NOBA

Thinking like a Psychological Scientist

Instructor Manual

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The module is designed as an introduction to the qualities of scientific thinking and theories that make science a trustworthy way to answer questions about the world, even if the claims are never proven. The module tackles concepts from the makings of a good scientific theory to null-hypothesis significance testing to the role of the scientist as an active participant in the scientific process. The goal of this module is to help students understand *why* science is a valuable tool in knowledge—even though its claims are based on probability—and *how* that knowledge is derived. Although the module is primarily conceptual (rather than a practical how-to of research), it can complement a variety of classroom goals. For example, it can be used at an introductory level to lay the foundations to the methods of scientific thinking. It could also be used at a more advanced level, as instructors guide their students in identifying and applying these concepts to real research.

Learning Objectives

Relevant APA Learning Objectives (Version 2.0)

- Describe key concepts, principles, and overarching themes in psychology (1.1)
- Develop a working knowledge of psychology's content domains (1.2)
- Demonstrate psychology information literacy (2.2)
- Engage in innovative and integrative thinking and problem solving (2.3)
- Interpret, design, and conduct basic psychological research (2.4)
- Apply ethical standards to evaluate psychological science and practice (3.1)
- Demonstrate effective writing for different purposes (4.1)

- Exhibit effective presentation skills for different purposes (4.2)
- Interact effectively with others (4.3)
- Apply psychological content and skills to career goals (5.1)

Content Specific Learning Objectives - Thinking Like a Psychological Scientist

- Compare and contrast conclusions based on scientific and everyday inductive reasoning.
- Understand why scientific conclusions and theories are trustworthy, even if they are not able to be proven.
- Articulate what it means to think like a psychological scientist, considering qualities of good scientific explanations and theories.
- Discuss science as a social activity, comparing and contrasting facts and values.

Abstract

We are bombarded every day with claims about how the world works, claims that have a direct impact on how we think about and solve problems in society and our personal lives. This module explores important considerations for evaluating the trustworthiness of such claims by contrasting between scientific thinking and everyday observations (also known as "anecdotal evidence").

Class Design Recommendations

This material should be covered in a single 50- 75-minute class period. Please refer to the Noba PowerPoint and the Lecture Framework below for specific details. Due to the difficulty and complexity of some of this material it is recommended to either cover fewer topics if you are only devoting a 50-minute class period, or consider covering all topics across two class periods. Instructors with only 50 minutes may need to reduce the discussion and/or eliminate Kuhn's "5 features of good scientific theories" focusing instead on falsifiability. Please refer to the Noba PowerPoint and the Lecture Framework below for specific details.

- Warm-up activity: what does it mean to be "healthy"
- Scientific Reasoning and Theories

- Interpreting Research (Correctly)
- Trusting Science without Proof
- Objectivity in Science
- Conclusion
- Wrap up: CAT: One Minute Paper

Module Outline

Scientific Versus Everyday Reasoning: Everyone uses to logic to reason about how the world works. Unfortunately, some reasoning is erroneous or prone to error. Cases of biased reasoning were made famous by Daniel Kahneman and Amos Tversky, who were among the first to pioneer research on heuristic biases in decision making.

Consider, for instance, the following example: Miguel is 32 years old, loves the *Star Wars* films, and collects comic books. Is Miguel more likely to be a software developer or to work in construction?

Many people identify that Miguel is more likely to be in software because he conforms to stereotypes of developers. That is, he has features that are representative of people working in that field. What those who guess often miss is base rates. There are about 3 times more construction workers than there are software developers (at least in the US, and the multiplier only grows when looking at the entire world). Therefore, it is about 3 times more likely that Miguel is in construction.

Scientists have to reflect on and understand their own reasoning processes so that they can ask the best questions, make the best guesses, and create the best studies possible. In order to make general conclusions about the world we use the method of *induction* which relies on specific observations. We make *hypotheses* or predictions about the state of the world and then test those predictions with a *sample* of observations. That constitutes the scientific way of thinking about the world.

Scientific thinking has five important features – accuracy, consistency, scope, simplicity and fruitfulness. Another equally important feature of scientific thinking is that scientific claims are falsifiable. A 20th century scientist Karl Popper has pioneered this term and has argued that claims that cannon be falsified aren't scientific in nature.

