NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

Finding Fact:

Evaluating Science Writing Using a Neuroscience Study

by

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Part 1 – Weekend in the Park

On Sundays, Central Park is full of runners and the energy is palpable. Your friend, Maria, is training for the upcoming New York City Half Marathon in the spring and you are meeting up with her for coffee after her run. She is brimming with energy and smiling, even after the workout.

After a sweaty hug she exclaims, "I love the energy I get from running, but I've also noticed that my mind seems sharper. I can remember what I ate for breakfast each day for the past two and a half weeks, and you might be disappointed to know that I remember you wore this outfit three days ago and two days before that. Maybe it's because I can clear my mind when I'm running, you know, like meditating. Considering you're now an associate news editor at a cutting edge neuroscience journal, I figured that you would be able to tell me if what I'm noticing is something real or if it's all in my head. No pun intended."

You respond, "Ok, first of all, these are the clothes that I wear in the ceramics studio and I've been there a lot in the last week. And second of all, I actually do think I know what you're referring to. Some studies have shown that exercise can not only slow down memory loss, but also improve memory. I specifically mean episodic memory, which is associated with the hippocampus and is described as the ability to remember specific autobiographical episodes or scenes. I'm actually expecting to review some work on the subject soon. I'll let you know if I come across some information!"

Part 2 – At Work

As expected, when you get to your office, there is a press release for a peer-reviewed article that is about to be published sitting on your desk. That means that by the end of the day there will be a news article covering the findings for you to edit.

Whenever you are editing a news article you always read the scientific article associated with it. You realized that was the best way for you to perform your job well, offering insightful edits on the content for the general public and setting the bar high for what gets published. Time to get to work.

Questions

1. What question are the researchers attempting to address?

2. What hypothesis is posed by the researchers?

PRESS RELEASE

Exercise Training Increases Size of Hippocampus and Improves Memory

It's no secret that as we get older we often become more forgetful. We forget our keys, where we parked the car, and sometimes appointments or meetings. Research shows that this phenomenon might be at least partially due to a shrinking hippocampus, a portion of the brain located in the medial temporal lobe that is responsible for episodic memory in addition to a few other functions. We are always trying to hack our lives, however, and develop ways to keep ourselves healthier longer. Sometimes this requires medical intervention, other times it might just be behavioral changes. Behavioral changes are often less costly, less invasive, and overall easier to enact than a potentially risky medical procedure. Anecdotally, many adults have noted that consistently participating in certain activities helped keep their minds sharp. In fact, neuroscience research is beginning to support what many people personally experience in their daily lives. Researchers from the University of Pittsburgh, University of Illinois, Ohio State University, and Rice University found that aerobic exercise in adults resulted in an increase in hippocampal volume. This led not only to having sustained memory when their sedentary peers were experiencing memory loss, but also improved memory.

****Distribute Widely****

3. In this study, what would instrumentation ideally be measuring to address the hypothesis?

4. What predictions (deductions) could you make if the above hypothesis is supported?

Part 3 – Methods

In the study (Erickson *et al.*, 2011) mentioned in the press release, researchers performed a single-blind, randomized control study, meaning that the control and experimental groups were chosen at random. The age and gender of all participants were recorded. Participants were either required to engage in moderate-intensity aerobic exercise or strengthening/toning exercises three days a week. The experiment lasted one year and measurements for hippocampal volume, additional brain structure volume, BDNF levels, VO2max, and fitness improvement were taken at the onset of the study, six months in, and upon completion of the one-year study. Volume measurements of the hippocampus and other brain structures were made using magnetic resonance imaging (MRI).

Useful Vocabulary

Neurogenesis: The creation of new neurons.

BDNF: Protein that promotes neurogenesis.

VO2max: Maximal oxygen uptake (ml/min/kg); measure of how much oxygen is used during physical exertion. For example, professional athletes tend to have higher VO2max.

Questions

1. What was the control group in this study?

2. The table below (Table 1) provides the recorded demographic information for the participants. Is there a statistically significant difference between the ages of the experimental and control group? Why is this important?

   Table 1. Demographic information for experimental and control group participants in the exercise study. Values obtained from Erickson *et al.* (2011).

Characteristic	*Experimental Group*	*Control Group*
n	60	60
Average Age (yrs)	67.6	65.5
Age Standard Deviation (yrs)	5.81	5.44
Sex (% female)	73	60

3. What are the limitations of the instrumentation used and measurements taken in this study?

4. Using the description in the press release and your existing knowledge, fill in the blank graphs (Figure 1, right) to predict the results based on the hypothesis you previously recorded.

