peer-review has considerable potential, and is a key component of modern quality management systems, **its actual value in most forensic science settings has yet to be determined**."

Comments on Technical and Administrative Review

- This article notes: "No published, empirically derived reports exist regarding the ability for technical and administrative reviews to detect errors, enhance accuracy or improve the communication of opinions and results, despite their mandated use."

- It continues: "Anecdotally, examiners regard technical review as valuable in **confirming standard operating procedures were followed**, **ensuring case file contents are complete**, and **that documentation of examinations, methods and findings is sufficient**."

- The authors point out: "…no standards or training on how to conduct technical reviews, what should be checked by reviewers, and to what level any disputes or disagreements should be documented… no detailed guidance exists for how to develop [written procedures on what to review], or how to measure empirically that the reviews fulfil the stated aims of enhanced accuracy."

Extra Slides

Journal Editors (as of Sept 2019)

Peter Schneider (Associate Editor)

Leonor Gusmão (Associate Editor)

Angel Carracedo (Editor-in-Chief)

Walther Parson (Associate Editor)

**Peter Vallone** (Associate Editor)

Adrian Linacre (Associate Editor)

Started in 2017   Started in 2019

Summary of *FSI Genetics* Articles

- **1912 total articles** (as of 9/6/2019)
- **68 issues so far (in 42 volumes)**
  - **now 6 issues (volumes)/year**
- **1891 published**
  - **1418 in print + 473 e-articles**
  - *13 in Nov. 2019 issue in progress (vol. 43)*
  - *8 in press* (available on journal website or Science Direct; as of 9/6/2019)
- Most accepted articles are published in print (with page numbers) in less than 4 months
  - Article-Based Publishing has increased speed…

Forensic Science International (FSI) Family of Journals is Expanding
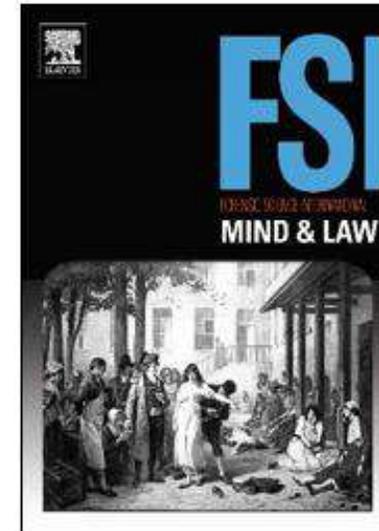
- Some new journals are being added by Elsevier in January 2020
- *FSI Reports* provides a new place for population data and validation data

Handling Population Genetics Articles

STRidER — STRs for identity ENFSI Reference database, v2 | GMI TIROL | iSFG

Leonor Gusmão   **Martin Bodner**
(Associate Editor, (Associate Editor,
FSI Genetics)   *FSI Reports*)

- **Martin Bodner** (Innsbruck), who runs STRidER, has been appointed Associate Editor of the new journal *FSI Reports*

- Martin will work with Leonor Gusmão to help handle population genetics articles

Examples
(hands on exercises and discussions)

Charlotte & John

Comparing Four Extraction Protocols – Quantitation Data

Average of total amount of DNA recovered

  Protocol 1 – 50 ng total

  Protocol 2 – 38 ng total

  Protocol 3 – 70 ng total

  Protocol 4 – 23 ng total

What conclusions might you draw from these results?

Comparing Four Extraction Protocols – Quantitation Data

Table 1. Quantitation values from each sample using the four extraction protocols.

	Sample 1	Sample 2	Sample 3	Average
Protocol 1	100*	50	1	50
Protocol 2	40	39	36	38
Protocol 3	55	75	80	70
Protocol 4	15	0	25	23

* Total amount of DNA recovered in ng

What conclusions might you draw from these results?

Problematic Studies

- Obtaining DNA from Fingerprints
  - How to control for the starting sample?
  - How to design the experiment?
  - What questions can you address?
  - How far can you go with the conclusions?
  - What are the limitations?

