

Literature Analysis

Bioen 326
lecture 20 for 2013

Overview of Lecture

- Level of Certainty in Literature Analysis
 - why we care
 - words we use to describe
 - how we determine level of certainty
- Describing what others say:
 - direct quotes
 - paraphrasing
 - citations
- Examples from Elias 2012 article on viscoelastic materials

Level of Certainty

Level of Certainty (LoC)

- You have learned to find articles about your topic and evaluate the source; e.g. is it peer-reviewed journal?
- When we read literature, we don't just ask, "**what do the authors learn?**"
- We ask "**How certain are they about this?**"
- Why do we care about the level of certainty?

- Today we learn how to critically analyze an article to determine the level of certainty

Authors Propose a New Diagnostic Test.
How Certain should they be,
that the Test is Better?

- They conclude that doctors should use the new test.
- They conclude that the test should be studied in clinical trials.
- They conclude that a new test should be designed based on their results.
- They conclude that a hypothesis should be tested, since it could lead to a way to design a new test.

We like to hear these ideas even when they are uncertain.

Describing Level of Certainty

List ways you might qualify a statement, from most certain to least certain:

Determining Level of Certainty

- **Prove:** requires a mathematical proof; not in biology!
- **(DSI) Demonstrate/Show/Indicate**, or an **Unqualified statement:** all reasonable alternatives were eliminated. HIGH
- **Strongly Suggests/May DSI/Seems/Appears:** the most likely alternatives were eliminated. MEDIUM
- **Suggests/Is consistent with:** if any alternative is considered, it was not eliminated. LOW

Certainty of Direct Observations

- When you describe the results of a type of experiment, you can use DSI if:
 - you have performed the proper positive and negative controls
 - you have performed a statistical analysis if there is any doubt about statistical significance
 - (depending on the expense) you have repeated the experiment at least twice to make sure that no mistake was made
- Until you have done the controls, you shouldn't use DSI and the work shouldn't be published. Does the paper conform to this?

Indirect Conclusions

Work is more significant if one can extrapolate from an experiment to what it could mean in a more general sense. For example:

- Propose a (conceptual or mathematical) model for a process underlying your observations.
- extend your observation to other types of molecules, cells, devices, diseases or organisms.
- propose alternative ways to build devices or treat patients

Certainty of Indirect Conclusions

- To increase level: Pose the alternatives people may consider, and contradict them with:
 - additional experiments
 - logical arguments or calculations
 - observations from the literature
- *People's training affects their identification of alternatives and their likelihood.*
- If you can't eliminate alternatives, still note the indirect conclusion, but use a conservative level of certainty.

Summary

- The level of certainty is applied to each statement or conclusion, NOT to the paper as a whole.

Certainty X Significance = Impact of Conclusion

- The impact of the paper is more or less determined by the highest Impact conclusion.

Skills you need to Learn for 326:

- Identify and describe the author's claimed level of certainty.
- Evaluate for yourself the level of certainty of a statement in a paper.
 - direct results
 - indirect conclusions

Paraphrases, Quotations, and Citations

Also called... How to avoid Plagiarism

Definitions

Direct Quotes

- use exact wording
- place in quotation marks
- cite the original article

Paraphrase

- Use your own words to describe someone else's ideas or data.
- cite the original article

Indirect Quotes

- use close wording
- use attributing words like "the authors argued that" or "he said that" instead of quotes.
- cite the original article

Plagiarize

- use someone's words without quotation marks or attributes, **even if you cite them.**
- Use someone's ideas or data without citing them.

Wendy's Rule of TextBook: You can **paraphrase** things found in undergrad textbooks without a citation

Conventions in Scientific Writing

- Use Paraphrasing as a general rule.
 - Your context is different from the original paper, so the words they used rarely fit well.
 - It takes work to think of the best way to frame their ideas for your context, but the work saves your reader time.
 - Thus, quotations are rare in scientific writing.
- Use Quotations (direct or indirect) when
 - you are discussing the author's wording or opinion.
 - there is no better way to state it for your purpose. The words should be so clear that you do not look lazy.
- **Thus, for this class, you should use quotes ONLY to describe the author's claimed level of certainty.**

