HPS&ST Newsletter
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Introduction

The HPS&ST Newsletter is sent monthly to about 11,000 emails of individuals who directly or indirectly have an interest in the contribution of history and philosophy of science to theoretical, curricular and pedagogical issues in science teaching, and/or interests in the promotion of innovative, engaging and effective teaching of the history and philosophy of science. The newsletter is sent on to different international and national HPS lists and international and national science teaching lists. In print or electronic form, it has been published for 40+ years.

The Newsletter, along with RESOURCES, OBITUARIES, OPINION PIECES and more, are lodged at the website: HERE

The newsletter seeks to serve the diverse international community of HPS&ST scholars and teachers by disseminating information about events and publications that connect to concerns of the HPS&ST community.

Contributions (publications, conferences, Opinion Piece, etc.) are welcome and should be sent direct to the editor: Michael R. Matthews, UNSW, **m.matthews@unsw.edu.au** .

17th International History, Philosophy and Science Teaching Conference 2-6 September 2024 - Buenos Aires, Argentina

Conference e-mail: ihpst2024@gmail.com

Conference Theme: **Trusting school science again**

Conference Chair: Agustín Adúriz-Bravo, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires

Invited Speakers

2024 Springer Lecturer: **Cyrus Mody,** Maastricht University, The Netherlands
HERE

2024 Latin-American Lecturer: **Olimpia Lombardi,** CONICET, Argentina
HERE

Important Dates

Submission of proposals: Until 15th April 2024

Early registration: Until 30th June 2024

Ordinary registration: From 1st July 2024 until the first day of the Conference

Registration fee:
IHPST members: early (till June 30) USD165; after July 1, USD200
Non-members: USD260 & USD320
Argentina participants: USD20 discount on above.

Details of online registration and payment will be given soon.

Revitalizing Science and Values, Conference, University of Pittsburgh, April 5-7, 2024

The arena of science and values has grown in size and prominence in recent philosophy of science. But debates about the role of science remain fairly limited in terms of both the scope of topics discussed and in the range of views expressed. This conference aims to broaden the horizons of work on science and values, partly by making room for new (or new versions of older) ideas and partly by getting it to interact with other parts of philosophy.

Keynote Speakers:

Arnon Levy - The Hebrew University of Jerusalem
Wendy Parker - Virginia Tech
Andrew Schroeder - Claremont McKenna College
Jacob Stegenga - University of Cambridge
Zina Ward - Florida State University

Information and Registration: **HERE**

European Society for History of Science Conference, Barcelona, 4-7 September 2024

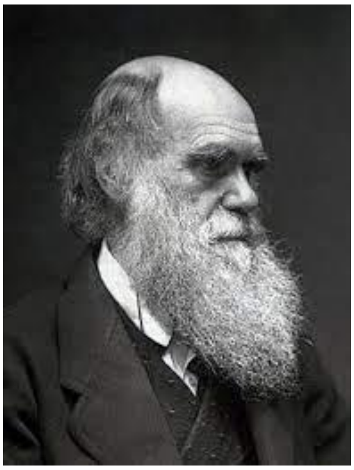
The 11th ESHS conference will take place in Barcelona (Spain), from 4 to 7 September 2024. The theme will be **Science, Technology, Humanity, and the Earth**. Science is the primary means by which mankind understands, represents and intervenes in the world. Humanity is facing challenges that can threaten its future and the future of the planet where it lives. As historians of science, we are committed to understand how epidemics, wars and climate change are connected. We invite the community of European historians of science to look at the object of their historical research with a view to the great challenges that humanity has been facing both nowadays and throughout its history. The aim is to distance the conference from a specific methodological approach, and to establish a dialogue between different historiographies, perspectives and topics.

The main venue of the conference will be the Campus Ciutadella of the Pompeu Fabra University (UPF).

More details can be found **HERE** .

Charles Darwin's Library: Online

The Darwin Online project has launched a major addition begun in Cambridge 18 years ago which may interest some of you - The Complete Library of Charles Darwin.



The catalogue is a reconstruction of Darwin's library as it was in his lifetime, hence not just recording extant books in institutional collections today (1,480 is the usual number, it turns out that many books have been overlooked). Combining these important works with hundreds of other titles derived from a huge array of sources- especially the work of many scholars, librarians and archivists and by including family catalogues to rare books sales from 1889 to the present *and* by including all print sources Darwin owned (not just bound ones) such as journals, pamphlets and clippings- we arrive at a collection of 7,400 titles across 13,000 volumes/items. Hundreds of these were not known to scholars before.

The project enlarged the catalogue of books known to be on HMS *Beagle* and digitized that library in its entirety in 2014.

After combining and collating many sources and identifying thousands of incomplete references, we have also assembled 9,500 links to electronic copies of the works. Of these, 5,035 are items within *Darwin Online* (850 are fully transcribed) and 4,500 are links to freely accessible internet copies.

Thus, the Darwin Library is now integrated with his entire corpus of published works, his manuscripts and private papers, the *Beagle* library, and the database with complete bibliographical records of his publications in 56 languages and union catalogue of his manuscripts across 80 institutions and collections.

An introduction to the reconstructed Darwin Library and link to the complete catalogue is HERE

Opinion Page. Rationality without Absolutes: How to Think like a Bayesian*

MICHAEL G. TITELBAUM, Philosophy, University of Wisconsin, Madison.

Michael G Titelbaum is Vilas Distinguished Achievement Professor of Philosophy at the University of Wisconsin-Madison. He is the author of Quitting Certainties (2013) and Fundamentals of Bayesian Epistemology, *Volume 1* and *Volume 2* (2022).

You're often asked what you believe. Do you believe in God? Do you believe in global warming? Do you believe in life after love? And you're often told that your beliefs are central to who you are, and what you should do: 'Do what you believe is right.'

These belief-questions demand all-or-nothing answers. But much of life is more complicated than that. You might not believe in God, but also might not be willing to rule out the existence of a deity. That's what agnosticism is for.