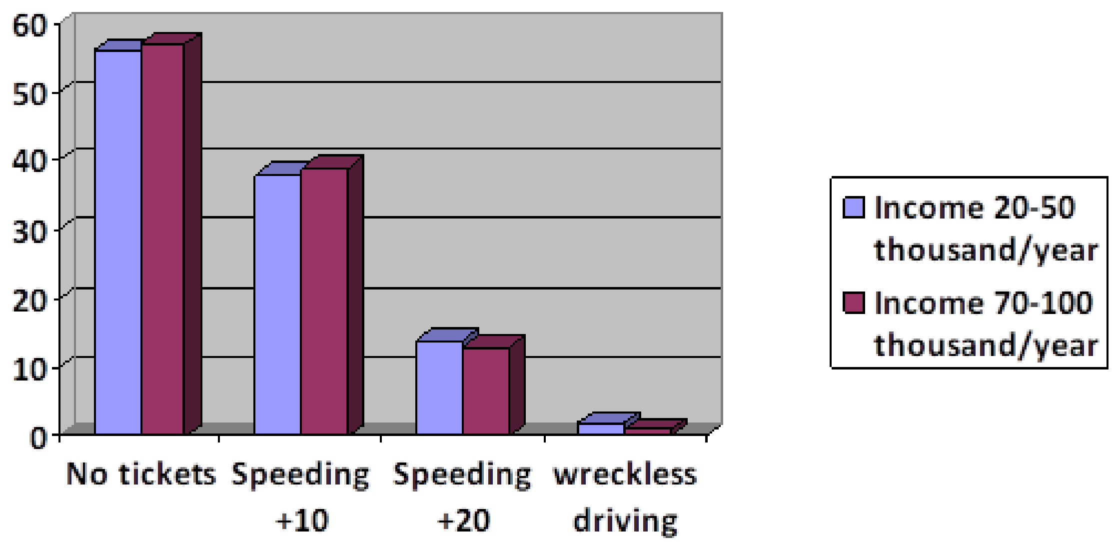
The Interpretation of Research Results: When a researcher examines the results of a study, they look at whether or not the results lend evidence in support of the initial hypothesis. For example, a researcher might hypothesize that people who smile are rated by others as being more attractive. If she conducts a study and finds that smiling men and women are rated 1.5 points higher on a ten-point scale of attractiveness then these results support her hypothesis. Results from a study, especially a single study cannot be used as *proof* and simply offer evidence that the initial claim that the researcher has made regarding the nature of things has been supported by the results of the study. The attractiveness study, for instance, is best interpreted as an initial piece of evidence. More research would need to be conducted to examine the interplay of smiling and attractiveness across cultures, ages, time periods, and so forth. This demonstrates inductive reasoning capabilities as opposed to deductive reasoning (which is when general information or principles are being applied to specific cases or instances).

Quality of the data gathered also matters in the interpretation of results. One way by which quality of data is determined is by that of its *generizability* or it it's applicability to a sample that is representative of the population being studied.

Why Should I Trust Science if it Can't Prove Anything?: Though scientific research doesn't prove anything, it does look at what the probability of the gathered data would be if the relationship between the variables in a given study didn't exist. In other words, what is the probability of the relationship between these variables existing due to chance rather than the researcher's manipulations? This is known as the *Null Hypothesis Significance Testing*.

The Null Hypothesis states that the variables studies aren't related in any way, i.e. that the relationship found between variables in a study is due to chance alone. For example, a researcher might want to investigate the relation of income and speeding. The null hypothesis would state that income is unrelated to whether people drive fast (ie, both rich and poor people are equally as likely to break traffic laws).

The Null Hypothesis is tested by looking into the distribution of data gathered during a study. Normal distribution of data shows most data points clustering in the middle (or the average points) and fewer data points in the extreme ranges. The measure of the probability that the results of any given study are due to chance is known as the *p value*. In the example of research on speeding, the researcher could look at the distribution of different traffic tickets by income group. If the distributions were the same between income groups, she would conclude that the groups do not differ (exactly what the null hypothesis says—there is no relation between income and speeding). If the distribution differ, then the research would reject the null hypothesis in favor of the alternative hypothesis (that there is a relationship between income and speeding). See the sample table below of two similar distributions.