- Transfer studies
- Body swabs

Conclusion Statement

Amplification kit X was better than kit Z at detecting mixtures from fingerprints (performed in same laboratory).

- What questions would you want to ask about the conclusions and experimental design?

- What if the two studies were done in different labs?

Handshaking Experiment

Paper 1 says no secondary transfer was observed.

Paper 2 says secondary transfer was observed 80% of the time.

What questions do you want to ask about these studies?

What could be different to account for the observed results and conclusions?

Cautions

- Word usage
  - "optimized" – what is it optimized for
  - "clearly demonstrates"
  - superlatives – generally not needed and not helpful
  - "significant"
  - "novel"

Francis Crick

The Astonishing Hypothesis (1994), page xiii

"There is no form of prose more difficult to understand and more tedious to read than the average scientific paper."

An Example of a Recent Article…

Research paper

STRmix™ collaborative exercise on DNA mixture interpretation

Jo-Anne Bright[a,*], Kevin Cheng[a], Zane Kerr[a], Catherine McGovern[a], Hannah Kelly[a], Tamyra R. Moretti[b], Michael A. Smith[b], Frederick R. Bieber[c], Bruce Budowle[d], Michael D. Coble[d], Rashed Alghafri[e], Paul Stafford Allen[f], Amy Barber[g], Vickie Beamer[h], Christina Buettner[i], Melanie Russell[j], Christian Gehrig[k], Tacha Hicks[l], Jessica Charak[m], Kate Cheong-Wing[n], Anne Ciecko[o], Christie T. Davis[p], Michael Donley[q], Natalie Pedersen[r], Bill Gartside[s], Dominic Granger[t], Erin Grammer[x], Ma..., Eugene Lien[D], Emil..., Alyse Yacovone-Ma..., Gary Shutler[M], Kate Stevenson[n], April R. Stonehouse[N], Lindsey Smith[O], Julie Murakami[P], Eric Halsing[Q], Darren Wright[R], Leigh Clark[S], Duncan A. Taylor[T,U], John Buckleton[a,V]

[a] Institute of Environmental Science and Research Limited, Private Bag 92021, Auckland, 1142 New Zealand

174 participants from 42 laboratories
(349 interpretations submitted across two samples)

Fig. 3. A plot of the log(*LR*) versus *NoC* for Sample 1. Submissions were interpreted assuming three (triangles) or four (diamonds) contributors.

Abstract: An intra- and inter-laboratory study using the probabilistic genotyping (PG) software STRmix™ is reported. Two complex mixtures from the PROVEDIt set, analysed on an Applied Biosystems™ 3500 Series Genetic Analyzer, were selected. 174 participants responded. …

Kevin Cheng will be discussing this article
Thursday (Sept 26) from 9:00-9:30am

Fig. 4. Sample 1 green channel. The D18S51 locus is the second from the right and shows seven peaks above the analytical threshold.

Bright et al. (2019) STRmix collaborative exercise on DNA mixture interpretation. *Forensic Sci. Int. Genet.* 40:1-8

A Summary Analysis of the Article…

Article	Performance-based Assessment (empirical error rates?, specific LR values listed?)	Factor Space Covered (number and range of tests performed?)	Limitations Identified (what are they?)
Bright et al. 2019 "STRmix collaborative exercise on DNA mixture interpretation" *Study organized by and data collected and analyzed by PGS developer*	174 participants from 42 laboratories (349 interpretations submitted) using STRmix v2.4 (64.5%) or v2.5 (35.5%); all LR values submitted are in supplemental materials	Two mixtures from PROVEDIt data set (GlobalFiler, ABI 3500); "Case 1": **4p (1:1:4:1)** 105 pg total (15,15,60,15pg) V was major and S minor with two allele drop-outs (vWA-18 and D1-16); "Case 2": **3p (1:4:4)** 750 pg total (83,333,333pg) both S & V were major profiles with no allele drop-out; *no discussion of degree of allele sharing*	Differences in log(LR) due to MCMC variation were less than one order of magnitude with good quality data; CE analysis methods; impact of non-resolution of CE peaks separated by 1 bp