For many important questions, even three options aren't enough. Right now, I'm trying to figure out what kinds of colleges my family will be able to afford for my children. My kids' options will depend on lots of variables: what kinds of schools will they be able to get into? What kinds of schools might be a good fit for them? If we invest our money in various ways, what kinds of return will it earn over the next two, five, or 10 years?

Suppose someone tried to help me solve this problem by saying: 'Look, it's really simple. Just tell me, do you believe your oldest daughter will get into the local state school, or do you believe that she won't?' I wouldn't know what to say to that question. I don't believe that she *will* get into the school, but I also don't believe that she *won't*. I'm perhaps slightly more confident than 50-50 that she will, but nowhere near certain.

One of the most important conceptual developments of the past few decades is the realisation that *belief comes in degrees*. We don't just believe something or not: much of our thinking, and decision-making, is driven by varying levels of confidence. These confidence levels can be measured as probabilities, on a scale from zero to 100 per cent. When I invest the money I've saved for my children's education, it's an oversimplification to focus on questions like: 'Do I believe that stocks will outperform bonds over the next decade, or not?' I can't possibly know that. But I can try to assign educated probability estimates to each of those possible outcomes and balance my portfolio in light of those estimates.

We know from many years of studies that reasoning with probabilities is hard. Most of us are raised to reason in all-or-nothing terms. We're quite capable of *expressing* intermediate degrees of confidence about events (quick: how confident are you that a Democrat will win the next presidential election?), but we're very bad at *reasoning* with those probabilities. Over and over, studies have revealed systematic errors in ordinary people's probabilistic thinking.

Luckily, there once lived a guy named the Reverend Thomas Bayes. His work on probability mathematics in the 18th century inspired a movement we now call Bayesian statistics. You may have heard 'Bayesian' talk thrown around in conversation, or mentioned in news articles. At its heart, Bayesianism is a toolkit for reasoning with probabilities. It tells you how to measure levels of confidence numerically, how to test those levels to see if they make sense, and then how to manage them over time.

That last part is important because, for any given claim, you're more confident in it at some times than you are at others. Once my oldest daughter takes a bunch of standardised tests, I'll have new evidence about her college prospects, and will adjust my levels of confidence accordingly. Bayesianism provides a recipe for doing that.

In this Guide, I'll provide five basic Bayesian ideas to improve your reasoning with probabilities. They're just a start – if you really want to delve into the details and grapple with the mathematics, I'll give you links and book recommendations at the end. I can't promise to make you a perfect probabilistic reasoner. (Heck, I teach this stuff for a living, and I still make mistakes.) But hopefully this will give you a start, helping you better apportion your opinions to your evidence, and make better decisions in the face of uncertainty.

Embrace the margins

The first step to Bayesianism is to stop thinking in all-or-nothing terms. Bayesians want to move past the dichotomy of you-either-believe-it-or-you-don't, to start thinking of belief as something that comes in degrees. Those degrees can be measured on a zero to 100 per cent scale. If you're certain an event will occur, that's 100 per cent confidence. If you're certain it won't occur, that's 0 per cent.

But again, Bayesians counsel against going to extremes. There are very few situations in which it makes sense to be *certain* that something will happen, or that it won't. In his book *Making Decisions* (1971), the Bayesian Dennis Lindley approvingly cited Oliver Cromwell's dictum to always 'think it possible that you may be mistaken.' Unless an event is strictly *impossible*, you shouldn't be certain that it won't occur.

All right, fine then. Maybe we shouldn't assign anything that's strictly speaking possible a confidence of zero. But we've all heard someone describe a possibility as 'one in a million'. If something's that improbable, it's pretty much not going to happen, right? So, one in a million might as well be zero? The very same Dennis Lindley also said he was fine assigning a confidence of one in a million that the Moon is made of green cheese.

A common mistake when reasoning with probabilities is to think that a fraction of a percentage point – especially near such extreme values as 0 per cent or 100 per cent – really doesn't matter. Any parent who's been fortunate enough to get high-quality modern-day prenatal care will have seen genetic tests reporting how likely their growing fetus is to develop certain kinds of ailments and birth defects. I remember looking at probabilities like 0.0004 per cent and 0.019 per cent with my pregnant wife, and wondering what we should be worried about and what we could write off. Such small probability differences are difficult to grasp intuitively. But a condition with a probability of 0.019 per cent is almost 50 times as likely to occur as one with a probability of 0.0004 per cent.

It's tempting to see a probability value like 0.0001 per cent – one in a million – and assume the difference between that and 0 per cent is little more than a rounding error. But an event with 0 per cent probability literally can't happen, while events with a probability of 0.0001 per cent happen all the time. If you have a couple of minutes and some loose change, go flip a coin 20 times. (We'll wait.) Whatever sequence of heads and tails you wound up observing, that specific sequence had a less than one-in-a-million chance of occurring.

To better assess the significance of the almost impossible and the almost certain, Bayesians sometimes switch from measuring probabilities on a percentage scale to measuring them with odds. If I bought you enough tickets to have a 0.001 per cent chance at winning the lottery and bought your friend enough tickets to give him a 0.1 per cent chance, you might wonder how offended you should be. Putting those values in odds form, we see that I've given your friend a 1 in 1,000 shot and you only 1 in 100,000 shot! Expressing the probabilities in odds form makes it clear that your friend has 100 tickets for every 1 of yours and clarifies that these two probabilities – while admittedly both close to zero – are nevertheless importantly different.

Evidence supports what makes it probable

What did the Rev Bayes do to get a whole statistical movement named after him? Prior to Bayes, much probability theory concerned problems of 'direct inference'. This is the kind of probability problem you were asked to solve many times in school. You're told that two fair, six-sided dice are rolled, and are asked to calculate the probability that their sum will be eight. Put a bit more abstractly: you're given a hypothesis about some probabilistic process in the world and asked to compute the probability that it will generate a particular kind of evidence.