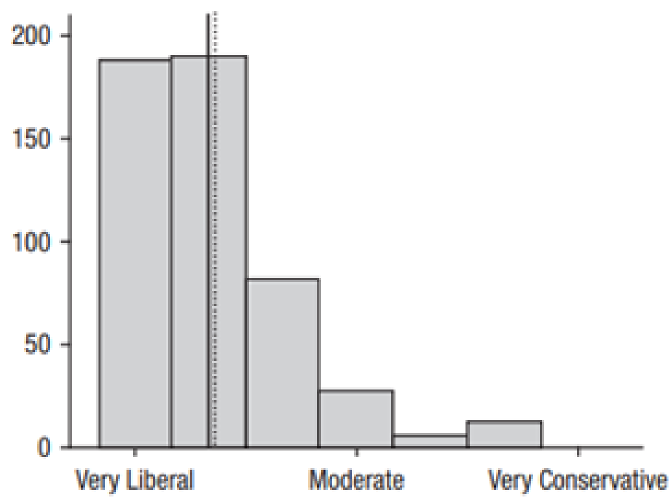


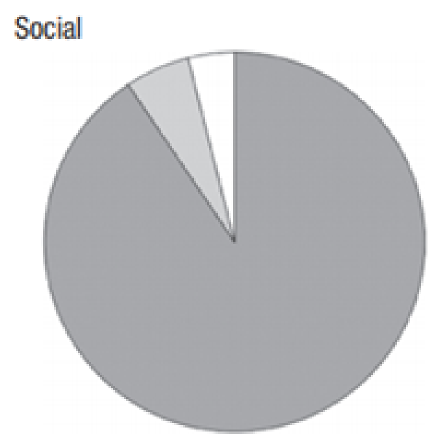
The chances of making an error in data interpretation are Type I and Type II errors, with former being when a researcher find a particular relationship between variables when there isn't one, and the latter being when a researcher doesn't find a relationship between variables when there is in fact, one. Current scientific standard to have the p value be less than 5%, that is there should be less than five percent chance that Type I and Type II errors have been committed.

Scientific Theories: When there has been an abundance of studies using representative data samples, normal distribution of data coming it at a significance level of 5% or less (i.e. p value is less than .05), scientists can form theories about the nature of various phenomena.

Is Science Objective? In the classic science fiction novel, *A Stranger in a Strange Land*, the author introduces the concept of a fair witness. These people are professionals who have photographic memories and who are trained to report only what they observe without making any assumptions. Their word is accepted as indisputable truth in legal courts. By way of example, a character asks a fair witness to report the color of a nearby house. The fair witness responds, "It is white on this side." This is a small but wonderful example of the many assumptions, values and prejudices we all harbor (we assume that a house is going to be uniformly painted on all sides).

Even the most objective scientist has subjective values that inform their research. The histogram and pie chart below, for instance, show the distribution of political liberalism-conservatism on social issues (from Inbar & Lammars, 2012- **http://yoelinbar.net/papers/political_diversity.pd...**). As you can see, social psychologists are largely liberal and these values could lead to unintended biases in 1) the ways that academics review papers submitted for publication, 2) the very topics they study and types of research questions asked, and 3) advocacy and policy recommendations coming from the American Psychological Association, British Psychological Society, and other professional groups. You may wish to note that there is a robust debate about political bias in psychology (eg. **https://www.newyorker.com/science/maria-konnikova/...**





Despite these biases, or perhaps because of them, it is important that psychological scientists engage in certain measures that help reduce the potential negative impact of personal attitudes. These include methodological techniques such as random sampling and assignment, blind and double-blind studies, and replication. They also include more conceptual safeguards. For example, collaborations between diverse scientists and cobbling together results that span various levels of analysis. Those levels are Social, Behavioral, Cognitive and Biological. While science does provide valuable and credible ways of understanding the world, it is important to understand and recognize its limitations in order to get a more objective information about the natural world.