Examine results, conclusions, etc. along with specific figures and other details…

Summary Points (1)

- Start with a defined clear question

- Make a good experimental design
  - Consider carefully what samples to use
  - Study a single variable at a time, if possible
    - If not, then think of how to control for variables (or redesign your experiments)
  - Think about what data to collect to address the question
  - Decide how to analyze and share the data

- An ideal experiment gives you useful data no matter what the outcome

Summary Points (2)

- Carefully write-up your experiment
  - With as much detail as is needed to repeat & understand how the data were evaluated
  - Have someone else read and critique your write-up
    - take comments from trainees to improve

- Carefully review published studies or validation studies
  - What's good, what's missing or not so good?
  - Do the data seem sound?

Summary Points (3)

- Ask questions of the results reported
  - Do the conclusions fit with the results stated?
  - Do you have enough information to evaluate?
  - Do you agree with the conclusions?
  - How do results relate to other studies? Were they discussed?

- A good paper (or validation summary) should spell out any limitations of the study and what couldn't be addressed

Q&A

Charlotte & John

Journal Clubs

- A journal club is a group of individuals who meet regularly (in person, online, or both) **to critically evaluate recent articles** in the academic literature *(Wikipedia)*

- **Do you have one in your laboratory?**

- **How often do you meet? Is it effective?**

- We can learn from how the medical profession has conducted journal clubs as a method to learn from colleagues
  - Deenadayalan, Y., et al. (2008) How to run an effective journal club: a systematic review. *Journal of Evaluation in Clinical Practice* 14(5): 898-911

How Do You Keep Track of Your Literature? Do You Use a "File Pile" Filing System?