Bayes was interested in the opposite: so-called 'inverse inference'. Suppose you observe some evidence and want to infer back to a hypothesis about what kind of process in the world might have generated that evidence. In *The Theory of Probability* (1935), Hans Reichenbach listed many occasions on which we engage in reasoning with this structure:

The physician's inferences, leading from the observed symptoms to the diagnosis of a specified disease, are of this type; so are the inferences of the historian determining the historical events that must be assumed for the explanation of recorded observations; and, likewise, the inferences of the detective concluding criminal actions from inconspicuous observable data.

Bayes's most important contribution to inverse inference wasn't recognised during his lifetime. After the reverend died in 1761, a Welsh minister named Richard Price published a theorem he had found in Bayes's notes. This theorem was later independently rediscovered by Pierre-Simon Laplace, who was responsible for much of its early popularisation.

Price, Laplace and others promoted Bayes's Theorem as a rule for adjusting one's confidence in a hypothesis after discovering some new piece of evidence. Modern Bayesians are called 'Bayesians' because of their adherence to Bayes's Rule (or Theorem). According to Bayes's Rule, your updated confidence in the hypothesis should be calculated from two factors: what your confidences looked like *before* you got the evidence (about which more later), and how strongly the evidence supports the hypothesis.

Here it pays to remember Bayesians' aversion to absolutes. While it makes for good drama when a character learns a single piece of information that changes their whole worldview, most of life isn't like that. Each new piece of information we gain changes only some of our opinions and changes them incrementally – making us slightly more confident or slightly less confident that particular events will occur. This is because evidential support also comes in degrees: a piece of evidence might support some hypotheses weakly and others strongly; or one piece of evidence might support a particular hypothesis better than another.

To gauge how strongly evidence supports some hypothesis, ask how likely that hypothesis makes the evidence. Suppose you get home late from work one night and walk in to find all the lights on in your home. You wonder who else is home – your husband? Your son? Well, your husband is constantly griping about the power bills, and walks around the house turning lights off all the time. But your teenage son barely notices his surroundings and exits a room without a thought to how he's left it. The evidence you've found is very likely if your son is in the house, and much less likely if your husband is home. So, the evidence supports your son's presence strongly, and your husband's presence little or not at all.

Bayes's Rule says that, once you gauge how much your new evidence supports various hypotheses, you should shift your confidence towards hypotheses that are better supported. However confident you were before you walked in the door that your husband or son was home, what you find inside should increase your confidence that your son is there, and decrease your confidence that your husband is. How much increase and decrease are warranted? That's all sorted out by the specific mathematics of Bayes's Rule. I'm trying to keep it light here and avoid equations, but the sources in the final section can fill in the details.

Attend to *all* your evidence

A consistent theme of Bayesian thinking is that working in shades of confidence can get much more complex and subtle than thinking in absolutes. One of the nice features of conclusive, slam-dunk evidence is that it can't be overridden by anything. If a mathematician proves some theorem, then nothing learned subsequently can ever undo that proof, or give us reason not to believe its conclusion.

Bayesianism aims to understand incremental evidence, coming to terms with the kinds of less-than-conclusive information we face every day. One crucial feature of such evidence is that it can *always* be overridden. This is the lifeblood of twisty mystery novels: an eyewitness said the killer held the gun in his *left* hand – but it turns out she was looking in a mirror – but the autopsy reveals the victim was poisoned *before* he was shot…

Because the significance of evidence depends so much on context, and because potential defeaters might always be lurking, it's important not to become complacent with what one knows and to keep an open mind for relevant new information. But it's also important to think thoroughly and carefully about the information one already has. Rudolf Carnap proposed the Principle of Total Evidence, which requires your beliefs about a question to incorporate and reflect *all* the evidence you possess relevant to that question.

Here's a kind of relevant evidence we often overlook: besides having information about some topic, we often know something about how we got that information. Now, that's not always true: I know that Abraham Lincoln was born in a log cabin, but I have no idea where I learned that titbit. But often – and especially in today's uncertain media environment – it pays to keep track of one's sources, and to evaluate whether the information you've received might have been selected for you in a biased way.

Sir Arthur Eddington gave an example in which you draw a large group of fish from a lake, and all of them are longer than six inches. Normally, this would be strong evidence that all the fish in the lake are at least that long. But if you know that you drew the fish using a net with six-inch holes, then you can't draw what would otherwise be the reasonable conclusion from your sample.

Paying attention to how the evidence was selected can have important real-life consequences. In *How Not to Be Wrong* (2014), Jordan Ellenberg recounts a story from the Second World War: the US military showed the statistician Abraham Wald data indicating that planes returning from dogfights had more bullet holes in the fuselage than in the engine. The military was considering shifting armour from the engine to the fuselage, to better protect their pilots. Wald recommended exactly the opposite, on the grounds that it was the *returning* planes that had holes in the fuselage; those not returning had holes to their engines, so that's where the additional armour should go.

Don't forget your prior opinions

You think carefully about the evidence you've just received. You're careful to take it *all* into account, to consider context, and to remember where it came from. With all this in mind, you find the hypothesis that renders that evidence most probable, the hypothesis most strongly supported by that evidence. That's the hypothesis you should now be most confident in, right?

Wrong.

Bayes's Rule says to respond to new evidence by *increasing* your confidence in the hypothesis that makes that evidence most probable. But where you land after an increase depends on where your confidence was before that evidence came in.

Adapting an example from the reasoning champion Julia Galef, suppose you're crossing a college campus and stop a random undergraduate to ask for directions. This undergrad has a distracted, far-off look in their eye; wears clothes that one would never think of bringing near an iron; and seems slightly surprised to even be awake at this hour of the day. Should you be more confident that your interlocutor is a philosophy or a business major?