Difficult Terms

Anecdotal evidence
Causality
Correlation
Data
Deductive reasoning
Distribution
Empirical
Falsify
Generalize
Hypothesis
Inductive reasoning
Levels of analysis
Null Hypothesis Significance Test
Objective
Population
Probability
Probability values
Pseudoscience
Representative
Sample
Scientific theory
Type I Error
Type II Error
Value

Lecture Frameworks

Overview: This material can be presented with a combination of direct instruction, discussion, and activities. It is possible—even likely—that many students will approach this module with certain prejudices. Some may believe that the topic is boring; in part, because it is so cluttered with difficult technical concepts such as falsifiability and the Null Hypothesis Significance Test. Others might see scientific reasoning as offensive in its challenge to other "ways of knowing" such as intuition, religion, and anecdotal evidence. The introduction is an opportunity to increase student engagement by addressing these very points. Here are some suggestions:

- *This material is difficult*: This concern is 100% accurate. Many students stumble over technical concepts such as Type I versus Type II error. It may be helpful to treat this module like learning a foreign language (It contains foreign vocabulary and is tough at first, but as each piece falls in place the others get easier). Encourage your students to take breaks in their study, to collaborate, and to review.

- *This material challenges my worldview*: It may be helpful to suggest that there are many legitimate ways of knowing. A person's own experience (anecdotal evidence) is just as legitimate as folk wisdom or religious belief. Because psychology is a science, however, it is important for students to understand the mechanics of science. The goal of the module is not to dismiss any person's worldview but, rather, to add an avenue of knowing and increase their appreciation of psychology.
- *This material is irrelevant*: Some students, especially non-majors, might balk at this material. Examples of historical figures might create the impression that we are studying a historic phenomenon. This is a golden opportunity to make this material seem especially relevant. We live in an era where scientific theory is at the heart of political debate (eg. Climate change) and in which being a savvy consumer of media reports (eg. Fake news) can lead to better knowledge and better participation in society.

Warm-up Activity: What does it mean to be healthy?: The purpose of this slide is to present a small group discussion activity in which students can sample thinking like a scientist. Students will have different views of science and scientists; views on science/scientists may range from a deep skepticism to a blind faith, with most falling somewhere in-between. Given that this module includes information about the limits of science (which science skeptics might use to discount science generally) and the utility of science (which uncritical science supporters might use to overstate the claims of scientific research), instructors might find it helpful to explicitly engage students' viewpoints here. To do so, direct students to break into small groups and discuss the prompt "what does it mean to be healthy?" See below in 'Activities/Demonstrations' and in the Noba PowerPoint for more details.

Direct instruction of Scientific Versus Everyday Reasoning: There are several slides associated with this section. They include the following topics: 1) Basic terminology (hypothesis and sample), 2) Inductive reasoning, and 3) features of good theories.

- *Basic terminology slide*: In order to make general conclusions about the world we use the method of induction which relies on specific observations. We make hypotheses or predictions about the state of the world and then test those predictions. That constitutes the scientific way of thinking about the world.
- *Inductive Reasoning slide*: Slide 5 -Using the list of descriptors students have generated for "what is health" to illustrate concepts of *hypotheses* (are these statements about the way

the world (is predicted) to work or not), *samples* (that can be used to test hypotheses) and *inductive reasoning* (a generalization about what is or is not healthy for people, based on the sample). Slide 6: The point here is to show that inductive reasoning provide conclusions based on past information. Principles of research design are important in evaluating the trustworthiness of the conclusions. For example, in this slide, 5 data points wasn't sufficient to infer the correct pattern. A rectangle was a reasonable guess, but incorrect. A take-home point of this slide is that inductive reasoning, even if there were 100,000 data points always involves an inference based on probability. (Though, a case with 100,000 data points has a smaller probability of an incorrect inference.) More on this in a few slides. Note: Slide 6 contains an activity. Please see Activities and Demonstrations below for more information.

- *Features of good theories slides*: Scientific thinking has five important features – accuracy, consistency, scope, simplicity and fruitfulness. Another equally important feature of scientific thinking is that scientific claims are falsifiable. A 20th century scientist Karl Popper has pioneered this term and has argued that claims that cannon be falsified aren't scientific in nature. This concept is demonstrated in three ways in the PowerPoints: 1) Video and direct explanation (slide 12), and practice (slide 13). See PowerPoints for details. Please see Activities and Demonstrations below for more information.