Office of a colleague who has been at NIST for >40 years
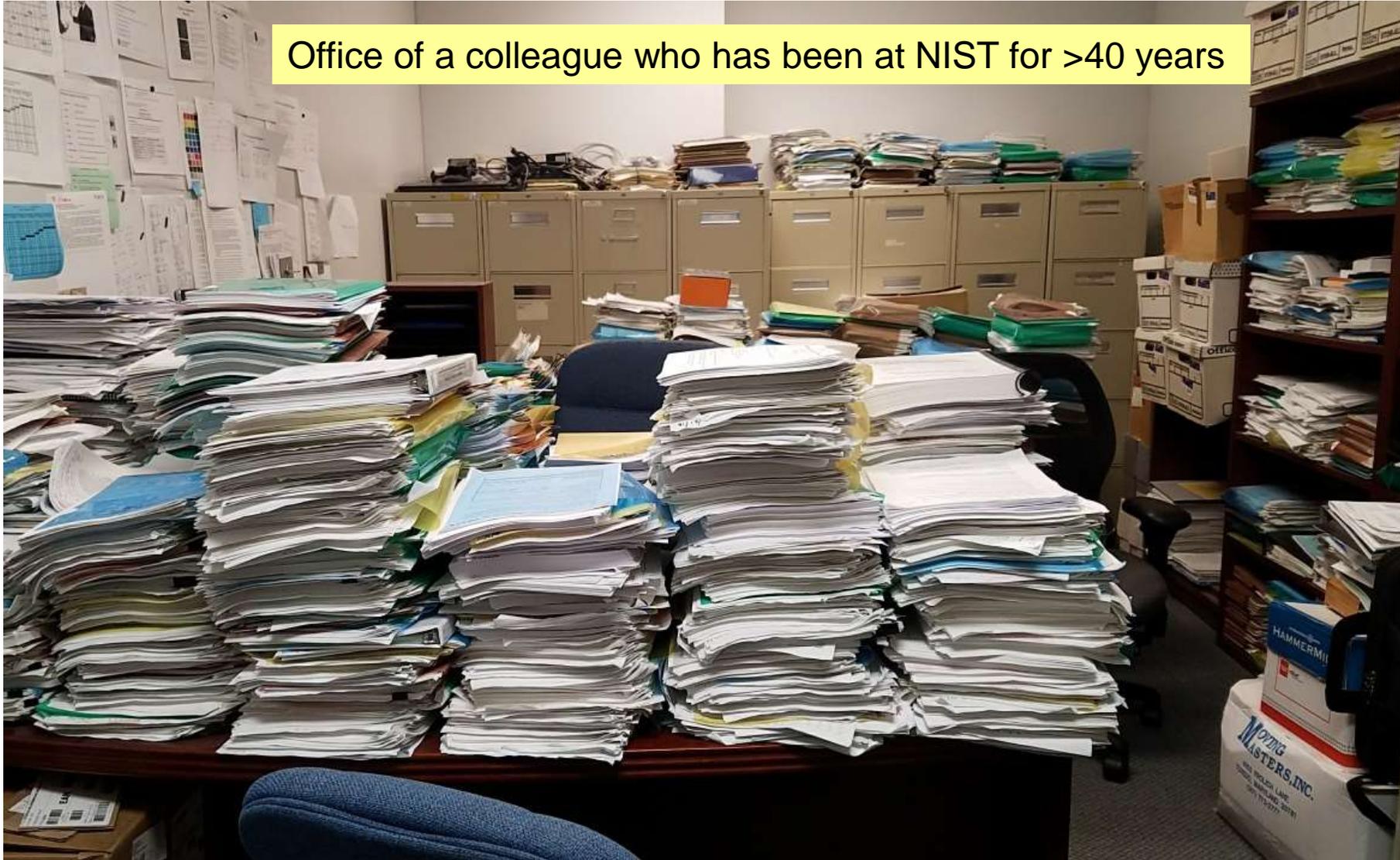
Further Information on Scientific Publication

Contents lists available at ScienceDirect

Forensic Science International: Genetics Supplement Series

journal homepage: www.elsevier.com/locate/FSIGSS

ELSEVIER

CrossMark
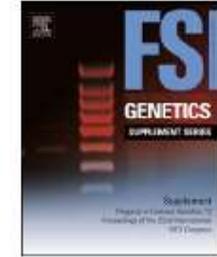
The triad of scientific publication: Reading, writing, and reviewing

John M. Butler*

National Institute of Standards and Technology, Gaithersburg, MD, USA

…"An important purpose of scientific publication is to document work performed to aid the advancement of science. In short, writing enables history."

…"Reviewing manuscripts is a chance to influence the community for good and to provide service back to journals…"

A 2016 AAFS Workshop on Improving Forensic Science Literature Searches

Susan Makar   Amanda Malanowski   Matthew Wood   John Butler   Jeff Teitelbaum   Melissa Taylor

W1: Information Does Exist Beyond the First Page of Your Google® Search!
American Academy of Forensic Sciences
Las Vegas, NV (February 22, 2016)

WELCOME Las Vegas 2016

Information Does Exist Beyond the First Page of Your Google® Search!
Tools and Strategies for Forensic Science Literature Searching and Use

Chair: **John M. Butler**
Co-Chair: **Matthew R. Wood**

FORENSIC SCIENCES

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

iso

WASHINGTON STATE PATROL

Topics Covered:

• Why Search & Read the Literature

• Free Information Resources

• Using Web of Science

• Case Examples

• ForSciPub Vision

• AAAS, NCFS, and OSAC Activities

http://strbase.nist.gov/training/AAFS2016_LiteratureWorkshop.htm

INTERPOL

18th INTERPOL International Forensic Science Managers Symposium
Lyon, France

11-13 October 2016
Review Papers

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The opinions expressed are those... governments, or Interpol.