Examples

JOURNAL OF THE MECHANICAL BEHAVIOR OF BIOMEDICAL MATERIALS 12 (2012) 63–73

Viscoelastic characterization of rat cerebral cortex and type I collagen scaffolds for central nervous system tissue engineering

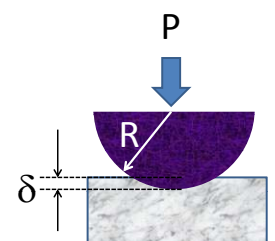
Paul Z. Elias^{a,b,*}, Myron Spector^{a,c}

Significance of Elias Paper

- In regenerative medicine, we want to implant a scaffold in the body to be populated by implanted or host cells, to develop new tissue.
- The scaffold needs to have similar mechanical properties to the host tissue
 - to control cell fate (mechanotransduction)
 - to avoid damaging host or implant.
- Here they note that same Young's modulus is not enough for viscoelastic material.
- They compare brain and collagen scaffolds

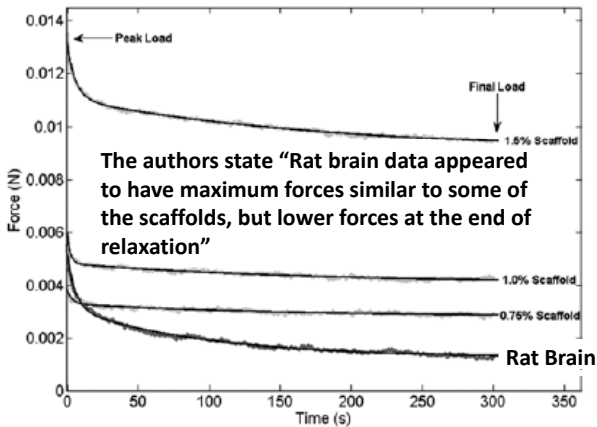
The Mechanical Test

- Indentation test: press hard hemisphere of radius R against softer material, and record indentation distance, δ , and load, P
- The shear modulus G is more important for this study than the elastic modulus E . Hydrogels are often incompressible, so $\nu = 0$. In this case, G can be calculated, and from it $E = 2(1 + \nu) = 2G$:



$$G = \frac{3P}{16\delta\sqrt{R}\delta^{3/2}}$$

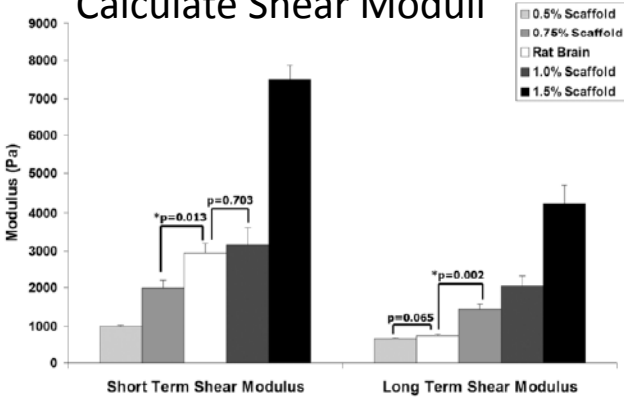
Fig. 2: Stress Relaxation: hold δ measure P



What is Their Level of Certainty?

- The authors qualify their statement with the word “appeared”, indicating a moderate level of certainty. Why? Do we agree with this?
- The figure only shows a single measurement on each sample, so the results could have been due to a random mistake, or could vary so much between experiments or different brain samples that they don’t repeat.
- It’s more likely to be true than not, however, so it is appropriate to use “appear” rather than “suggests” or something else.

Calculate Shear Moduli



They calculated G at start and end of stress relaxation from the force using:

$$G = \frac{3P}{16\delta\sqrt{R}\delta^{3/2}}$$

Now What is Their Level of Certainty?

- Now they have done multiple pulls and calculated statistics.
- Were they done on different samples? that is, truly independent?
- since we are comparing samples, negative and positive controls are not so obvious.

Deviatoric vs Volumetric Stress and Strain

- Volumetric stress and strain is the part due to average normal stress, which changes the volume.