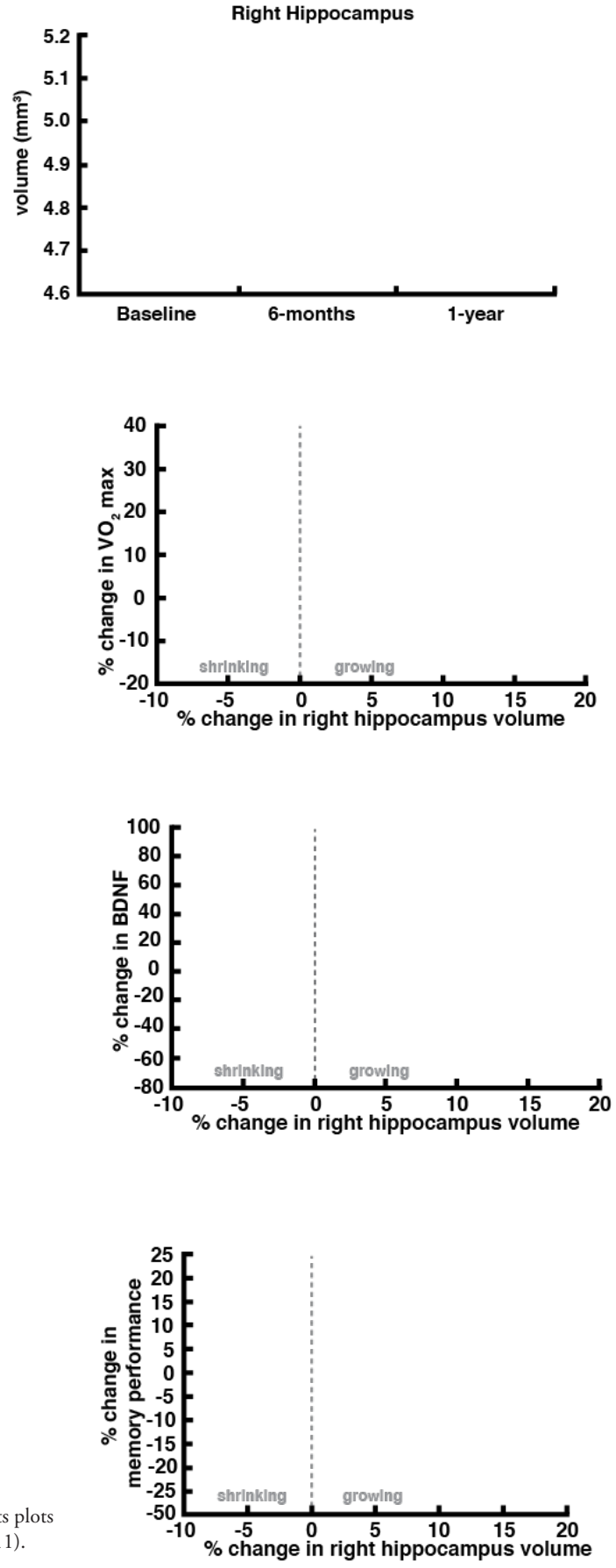

Figure 1. Blank plots with axes identical to those found in select results plots in the exercise and hippocampus volume study of Erickson *et al.* (2011).