Direct Instruction of Interpreting Research Correctly: Slides 15-17 provide a specific research question and some of the possible responses to (hypothetical) data about "standing desks." The specific question in this slide could be easily changed, or students could be asked to develop a question that is used in classroom explanation. The standing desk research example includes questions of research design and measurement, but focuses on what to the implications are if the data support (or fail to support) the hypothesis. Specifically, the lecture focuses on whether inductive reasoning (conclusions based on a sample of data) can generate "proof" of a conclusion.

Direct Instruction of Trusting Science Without Proof: It's a difficult concept for many students (and adults!) to recognize that the absence of proof is not the same as "all opinions are equal." Just because something isn't proven, doesn't mean that we don't know anything about it. Discussion activities (Slides 19, 20): These discussion activities focus on students understanding of proof in science (slide 19) and where that understanding has come from (slide 20). Part of being a savvy consumer of information includes understanding the intended audience of the communication. For media reports, where many people read about scientific research, the intended audience is a consumer and the goal is dissemination *and* headlines that are attractive enough for the click or purchase. Slide 19 contains a group discussion; Please see Activities and Demonstrations below for more information.

- Special section within Trusting Science Without proof—The Null Hypothesis Significance Test. Null-hypothesis Significance Testing (Slides 21-22). Slide 21 focuses on the mechanics of NHST and slide 22 contextualizes why NHST is one means to assess the trustworthiness of scientific evidence. All opinions are not equal because some evidence, even if unproven, is better evidence. This concept can be difficult for students.

Direct Instruction of Objectivity in Science: Slide 24 highlights the role that scientists themselves play in science. Decisions are made throughout the research process (e.g., what questions should be asked to p-value cut-offs) that impact the results. This active engagement is in contrast to the idea of a scientist as objective observer and highlights a distinction between facts (information from research) and values (beliefs about the way the world ought to be). The facts that we gather in research are influenced by our values and these facts, in turn, inform our values. This highlights why diversity is important in the scientific process. Please see Activities and Demonstrations below for more information.

Direct Instruction of Levels of Analysis: Slide 25 highlights one kind of diversity in the scientific process: levels of analysis. Levels of Analysis is the idea that the same question can be answered from any number of levels; neither of these levels are more correct, per se, but together all contribute to a full understanding of any phenomenon. This slide highlights the example of hunger. Hunger can be viewed at the hormonal level (it is associated with leptin and ghrelin, at the level of cognition and emotion (stress during a busy workday suddenly signals you to seek out a dessert), or at the behavioral and social levels (seeing someone else eating a sandwich suddenly makes you hungry). Please see Activities and Demonstrations below for more information.

*Conclusion:*There are a lot of potential directions for a conclusion. Asking students to revisit any number of the earlier discussions and reflect on them again (e.g., revisit a discussion about what a scientist does/how they know; what health is, etc.). An additional optional activity, best suited for more advanced students, is described in the PowerPoint.

CAT: One Minute Paper: You can find instructions for this CAT and others in the PowerPoint which accompanies this Instructor Manual.

Activities & Demonstrations

To view the slides for these activities, please see the accompanying PowerPoint Presentation.

Warm up Activity—What does it mean to be healthy?

The purpose of this slide is to present a small group discussion activity in which students can sample thinking like a scientist.

Materials: pen/paper or computer for notes

Time: 5 minutes

Instructions:Direct one member of each group to take notes so that they can act as reporter for the subsequent large group debriefing. Students may focus on any number of aspects of health. They might emphasize physical health such as diet, balance, sleep, weight, or being free of illness/disease/infection. They might also emphasize mental aspects of health such as happiness, freedom from depression or other disorders. Other themes might include social health, spiritual health, economic health, opportunity and empowerment, and growth.

To tie their comments together with important themes from this module address the following points:

- While it is often tempting to fall back on a position of "everyone has the right to her own opinion" this activity reveals that some ideas have more merit than do others. For example, a person who suggests that health is best defined by positive physical, mental and social circumstances has a better idea than someone who proposes that health is best defined by skin color.
- The students have begun operationalizing the concept of health. This is an important first step in creating hypotheses and direct research questions (eg. Is eating a vegetarian diet healthier than eating a non-vegetarian diet?).
- The scientific process is largely about figuring out trustworthy ways to answer questions such as the one about vegetarian diet, above. While morality and other concerns are entirely legitimate avenues for making dietary decisions, a sophisticated answer about health requires systematic observations and an exploration of boundary conditions (for whom might one or another diet be healthy?).