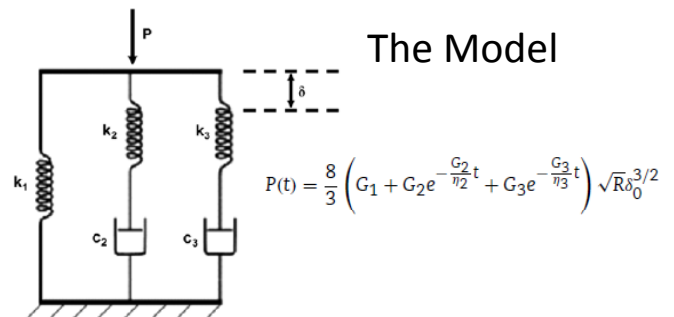
$$\sigma_{av} = \frac{1}{3}(\sigma_x + \sigma_y + \sigma_z)$$

- Deviatoric stress and strain is in a state of pure shear, which changes the shape.

$$\begin{bmatrix} \sigma_x & \tau_{xy} & \tau_{xz} \\ \tau_{xy} & \sigma_y & \tau_{yz} \\ \tau_{xz} & \tau_{yz} & \sigma_z \end{bmatrix} = \begin{bmatrix} \sigma_{av} & 0 & 0 \\ 0 & \sigma_{av} & 0 \\ 0 & 0 & \sigma_{av} \end{bmatrix} + \begin{bmatrix} \sigma_x - \sigma_{av} & \tau_{xy} & \tau_{xz} \\ \tau_{xy} & \sigma_y - \sigma_{av} & \tau_{yz} \\ \tau_{xz} & \tau_{yz} & \sigma_z - \sigma_{av} \end{bmatrix}$$

stress tensor = volumetric stress + deviatoric stress

- The Authors use deviatoric stress and strain in developing their model since it is for pure shear.



- The authors derive the stress relaxation response to a 5-parameter model (after replacing k_i with G_i and c_i with η_i)
- They then fit the model to data to calculate the parameters for each of their samples.

for example

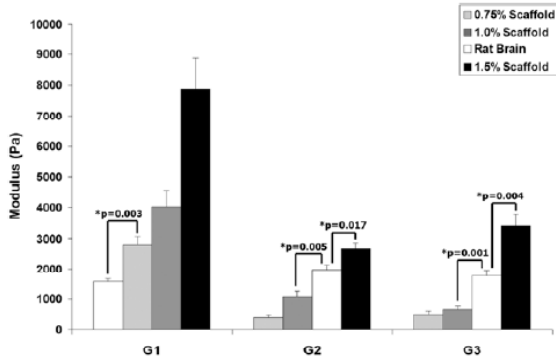


Fig. 4 – Shear moduli G_1 , G_2 , G_3 for rat brain and collagen

Level of Certainty for conclusions from Models or Data analysis

- Conclusion about the model can be stated with same certainty as the data
- Conclusion that extends the model conclusions to the real system should be more conservative
- In this paper, do they rely only on their parameter estimation to conclude that the brain has different viscoelastic properties from collagen scaffolds?

Statement in Discussion:

For the scaffolds, the increase in relaxation with increasing collagen concentration may be the result of increased water uptake by the scaffold struts. Increasing the collagen concentration further would likely achieve more relaxation, but the associated increase in stiffness might not be compatible with the desired application. While there are clearly limitations in terms of how a particular biomaterial can be manipulated to alter its mechanical properties, addition of other materials to form a composite may be a helpful tool. As an example, elements of brain extracellular matrix such as hyaluronic acid can be incorporated into a collagen scaffold so that it more closely resembles the brain from a material standpoint (Tang et al., 2007; Wang and Spector, 2009). Addition of hyaluronic acid could potentially increase the amount of water in the struts of a hydrated scaffold, which may then result in a greater degree of relaxation without increasing the stiffness as much as collagen has been shown to do.

Notes from class discussion

Authors propose addition of hyaluronic acid (HA) could match relaxation better.

- How certain do the authors claim to be?
 - Low to very low, because they used words like 'can be', 'could potentially', and 'may result in'
- Do you agree? More or less, because certainty is
 - increased by citations
 - Decreased by not being specific about citations and mechanisms (see below)
- Should they have addressed this point at all?
 - Yes, this could inspire new experiments with HA
- How could they have increased the certainty?
 - Cite papers showing that HA increases water uptake
 - Determine whether increased collagen increased water uptake in their samples or those of others (citations)
 - Add HA to their scaffolds and repeat tests