Easy answer: this look is much more typical of a philosophy major than a business major, so you should be more confident you're dealing with the former. At a first pass, that answer seems backed up by the Bayesian thinking I've described. Just to pick some numbers (and be a bit unfair to philosophers), let's suppose a third of all philosophy majors meet this description, but only one in 20 business majors does (the quants, perhaps?) On the hypothesis that the person you randomly stopped for directions is a philosophy major, the probability of your evidence is one-third. On the hypothesis that you stopped a business major, the probability is one-20th. So, your evidence about this student from their appearance more strongly supports the notion that they study philosophy.

But now consider the following: on my campus, there are currently just shy of 250 undergraduate philosophy majors and roughly 3,600 business majors. If the fractions in the previous paragraph are correct, we should expect there to be about 80 philosophy students on campus disconnected from their surroundings, and about 180 business majors. So, if you select a random undergrad, you're still at least twice as likely to get a distracted business major as a distracted philosopher.

The key here is to remember that, before you appraised this student's appearance, the odds were much, much greater that they were into business than philosophy. The evidence you gain from interacting with them should *increase* your confidence that they're a philosopher, but increasing a small number can still leave it quite small!

Bayes's Rule demands that your updated confidence in a hypothesis after learning some evidence combines *two* factors: your prior confidence in the hypothesis, and how strongly it's supported by the new evidence. Forgetting the former, and attending only to the latter, is known as the Base Rate Fallacy. Unfortunately, this fallacy is committed frequently by professionals, even those working with life-altering data.

Suppose a new medical test has been developed for a rare disease – only one in 1,000 people has this disease. The test is pretty accurate: someone with the disease will test positive 90 per cent of the time, while someone without the disease will test positive only 10 per cent of the time. You randomly select an individual, apply the test, and get a positive result. How confident should you be that they have the disease?

Most people – including trained medical professionals! – say you should be 80 per cent or 90 per cent confident that the individual has the disease. The correct answer, according to Bayes's Rule, is under 1 per cent. What's going on is that most respondents are so overwhelmed by the accuracy of the test (the strength of the evidence it produces) that they neglect how rare this disease is in the population.

But let's do some quick calculations: suppose you applied this test to 10,000 randomly selected individuals. Around 10 of them would have the disease, so nine of them would get a positive test result. On the other hand, around 9,990 of the individuals you selected wouldn't have the disease. Since the test gives healthy individuals a positive result 10 per cent of the time, these 9,990 healthy individuals would yield around 999 false positive tests. So having tested 10,000 people, you'd get a total of 1,008 positive results, of which only nine (just under 1 per cent) would be people who actually had the disease.

Again, when dealing with cases of extreme probabilities, it can help to think about the odds. A piece of evidence that strongly supports a hypothesis (like the reliable medical test just described) might multiply the odds of that hypothesis by a factor of 10, or even 100. But if the odds start small enough, multiplying them by 10 will take you from one chance in 1,000 to one in 100.

Subgroups don't always reflect the whole

Bayesians work a lot with conditional probabilities. Conditional probability arises when you consider how common some trait is among a subgroup of the population, instead of considering the population as a whole. If you pick a random American, they're very unlikely to enjoy pizza made with an unleavened crust, topped with Provel cheese, and cut into squares. But conditional on the assumption that they grew up in St Louis, the probability that they'll enjoy such a monstrosity is much higher.

Conditional probabilities can behave quite counterintuitively. Simple principles that one would think should be obvious can fail in spectacular fashion. The clearest example of this is Simpson's Paradox.

Hopefully all of us have learned in our lives not to draw broad generalisations from a single example, or to assume that a small group is representative of the whole. A foreigner who judged American pizza preferences by visiting only St Louis would be seriously misled. By carelessness or sheer bad luck, we can stumble into a subpopulation that is unlike the others, and so bears traits that aren't reflected by the population in general.

But Simpson's Paradox demonstrates something much weirder than that: sometimes *every* subpopulation of a group has a particular trait, but that trait still isn't displayed by the group as a whole.

In the 2016-17 NBA season, James Harden (then of the Houston Rockets) made a higher percentage of his two-point shot attempts than DeMar DeRozan (of the Toronto Raptors) made of *his* two-point shots. Harden also sank a higher percent of his three-point attempts than DeRozan. Yet DeRozan's overall field-goal percentage – the percent of two-pointers and three-pointers combined that he managed to sink – was higher than Harden's. Harden did better on both two-pointers and three-pointers, and those are the only kinds of shots that factor into the field-goal percentage, yet DeRozan was better overall. How is that possible?

Pro hoops aficionados will know that, for any player, two-point shots are easier to hit than three-pointers, yet Harden stubbornly insists on making things difficult for himself. In the 2016-17 season, he attempted almost the same number of each kind of shot (777 three-pointers versus 756 two-pointers), while DeRozan attempted more than 10 times as many two-pointers as three-pointers. Even though Harden was better at each kind of shot, DeRozan made the strategic decision to take high-percentage shots much more often than lowpercentage ones. So, he succeeded at an overall higher rate.

The same phenomenon appeared when graduate departments at the University of California, Berkeley were investigated for gender bias in the 1970s. In 1973, 44 per cent of male applicants were admitted to Berkeley's graduate school, while only 35 per cent of female applicants succeeded. Yet a statistical study found that individual departments (which actually made the admissions decisions) were letting in men and women at roughly equal rates, or even admitting women more often. The trouble was that some departments were much more difficult than others to get into (for all applicants!), and women were applying disproportionately to more selective fields.

Of course, that doesn't eliminate all possibilities of bias; a study found that women were applying to more crowded fields because they weren't given the undergraduate mathematical background to study subjects that were better-funded (and therefore could admit more students). But the broader point about conditional probabilities stands: You can't assume that an overall population reflects trends in its subpopulations, even if those trends occur in *all* the subpopulations. You also have to consider the distribution of traits *across* subpopulations.

Why it matters

Bishop Joseph Butler said: 'Probability is the very guide of life.' Rev Bayes taught us to use that guide and update it over time as our lives change and we learn new things.