Note: Instructors might find that the warm-up alone of the introduction discussion alone is sufficient. For instructors with more time, the addition of the warm-up activity may provide specific points to reference at the conclusion. If time permits for only one, it is recommended that time be spent on the instruction discussion (about health), for the context it can provide in scaffolding direct instruction on some of the concepts.

Inductive reasoning activity

Materials: none

Time: 2 minutes

Instructions: Based on the information here, what would you believe about what comes next? What is your hypothesis? (A rectangle.)

Follow-up Discussion (5 minutes): Why would control over, quality and quantity of the observations influence the trustworthiness of the conclusion that is based on those observations?

If Consumer Reports, an independent research group who assesses the quality of various consumer items, suggests that the most reliable vehicle available is a Toyota, but your friend just purchased that car and has had nothing but trouble with it (e.g., it's needed a lot of repairs), what information should be most meaningful to you and why? Should you buy or avoid that Toyota?

Features of Good Scientific TheoriesActivity

Materials: Pen, paper, internet access

Time: 10-15 minutes (though for students with limited knowledge in research, this might take a lot longer)

Instructions: Divide students into groups to develop/search for specific examples of Kuhn's features in scientific theories/research (historically or in recent research debates). Individual groups could each be given a different feature and asked to report back to the class with their examples. Examples could be used/elaborated/critiqued to illustrate these concepts.

Falsification: Small Group Discussion

Materials: Pen and paper for notes

Time: 5-10 minutes

Instructions: A) First, ask students Why is falsification necessary in science? What's wrong with searching for confirmatory evidence (what can result when we do this)? B) Given falsification, why isn't astrology, and the horoscopes produced by it, considered scientific? If there are enough students, they could be broken into groups to discuss.

Falsification: Activity/Discussion

Materials: Paper and pen for notes

Time: 5 minutes

Instructions: Ask students to discuss which of the statements on the slide are falsifiable, what kinds of evidence could be gathered to falsify it/how they could be modified to be made falsifiable. If time, ask them to develop a few hypotheses, phrased in a way that they could be tested/falsified. Some are falsifiable, but would need to be made more specific in order to be tested.

- Note:The fourth statement is included as a discussion starter and is most applicable to more advanced students. This is relevant to discussions about the limits of science. Science can offer physical evidence about the physical world. So can science provide answers about immaterial concepts (e.g., minds)? This is an ongoing debate. At minimum, it's accurate to say that science cannot prove, nor can it disprove, the existence of any non-material thing. That doesn't mean, however, that science can't contribute meaningfully to the conversation. This conversation is most appropriate for upper-division students because it introduces a host of complicated ideas around consciousness, science, philosophy, and religion (among others).

Proof in Science: Discussion

Materials: pen, paper, and internet access

Time: 5 minutes

Instructions: Have a group discussion about things they have heard have been "proven by science" or break students into small group and have them search the internet for "things science has proven".

In this activity, one of the key things you will want to do is note the sources of these claims. Part of why “proof” is so common in our thinking about science is because most of us get our science from popular reports of science. This is great, but it also means that there will be some shortcuts. (And, in the same way that not all research is created equal, not all science journalists equally engage with the complexities and nuances of scientific research.)

The goal of this activity is not to create skepticism toward science, but to set the stage for the content to come, which focuses on why science is trustworthy, even in the absence of “proof” (as understood with deductive reasoning).

Proof in Science: Discussion

Materials: paper and pen for notes

Time: 5 minutes

Instructions: Ask students to discuss why media reports of science talk about proof, if the inductive reasoning used by scientists can’t prove its conclusions. Ask students to consider the purpose of media/reporting versus the purpose of scientific reports.

Objectivity in Science

Materials: pen and paper for notes

Time: 5 minutes

Instructions: Ask students to revisit the earlier discussion about what scientists do/what science tells us. This can also be applied to the earlier discussion of health; if a scientist were testing these hypotheses (Introduction Discussion), what kinds of decisions would they have to make in the research process? What are the implications of these decisions for objectivity? With this in mind, what is an accurate view of scientists (disengaged and objective or active and participatory in their research)?