Part 4 – Results and Discussion

Results Questions

1. Is the hypothesis confirmed by the researchers' results and why?

2. Which of the presented results are statistically significant (Figure 2)? How do you know?

3. How do your predicted results compare to the researchers'? In what aspects are they similar or different? Why?

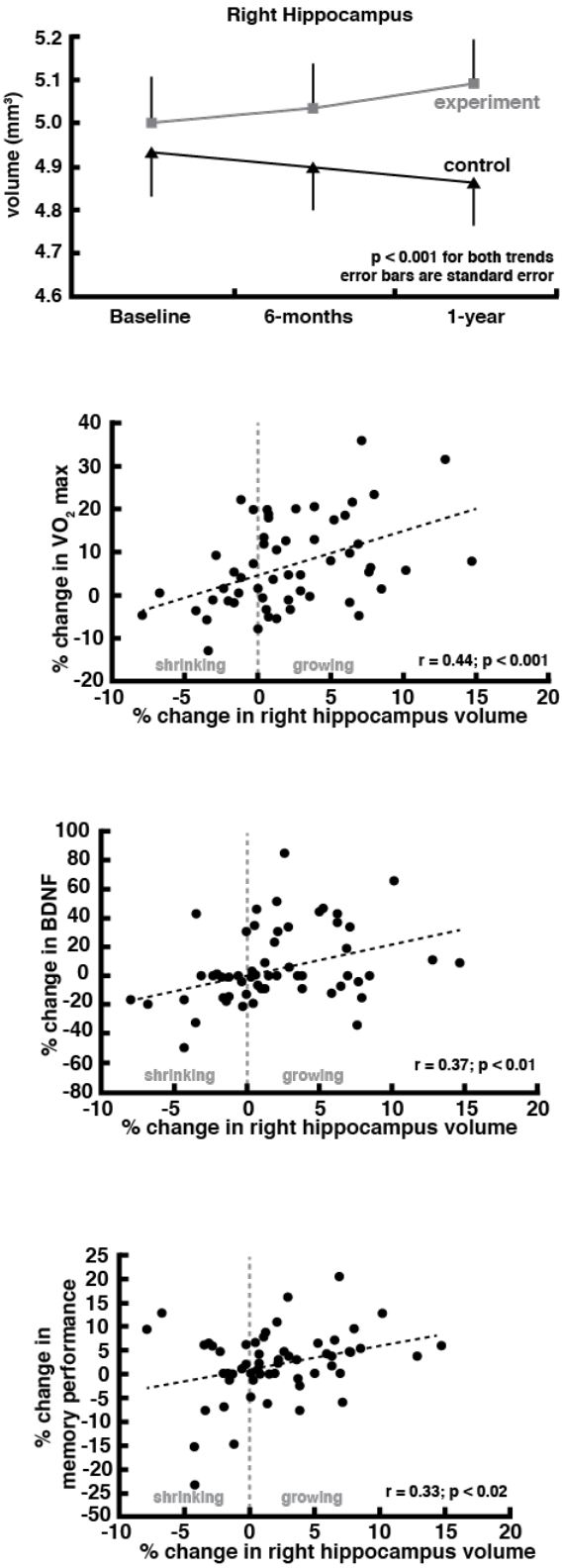

Figure 2. Selected results plots for the right hippocampus. Individual plots include points, trends, and indicators of statistical significance. Plots are modified from Erickson *et al.* (2011).

Discussion Questions

4. Do you have enough information to make a recommendation to Maria, your runner friend, about exercise and memory based on these findings? Why or why not?

5. What are the real-world aspects and implications of this work? What kind of recommendations can you make to the general public based on these findings?

6. If you were professionally reviewing this paper, what questions and recommendations would you have for the researchers to clarify or build on their published results?

7. What groups do you think will be most interested and benefit the most from this information?

Part 5 – Monday Closing

In accordance with your boss's instructions, you pick up the full scientific article that is waiting for you in the printer down the hall. They remind you that even though the article is for the general public, the journal holds itself to a high publication standard. In order to edit the news article, you must have a solid grasp of the peer-reviewed material. Prior to coming back to work you will: (1) read the full scientific article (Erickson *et al.*, 2011) (5.5 pages only!), (2) read the proposed news article (Sanders, 2011), and (3) answer your boss's questions. You can almost taste the promotion; "Senior Editor," here you come!

Readings

Erickson, K.I., M.W. Voss, R.S. Prakash, C. Basak, A. Szabo, L. Chaddock, J.S. Kim, S. Heo, H. Alves, S.M. White, T.R. Wojcicki, E. Mailey, V.J. Vieira, S.A. Martin, B.D. Pence, J.A. Woods, E. McAuley, and A.F. Kramer. 2011. Exercise training increases size of hippocampus and improves memory. *Proceedings of the National Academy of Sciences (PNAS)* 108(7): 3017–22. <https://doi.org/10.1073/pnas.1015950108>

Sanders, L. 2011. Aerobic exercise boosts memory. *U.S. News and World Report*, Feb. 1, 2011. <https://www.usnews.com/science/articles/2011/02/01/aerobic-exercise-boosts-memory>

Questions

1. Is a hypothesis stated in the news article? If so, what is it?

2. Is the hypothesis supported by results and a study description in the news article?

Recommendations for Reading a Peer-Reviewed Article

A peer-reviewed article is one that is reviewed by other experts in the field. It goes through a rigorous editing process and is often sent back to the authors for revision prior to being published. Authors do not receive money for publishing in peer-reviewed journals. In fact, they often have to pay to be published.