Bayes's Rule is an equation; if you want the numerical details, you can find them in the sources at the end of the Guide. But the basic recipe for updating your confidences is: Start with your prior opinions. Consider your new evidence – *everything* you just learned, including what you know about how you learned it. Of the hypotheses you entertain, determine which make that evidence more probable. Then shift your confidence towards those.

You might ask: where do the prior opinions come from? If you're a Bayesian, the opinions you take into a particular investigation will have been influenced by evidence you gathered in the past. You don't just apply Bayes's Rule once. Every time you gain new information about a subject, you update your opinions on that subject, with those newly updated opinions supplying the priors for your next update in the future. Your ongoing, ever-evolving picture of the world is like Otto Neurath's image of the boat:

> '[W]e are like sailors who on the open sea must reconstruct their ship but are never able to start afresh from the bottom…'

No two people ever have the same course of evidence, and no two people ever have the same sequence of opinions over their lives. We should keep these divergent paths in mind when we encounter different views. But we should also remember one beautiful piece of Bayesian mathematics: If we apply Bayes's Rule every time we update our opinions, then, no matter where our opinions begin, there's a high probability that gathering more and more evidence will move them ever closer towards the truth. If we keep learning, and keep updating, then Bayes's guide will lead us to our destination.

Recapitulation: Thinking Like a Bayesian

1. **Embrace the margins.** It's rarely rational to be certain of anything. Don't confuse the improbable with the impossible. When thinking about extremely rare events, try thinking in odds instead of percentages.
2. **Evidence supports what makes it probable.** Evidence supports the hypotheses that make the evidence likely. Increase your confidence in whichever hypothesis makes the evidence you're seeing most probable.
3. **Attend to *all* your evidence.** Consider all the evidence you possess that might be relevant to a hypothesis. Be sure to take into account *how* you learned what you learned.
4. **Don't forget your prior opinions.** Your confidence after learning some evidence should depend both on what that evidence supports and on how you saw things before it came in. If a hypothesis is improbable enough, strong evidence in its favour can still leave it unlikely.
5. **Subgroups don't always reflect the whole.** Even if a trend obtains in *every* subpopulation,

it might not hold true for the entire population. Consider how traits are distributed *across* subgroups as well.

Links & books

Many of the lessons and examples in this piece were taken from my book *Fundamentals of Bayesian Epistemology* (2022). That text takes you through all the mathematical details, teaches you to apply Bayesianism to decision theory and the theory of evidential support, and contrasts Bayesianism with rival statistical schools.

A less detailed treatment, written at a more introductory level, is Jonathan Weisberg's online, open-source *Odds & Ends*. Along similar lines is Darren Bradley's *A Critical Introduction to Formal Epistemology* (2015).

The online Stanford Encyclopedia of Philosophy has an excellent article called Bayesian Epistemology by Hanti Lin, that will give you loads of information (mathematical, philosophical, argumentative) about the subject without your having to read an entire book.

Among the many philosophical videos on her YouTube channel Measure of Doubt, Julia Galef has a number of good ones on Bayesian thinking. She's especially skilled at illustrating the relevant numerical manipulations with clear diagrams. Galef also hosts the podcast *Rationally Speaking*. Some of its early episodes, with co-host Massimo Pigliucci, answer questions about Bayesianism.

***** This essay first appeared in Psyche Magazine , 08 January 2024. Reproduced with permission.

Editor: As documented in this essay, Bayesianism commands a large audience in contemporary philosophy, logic, and debate on research methodology in the natural and social sciences.

Mario Bunge, the Argentine/Canadian physicist/philosopher had, since the early 1950s, been a critic of the programme. This began in 1951 with his paper 'What is Chance?', readable HERE. His final 2008 contribution was the paper: 'Bayesianism: Science or Pseudoscience?', readable HERE.

Invitation to Submit Opinion Piece

In order to make better educational use of the wide geographical and disciplinary reach of this *HPS&ST Note*, invitations are extended for readers to contribute opinion or position pieces or suggestions about any aspect of the past, present or future of HPS&ST studies.

Contributions can be sent direct to editor. Ideally, they might be pieces that are already on the web, in which case a few paragraphs introduction, with link to web site can be sent, or else the pieces will be put on the web with a link given in the Note.

They will be archived, and downloadable, in the OPINION folder at the HPS&ST web site **HERE**.

Varia

- Vale: Mary Terrall (1952-2023)
- Mario Bunge, *Between Two Worlds: Memoirs of a Philosopher-Scientist*, 548 pp book availabe **HERE**.
- Macfarlane, Bruce: 2023, 'The DECAY of Merton's scientific norms and the new academic ethos', *Oxford Review of Education*, September. Open Access HERE
- HPS&ST books, downloadable files **HERE**
- *Science & Education* Open Access articles (138) **HERE**
- History of *Nature* magazine **HERE**

Recent HPS&ST Research Articles

Assaraf, A. et al. (2024) Climate change education implementation: the voices of policymakers, professional development providers, and teachers in five countries. *International Journal of Science Education*, 1-24. https://doi.org/10.1080/09500693.2024.2314572

Barelli, E., Lodi, M., Branchetti, L. et al. (2024). Epistemic Insights as Design Principles for a Teaching-Learning Module on Artificial Intelligence. *Sci & Educ*, 1-36. https://doi.org/10.1007/s11191-024-00504-4

Blackie, M., Luckett, K. (2024). Embodiment Matters in Knowledge Building. *Sci & Educ*, 1-

14. https://doi.org/10.1007/s11191-024-00506-2

Erduran, S. & Levrini, O. (2024) The impact of artificial intelligence on scientific practices: an emergent area of research for science education. *International Journal of Science Education*, 1-9. https://doi.org/10.1080/09500693.2024.2306604

Gorelik, G. (2024). How a falling apple could have helped Newton discover universal gravity. *EPJ H*, 49, 1. https://doi.org/10.1140/epjh/s13129-023-00065-0

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Li, Q., Yue, J., Sun, J. et al. (2024). Frontier Development and Insights of International Educational Science Research in the journals Nature and Science: a Systematic Literature Review over 40 Years. *Sci & Educ*, 1-29. https://doi.org/10.1007/s11191-024-00509-z

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Recent HPS&ST Related Books

Chirimuuta, M. (2024). *The Brain Abstracted: Simplification in the History and Philosophy of Neuroscience*. Cambridge MA: The MIT Press. ISBN: 9780262548045

"All science needs to simplify, but when the object of research is something as complicated as the brain, this challenge can stretch the limits of scientific possibility. In fact, in *The Brain Abstracted*, an avowedly "opinionated" history of neuroscience, M. Chirimuuta argues that, due to the brain's complexity, neuroscientific theories have only captured partial truths—and "neurophilosophy" is unlikely to be achieved.