Levels of analysis and objectivity in science

Materials: pen, paper, and access to article(s) linked in Outside Resources/PowerPoint

Time: 25 minutes

Instructions: Some scientists endorse reductionist explanations for phenomena (e.g., hunger is purely biological; all of the higher level experiences are ultimately fully understood by breaking them down to their biological parts). This is an ongoing debate; advanced classes many enjoy engaging in this discussion. Ask students to read the short article by M. Gazzaniga in the outside resources section of the module or this article by D. Amodio (2010) on how neuroscience and social psychology can *together* contribute to a better understanding of complex phenomena. Use these to scaffold a discussion about the importance of independent, but complimentary roles of different levels (and ways) of explaining. This discussion can also lead to a discussion about the domain of science (what it can say and what it can't), as related to the fact-value distinction.

Amodio article: **http://www.psych.nyu.edu/amodiolab/Publications_fi...**

Additional Activities

Scientific Reasoning MCAT Modules for Large Intro Psych Courses

A series of 8 classroom-tested lessons to improve students' scientific reasoning skills. They cover a range of topic areas relevant to students and touch important areas of an intro-to-psych course - methods, bio-psych, development, memory, and more. Each module comes with everything you could need to implement them immediately, includin an instructor guide, PowerPoint slides, and student handouts.

Becker-Blease, K. A., Stevens, C., & Witkow, M. R. (2017). Intro Psych Scientific Reasoning Modules. Retrieved from **http://bit.ly/2xPqWMN**

Outside Resources

Article: A meta-analysis of research on combating mis-information
http://journals.sagepub.com/doi/full/10.1177/0956797617714579

Article: Fixing the Problem of Liberal Bias in Social Psychology
https://www.scientificamerican.com/article/fixing-the-problem-of-liberal-bias-in-social-psychology/

Article: Flat out science rejection is rare, but motivated rejection of key scientific claims is relatively common.
https://blogs.scientificamerican.com/guest-blog/who-are-you-calling-anti-science/

Article: How Anecdotal Evidence Can Undermine Scientific Results
https://www.scientificamerican.com/article/how-anecdotal-evidence-can-undermine-scientific-results/

Article: How fake news is affecting your memory
http://www.nature.com/news/how-facebook-fake-news-and-friends-are-warping-your-memory-1.21596

Article: New Study Indicates Existence of Eight Conservative Social Psychologists
https://heterodoxacademy.org/2016/01/07/new-study-finds-conservative-social-psychologists/

Article: The Objectivity Thing (or, Why Science Is a Team Sport).
https://blogs.scientificamerican.com/doing-good-science/httpblogsscientificamericancomdoing-good-science20110720the-objectivity-thing-or-why-science-is-a-team-sport/

Article: Thomas Kuhn: the man who changed the way the world looked at science
https://www.theguardian.com/science/2012/aug/19/thomas-kuhn-structure-scientific-revolutions

Video: Karl Popper's Falsification - Karl Popper believed that human knowledge progresses through 'falsification'. A theory or idea shouldn't be described as scientific unless it could, in principle, be proven false.
https://www.youtube.com/watch?v=wf-sGqBsWv4

Video: Karl Popper, Science, and Pseudoscience: Crash Course Philosophy #8
https://www.youtube.com/watch?v=-X8Xfl0JdTQ

Video: Simple visualization of Type I and Type II errors
https://www.youtube.com/watch?v=Dsa9ly4OSBk

Web: An overview and history of the concept of fake news.
https://en.wikipedia.org/wiki/Fake_news

Web: Heterodox Academy - an organization focused on improving "the quality of research and education in universities by increasing viewpoint diversity, mutual understanding, and constructive disagreement".
https://heterodoxacademy.org/

Web: The People's Science - An orgnization dedicated to removing barriers between scientists and society. See examples of how researchers, including psychologists, are sharing their research with students, colleagues and the general public.
http://thepeoplesscience.org/science-topic/human-sciences/

Evidence-Based Teaching

Myers, D. G. (2007). Teaching psychological science through writing. *Teaching of Psychology, 34* (2), 77-84.

The teaching of psychological science occurs face-to-face in classrooms and also through writing via op-ed essays, magazine articles, trade books, Web sites, and textbooks. I discuss the teaching of psychological science through such outlets, offer some practical suggestions for writing, and reflect on what I have found motivating, helpful, and satisfying.