Reading a peer-reviewed article can be daunting. We have already walked through portions of the two most challenging components, the results (e.g., figures) and methods. To effectively and efficiently read a peer-reviewed article it is often recommended to read it out of order. This allows you to focus on the important conclusions, and the supporting information, without getting bogged down in jargon. The following instructions and reflection questions were adapted from materials used in *Frontiers of Science* at Columbia University (2004–2020).

1. Preview the article and identify the different sections.
2. Find the abstract or the summary and read this first. The abstract is generally at the beginning of the article while the summary can be at the beginning or the end. Both of these sections give an overview of the essential information covered in the other sections of article.
3. Instead of reading the results, look at the figures, graphics, and tables. Make sure to look at the data, trendlines, statistics, captions, and other related aspects. If you are finding it hard to determine the relevance of a figure or table, find where it is referenced in the article. References in the "results" section will often provide background on how the information was obtained while references in the "discussion" or "summary" will relate the information in the figure or table to the broader context of the article.
4. Read the methods to review how the results were obtained. This is a good opportunity to think about limitations or sources of error in an experimental or observational study.
5. If you want additional context or background information, read the introduction, discussion, and conclusions. These portions can get technical and often refer to data, trends, or implications from other studies. This can give you a better understanding of why the study was conducted and how it relates to other work among many other things.

3. What conclusions and claims are made in the news article? Are they supported?

4. As it is presented in the news article, is the claim well supported? Why?

5. After reading the peer-reviewed science article, do the stated conclusions align with those discussed in class? Explain.

6. Are the methods presented in the peer-reviewed article rigorous enough to support the claim the authors are making? Why or why not?

7. Do the authors describe the limitations of the study? If so, are their assertions in line with their methodology? If not, what limitations should be addressed?

8. Are the claims presented in the news article in line with what is presented in the peer-reviewed article? Support your answer.

9. Considering what you learned while reading the peer-reviewed article, do you believe that the news article is a reliable example of science writing? Why or why not?

Part 6 – "Good" Science Reporting

In our technology-centered world, we are constantly bombarded with information and news. Part of our job is to sort through this information and determine what to trust and what raises red flags. This is especially true when news, or social media, report recent scientific findings. Read the following two articles and answer the questions below.

- Medrano, K. 2018. How to stop aging: naked mole rats do not get old and could hold clues for extending life. *Newsweek*, Jan. 29, 2018. <https://www.newsweek.com/how-stop-aging-naked-mole-rats-do-not-get-old-and-could-hold-clues-extending-794141>
- Kupferschmidt, K. 2018. Naked mole rats defy the biological law of aging. *Science*, Jan. 26, 2018. <https://doi.org/10.1126/science.aat1320>.

****Alternative (check with your instructor before proceeding): Select two different news articles on the same article, or closely related articles. This will allow you to use more recent articles or to chose topics that align more directly with your course. When choosing two news articles pay attention to the quality and make sure that you are not choosing one that is clearly "fluff." Pick two reasonable articles each that have flaws and benefits.****

Questions

1. What aspects of the scientific study are present or well represented in the news article?

2. What aspects of the scientific study are missing or misrepresented in the news article?

Part 7 – Back at Work

You have successfully reviewed the scientific evidence presented in the peer-reviewed science article and read and reflected on an associated news article. Now your primary task lies ahead: are you going to approve the publication of the news article or are you going to reject it? Don't forget that you will need to justify your decision.

Questions

1. What are the key pieces of information from the science article that should be present in the news article?

2. What components of good science writing are present in the news article (Sanders, 2011)?

3. What is lacking or what is excessive?

Part 8 – End of the Day

It's been a long day and you are almost home free. The last thing to do is write a brief cover letter to your boss with your assessment of the news article.

Final Deliverable

As a group, write one paragraph (about five sentences) to your boss that explains why you are or are not accepting the news article that you read prior to class for publication. One copy of the paragraph with signatures from each group member will be turned in prior to the end of class.

Possible topics to address include the following (you do not need to address them all):

- Aspects the class defined as "good" reporting of science news.
- Representation of the components of the science article.
- Recommendations for content to be removed, and why.
- Recommendations for content to be added, and why.
- Recommendations for content to be altered, and why.
- Word choice.
- Style or structure of the news article changes.