"Looking at the theory and practice of neuroscience, both past and present, Chirimuuta shows how the science has been shaped by the problem of brain complexity and the need, in science, to make things as simple as possible. From this history, Chirimuuta draws lessons for debates in philosophy of science over the limits and definition of science and in philosophy of mind over explanations of consciousness and the mind-body problem.

"*The Brain Abstracted* is the product of a historical rupture that has become visible in the twenty-first century, between the "classical" scientific approach, which seeks simple, intelligible principles underlying the manifest complexity of nature, and a data-driven engineering approach, which dispenses with the search for elegant, explanatory laws and models. In the space created by this rupture, Chirimuuta finds grounds for theoretical and practical humility. Her aim in *The Brain Abstracted* is not to reform neuroscience, or offer advice to neuroscientists, but rather to interpret their work—and to suggest a new framework for interpreting the philosophical significance of neuroscience." (From the Publisher)

More information HERE

Coelho, Ricardo L. (2024) *What Is Energy?An Answer Based on the Evolution of a Concept*. Dordrecht: Springer. ISBN: 978-3-031-51854-6

"This book provides a solution to the problem with the energy concept. This problem manifests itself in the fact that physicists clearly diverge regarding the question of what energy is. Some define it but others state that we do not know what it is. Although this is a problem for physicists who need to explain the concept, it is not a problem for physics that can be solved by laboratory means. Penetrating into the origin of the notion of energy, this book offers a clear idea of what was discovered and what was invented to interpret the findings.

“Following the development of the concept, it provides an explanation of the trends in contemporary textbooks. The author's repetition, in his "History and Philosophy of Physics Laboratory", of Joule’s famous experiment – the paddle wheel experiment – with a calorimeter as originally used by Joule and with a calorimeter as proposed in textbooks, is presented, yielding new insight into the phenomenon. Thus, science teachers and students will benefit from reading the book as well as historians, philosophers, students of the history and philosophy of science, and all who are interested in knowing about what it is that we call energy.” (From the Publisher)

More information HERE

Dawson, Gowan (2024). *Monkey to Man The Evolution of the March of Progress Image*. New Haven, CT. Yale University Press. ISBN: 9780300270624

“We are all familiar with the “march of progress," the representation of evolution that depicts a series of apelike creatures becoming progressively taller and more erect before finally reaching the upright human form. Its emphasis on linear progress has had a decisive impact on public understanding of evolution, yet the image contradicts modern scientific conceptions of evolution as complex and branching.

“This book is the first to examine the origins and history of this ubiquitous and hugely consequential illustration. In a story spanning more than a century, from Victorian Britain to America in the Space Age, Gowan Dawson traces the interconnected histories of the two most important versions of the image: the frontispiece to Thomas Henry Huxley's *Evidence as to Man's Place in Nature* (1863) and “*The Road to Homo Sapiens*," a fold-out illustration in the best-selling book Early Man (1965). Dawson explores how the recurring appearances of this image pointed to shifting scientific and public perspectives on human evolution, as well as indicated novel artistic approaches and advancements in technology.” (From the Publishers)

More information HERE

Dove, Michael R. (2024). *Hearsay Is Not Excluded: A History of Natural History*. New Haven, CT. Yale University Press. ISBN: 9780300270105

“For millennia, the field of natural history promoted a knowledgeable and unifying view of the world. In contrast, the modern rise of narrow scientific disciplines has promoted a dichotomy between nature and culture on the one hand and between scientific and folk knowledge on the other. Drawing on the fields of anthropology, history, and environmental science, Michael R. Dove argues that the loss of this historic holistic vision of the world is partly to blame for contemporary environmental degradation and science skepticism.

“Dove bases this thesis on a study of four pioneering natural historians across four centuries: Georg Eberhard Rumphius (seventeenth century), Carl Linnaeus (eighteenth century), Alfred Russel Wallace (nineteenth century), and Harold C. Conklin (twentieth century). Dove studies their field craft and writing; the political, cultural, and environmental circumstances in which they worked; the sources of their insight; and the implications of their work for modern society. Most of all, the book seeks to discover what enabled those natural historians to straddle boundaries that today seem impassable and to distill that wisdom for a modern world greatly in need of a holistic vision of people and environment.” (From the Publishers)

More information HERE

Frank, A., Gleiser, M. & Thompson, E. (2024). *The Blind Spot: Why Science Cannot Ignore Human Experience*. Cambridge MA: The MIT Press. ISBN: 9780262048804

“It's tempting to think that science gives us a God's-eye view of reality. But we neglect the place of human experience at our peril. In *The Blind Spot*, astrophysicist Adam Frank, theoretical physicist Marcelo Gleiser, and philosopher Evan Thompson call for a revolutionary scientific worldview, where science includes—rather than ignores or tries not to see—humanity's lived experience as an inescapable part of our search for objective truth. The authors present science not as discovering an absolute reality but rather as a highly refined, constantly evolving form of human experience. They urge practitioners to reframe how science works for the sake of our future in the face of the planetary climate crisis and increasing science denialism.