Toomey, T., Richardson, D., & Hammock, G. (2017). Introductory psychology: How student experiences relate to their understanding of psychological science. *Teaching of Psychology, 44* (3), 246-249.

Many students who declare a psychology major are unaware that they are studying a scientific discipline, precipitating a need for exercises and experiences that help students understand the scientific nature of the discipline. The present study explores aspects of an introductory psychology class that may contribute to students' understanding of psychological science. Surveys were distributed to 168 students, asking how each of several in-class (e.g., attending lecture) and out-of-class (e.g., participating in research studies) research experiences contributed to their knowledge of psychology as a science and understanding of psychological research. Students reported that in-class experiences contributed more to their understanding of psychological research than out-of-class experiences.

Holmes, J. D., & Beins, B. C. (2009). Psychology is a science: At least some students think so. *Teaching of Psychology, 36*(1), 5-11.

The American Psychological Association's (2007) curricular guidelines recommend that students develop both an understanding of how psychologists do research and an appreciation for why scientific thinking is necessary. We surveyed a large sample of psychology majors on specific interests, as well as individual difference variables relevant to scientific thinking. Our results suggest that over time, students' knowledge of scientific thinking increased, whereas their tendency to see psychology as a science did not. Further, students reported greater interest in practitioner activities than scientific ones, and these divergent interests were associated with differential ways of thinking and of viewing the field of psychology. We discuss some implications for conceptualizing undergraduate instruction given that some student characteristics are more malleable than others.

Lilienfeld, S. O., Lohr, J. M., & Morier, D. (2001). The teaching of courses in the science and pseudoscience of psychology: Useful resources. *Teaching of Psychology, 28*(3), 182-191.

Several authors have increasingly recognized the problem of pseudoscience as a major threat confronting psychology and allied disciplines. We discuss the importance of courses in science and pseudoscience to undergraduate education in psychology and provide (a) a model syllabus for courses in the science and pseudoscience of psychology, (b) a list and description of suggested primary and supplemental texts for such courses, (c) a list of useful educational videos on science and pseudoscience, and (d) suggested Web sites that offer critical evaluations of pseudoscientific claims. Finally, we briefly review the literature concerning the efficacy of courses in the science and pseudoscience of psychology and offer suggestions for future research in this area.

Links to ToPIX Materials

Research Methods
http://topix.teachpsych.org/w/browse/#view=ViewFolder&param=Research%20Methods

Teaching Topics

Teaching The Most Important Course
https://nobaproject.com/documents/1_Teaching_The_Most_Important_Course.pdf

Content Coverage
https://nobaproject.com/documents/2_Content_Coverage.pdf

Motivating Students
https://nobaproject.com/documents/3_Motivating_Students_Tips.pdf

Engaging Large Classes
https://nobaproject.com/documents/4_Engaging_Large_Classes.pdf

Assessment Learning
https://nobaproject.com/documents/5_Assessment_Learning.pdf

Teaching Biological Psychology
https://nobaproject.com/documents/6_Teaching_Bio_Psych.pdf

PowerPoint Presentation

This module has an associated PowerPoint presentation. Download it at https://nobaproject.com//images/shared/supplement_editions/000/000/305/Thinking%20like%20a%20Psychological%20Scientist.pptx?1514484771.

About Noba

The Diener Education Fund (DEF) is a non-profit organization founded with the mission of re-inventing higher education to serve the changing needs of students and professors. The initial focus of the DEF is on making information, especially of the type found in textbooks, widely available to people of all backgrounds. This mission is embodied in the Noba project.

Noba is an open and free online platform that provides high-quality, flexibly structured textbooks and educational materials. The goals of Noba are three-fold:

- To reduce financial burden on students by providing access to free educational content
- To provide instructors with a platform to customize educational content to better suit their curriculum
- To present material written by a collection of experts and authorities in the field

The Diener Education Fund is co-founded by Drs. Ed and Carol Diener. Ed is the Joseph Smiley Distinguished Professor of Psychology (Emeritus) at the University of Illinois. Carol Diener is the former director of the Mental Health Worker and the Juvenile Justice Programs at the University of Illinois. Both Ed and Carol are award- winning university teachers.

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