3-year Review of Forensic Science Literature

- Interpol holds a forensic science symposium **every three years** that involves a review of literature in multiple forensic disciplines

- With the last cycle of reviews in 2016, **17 topics** are reviewed by **authors from countries around the world** that cover a total of **4891 reference citations**

- A 769 page (8.5 MB) pdf file

Available on the INTERPOL website at
https://www.interpol.int/content/download/33314/426506/version/1/file/INTERPOL%2018th%20IFSMS%20Review%20Papers.pdf

Forensic DNA Review for INTERPOL 2016-2019

- Written in July 2019 by John M. Butler and Sheila Willis
- **Examines 235 articles** published in 35 different journals

- Topics covered
  - Core STR loci expansion
  - Rapid analysis of STR markers
  - Investigative genetic genealogy
  - Next-generation sequencing
  - DNA mixture interpretation and probabilistic genotyping software
  - DNA transfer and activity level evaluations
  - Forensic biology and body fluid identification
  - DNA phenotyping
  - Privacy and ethical issues
  - Guidance documents
  - Contamination avoidance and DNA success rates
  - Recent special issues and review articles of note

A Recent Review Article on Forensic DNA

246 references cited

Forensic DNA Analysis

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Forensic serology
Chemical & spectroscopic methods
Body fluid identification via RNA typing
Proteomic body fluid identification
Epigenetics
DNA extraction & sample recovery
Genotyping methods using STRs
Mixtures and probabilistic genotyping
Estimating the number of contributors

Y-STRs and X-STRs; Y-SNPs and X-SNPs
SNPs; Insertion/Deletions; Mitochondrial DNA
Ancient DNA, bones, and teeth
Improving DNA extractions from teeth and bone
Nonhuman DNA; Wildlife forensics
Drug sourcing
Massively parallel sequencing
The microbiome as a source of DNA
Postmortem interval

Thank you for your attention
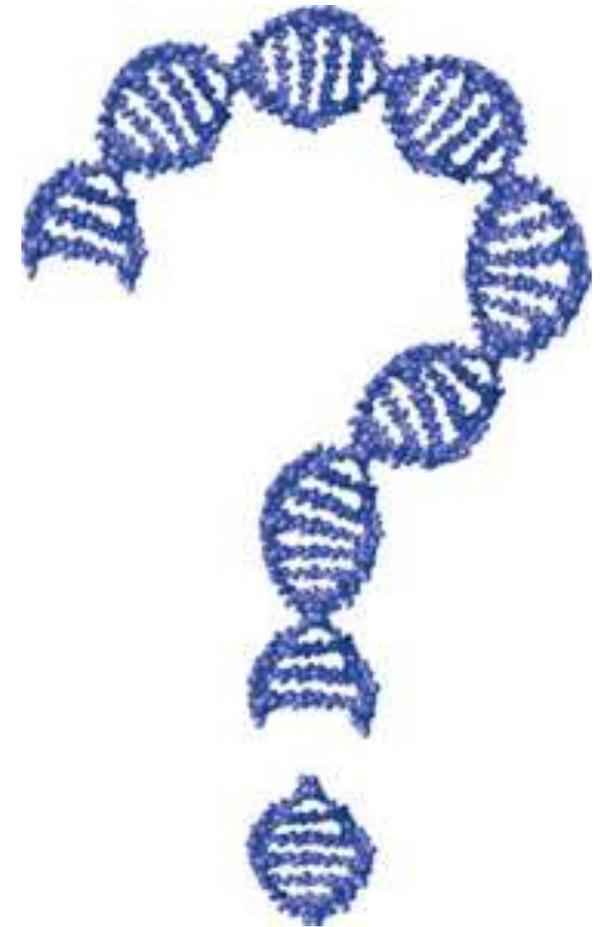
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A copy of this presentation will be available at:
http://strbase.nist.gov/training.htm