"Since the dawn of the Enlightenment, humanity has looked to science to tell us who we are, where we come from, and where we're going, but we've gotten stuck thinking we can know the universe from outside our position in it. When we try to understand reality only through external physical things imagined from this outside position, we lose sight of the necessity of experience. This is the Blind Spot, which the authors show lies behind our scientific conundrums about time and the origin of the universe, quantum physics, life, AI and the mind, consciousness, and Earth as a planetary system.

"The authors propose an alternative vision: scientific knowledge is a self-correcting narrative made from the world and our experience of it evolving together. To finally "see" the Blind Spot is to awaken from a delusion of absolute knowledge and to see how reality and experience intertwine.

"*The Blind Spot* goes where no science book goes, urging us to create a new scientific culture that views ourselves both as an expression of nature and as a source of nature's self-understanding, so that humanity can flourish in the new millennium." (From the Publishers)

More information HERE

Nathan, Marco J. (2024). *The Quest for Human Nature: What Philosophy and Science Have Learned*. Oxford, UK: Oxford University Press. ISBN: 9780197699249

"Over the last fifty years, scholars in biology, psychology, anthropology, and cognate fields have substantially enriched traditional philosophical theories about who we are and where we come from.

"The assumption of a shared human nature lies at the core of some of the most pressing socio-political issues of our time. From race to sex and gender, from medical therapy to disability, from biotechnological enhancement to transhumanism, all these timely debates presuppose a robust notion of human nature. Nevertheless, the riddle of human nature remains frustratingly elusive. Why? Marco J. Nathan here provides an accessible, detailed, and up-to-date overview of cutting-edge empirical research on human nature, including evolutionary psychology, critiques of essentialism, innateness, and genetic determinism, addressing the question of why these fields have failed to provide a full-blown theory of human nature.

"Nathan's answer is that our nature is not the kind of notion that is susceptible to explanation. Human nature rather plays a crucial role as an epistemological indicator, a pivotal concept that sets out the agenda for much social, political, and normative discourse. Nevertheless, science cannot adequately grasp it without dissolving it in the process." (From the Publisher)

More information HERE

O'Hear, A. (Ed.) (2024). *Karl Popper*. Cambridge, MA: Cambridge University Press. ISBN: 9781009230100

"Sir Karl Popper was a major thinker of the twentieth century, one who – as Anthony O'Hear writes in his new Foreword – 'has had a beneficent influence on those who have come under the spell of his thought and of the inimitable prose in which he articulates it'. It is now twenty-five years since Popper died, and thus seems – after a quarter of a century – an apposite moment to revaluate his impact, significance, and influence. The several chapters in this classic volume focus on many key elements of Popper's thought and philosophy. They are by no means uncritical, but afford Popper the respect due to a philosopher who wrote always with a degree of clarity, precision, and directness rare in the academic world of his time, and – as O'Hear puts it – 'even rarer subsequently'. This important book constitutes an essential introduction to some of the most esteemed philosophical writing of our times.” (From the Publisher)

More information HERE

Segala, M. (2024). *A Convex Mirror: Schopenhauer's Philosophy and the Sciences*. Oxford, UK: Oxford University Press. ISBN: 9780197599150

“Schopenhauer is most recognizable as "the philosopher of pessimism," the author of a system that teaches how art and morality can help human beings navigate life in "the worst of all possible worlds." This dominant image of Schopenhauer has cut off an important branch of his tree of philosophy: the metaphysics of nature and its dialogue with the sciences of the time.

“*A Convex Mirror* sheds new light on the development of Schopenhauer's philosophy and his ongoing engagement with the natural sciences. Understanding Schopenhauer's metaphysics requires both an insight into his relationship with science and an appreciation of the role of the natural sciences in his philosophical project.

“In the first edition of *The World as Will and Representation* (1819), Schopenhauer dealt with science within the framework of Kant and Schelling's philosophies of nature, but his growing perplexity with them led him to an original, more complex conception of the relationship between science and metaphysics. He therefore embarked on a revision of his metaphysics of nature, which ultimately affected its core concepts—namely, the will and ideas—and influenced his decision to publish a volume of *Supplements* (1844) rather than a revised edition of his main work.

“The evolving relationship of Schopenhauer's philosophy to the natural sciences is a powerful interpretative tool: a "convex diffusing mirror" that reflects the totality and complexity of his system and sheds light on the core concepts of his philosophy, such as the systematic structure of his philosophy, reality and representation, idealism and realism, the polysemic nature of ideas, and the will as the thing in itself.” (From the Publishers)

More information HERE

Wolverton, M. (2024). *Splinters of Infinity: Cosmic Rays and the Clash of Two Nobel Prize–Winning Scientists over the Secrets of Creation*. Cambridge MA: The MIT Press. ISBN: 9780262048828

“Set in a revolutionary era of physics and science when a series of rapid-fire discoveries was upending our understanding of the universe, *Splinters of Infinity* by Mark Wolverton tells a little-known story: the tale of two of America's foremost physicists, Robert Millikan (1868–1953) and Arthur Compton (1892–1962), who found themselves locked in an intense, often deeply personal, conflict about cosmic rays. Confirmed in 1912, cosmic rays—enigmatic forms of penetrating radiation—seemed to raise all new questions about the origins of the universe, but they also offered the potential to explain everything—or reveal the existence of God.

“In engaging, accessible prose, Wolverton takes the reader through the twists and turns of the Millikan-Compton debate, one of the first major public examples of how heated the controversies among scientists could become—and the lengths that scientists would go to settle their disputes. What set them apart, at least in most cases, Wolverton shows, was their ability to concentrate finally on what mattered: the science. Along the way, Wolverton probes the forever elusive question, still unanswered today, about where cosmic rays come from and what they reveal about black holes, distant galaxies, the existence of dark matter and dark energy, and the birth of the universe, concluding that these splinters of infinity may not hold the keys to the secret of creation but do bring us ever closer to it.” (From the Publisher)

More information HERE

Authors of HPS&ST-related papers and books are invited to bring them to attention of the Newsletter's assistant editor Paulo Maurício (**paulo.asterix@gmail.com**) for inclusion in these sections.

PhD Award in HPS&ST

We welcome publishing details of all PhDs awarded in the field of HPS&ST. Send details (name, title, abstract, supervisor, web link) to editor: m.matthews@unsw.edu.au

Science & Education, Editor Sought

The International History, Philosophy, and Science Teaching Group (IHPST) invites applications for the position of Editor of the journal *Science & Education*, to begin on **January 1st, 2025**.

Science & Education, which is owned and published by Springer, is the official journal of the International History, Philosophy and Science Teaching Group (IHPST). The journal publishes articles at the intersection of the history, philosophy, and sociology of science including the results of research, model curricula, teacher education, policy and related history, and nature of science perspectives to improve teaching and learning in science and mathematics. *Science & Education* is distinctly interdisciplinary and aims to foster fruitful discourse among scientists, mathematicians, historians, philosophers, cognitive psychologists, sociologists, science and mathematics educators, and school and college teachers. The journal currently publishes at least 60 articles per year, with an impact factor of 2.8 (2022).

The Editor will begin a five-year term on **January 1, 2025**. They will receive a contract with Springer that includes an annual editorial budget and will negotiate the terms of this contract directly with the publisher.

Applications due **May 6, 2024**. They should include:

➢ a vision statement for *Science & Education*, including motivations and aims for serving as Editor and a personal interpretation of the scholarly issues to be addressed by the journal during the five-year term of service

➢ summary of primary qualifications

➢ a current curriculum vitae

➢ names and contact information of 3 references who can address the candidate's required qualifications as outlined above

Interested persons or teams are encouraged to send questions about the role of the editor-in-chief position to the current Editor, Sibel Erduran (Sibel.Erduran@education.ox.ac.uk) and/or *Science & Education's* Advisory Board Chair, Andreia Guerra (editor-search@ihpst.net).

Coming HPS&ST Related Conferences

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March 7-11, 2024, Philosophy of Education Society (PES) Annual Conference, Salt Lake City, UT
Details **HERE**

March 17-20, 2024, NARST Annual Conference, Denver CO
Details **HERE**

March 29-30, 2024, Philosophy of Social Science, Roundtable, University of Texas, Dallas. Submissions by December 15
Details from: PSSR2024@gmail.com

April 5-7, 2024, Revitalising Science & Values, conference, University of Pittsburg
Details: **HERE**

May 16-18, 2024, Society for Philosophy of Science in Practice (SPSP) Tenth Biennial Conference, University of South Carolina, Columbia, SC USA
Details **HERE**

May 29-31, 2024, Italian Society for the History of Science, conference, Bari
Details **HERE**

June 13-15, 2024, XXXI Baltic Conference on the History and Philosophy of Science, Tartu
Details: **HERE**

June 26-28, 2024, Singapore National Institute of Education, STEM conference
Details **HERE**

July 1-5, History and Pedagogy of Mathematics Conference, University of New South Wales, Sydney.
Details: Jim Pettigrew, UNSW

July 4-14, 2024, International Congress on Mathematical Education, Sydney
Details HERE

July 8-10, 2024, Science in Public, annual conference, University of Birmingham.
Details: HERE

August 1-8, 2024, 25th World Congress of Philosophy, Rome
Details **HERE**

August 28-30, 2024, European Network for Philosophy of the Social Sciences (ENPOSS), 13th Conference, University of Bergen, Norway
Details: **HERE**

September 2-6, 2024, International History, Philosophy and Science Teaching Group (IHPST), biennial conference, Buenos Aires
Details: ihpst2024@gmail.com

September 4-7, 2024, 11th European Society for History of Science conference, Barcelona
Details **HERE**

September 16-20, 2024, Eighth International Conference on the History of Mathematics Education (ICHME-8), Warsaw
Details: Organiser Karolina Karpinska

September 17-19, 2024, Forum on Philosophy, Engineering and Technology, Karlsruhe Institute of Technology
Details: **HERE**

March 6-10, 2025, US Philosophy of Education Society, PES, annual conference, Baltimore.
Details: **HERE**

HPS&ST Related Organisations and Websites

IUHPST – International Union of History, Philosophy, Science, and Technology
DLMPST – Division of Logic, Mathematics, Philosophy, Science, and Technology
DHST – Division of History, Science, and Technology
IHPST – International History, Philosophy, and Science Teaching Group
NARST - National Association for Research in Science Teaching
ESERA - European Science Education Research Association
ASERA - Australasian Science Education Research Association
ICASE - International Council of Associations for Science Education
UNESCO – Education
HSS – History of Science Society
ESHS – European Society for the History of Science
AHA – American History Association
FHPP APS - Forum on History and Philosophy of Physics of the American Physical Society
HAD AAS - Historical Astronomy Division of the American Astronomical Society.
ACS HIST – American Chemical Society Division of the History of Chemistry
GWMT - Gesellschaft für Geschichte der Wissenschaften, der Medizin und der Technik
ISHEASTME – International Society for the History of East Asian History of Science Technology and Medicine
EASE - East-Asian Association for Science Education
BSHS – British Society for History of Science
EPSA - European Philosophy of Science Association
AAHPSSS - The Australasian Association for the History, Philosophy, and Social Studies of Science
HOPOS – International Society for the History of Philosophy of Science
PSA – Philosophy of Science Association
BAHPS - Baltic Association for the History and Philosophy of Science
BSPS – The British Society for the Philosophy of Science
SPSP - The Society for Philosophy of Science in Practice
ISHPSB - The International Society for the History, Philosophy, and Social Studies of Biology
PES– The Philosophy of Education Society (USA)

The above list is updated and kept on the HPS&ST website at: **HERE**

HPS&ST related organizations wishing their web page to be added to the list should contact assistant editor Paulo Maurício:
paulo.asterix@gmail.com

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