Defining science-informed decision-making

We begin with a hypothetical person's informed decision-making as an example of how an individual uses both values and information to make decisions. We go onto define what we mean by evidence and science.

1. **A hypothetical individual decision-maker choosing between paths based on values but informed by multiple sources of information.**

Rocky wants to backpack to the summit of Eagle Peak to get a view of the surrounding landscape and along the way identify a location to build a tower to detect wildfires. These two goals are value-based: fire suppression and personal value of aesthetic appreciation of scenery for hiking. their secondary priority is to complete the return trip in a few days which is a professional value of efficient use of time. Their colleague encourages them to take the helicopter for greater urgency because wildfire season is only a few months away. Rocky declines because they value quiet, inexpensive, non-polluting hiking that scares wildlife less (secondary values, some of which are strongly emotion-laden [1],[2]). They prepare by collecting information, which is a distinct source of support for decisions different from values [3]

Rocky obtains a topographic map and studies possible routes to the top of the peak. The paths are fairly new and not yet well explored or heavily used. they identify two routes: one that will allow them to reach the summit in four days if all goes well and another that will take five days if all goes well (Fig. 1).

The longer route is along a river more sheltered by trees. But the shorter high-elevation route will also be scenic; and because it is shorter they can carry less food, making their pack lighter. On the other hand, they can pack their fishing rod and, with luck, catch trout in the river if they run out of food on the longer river-side path. The pros and cons represent secondary values at

[1] Note that references in footnotes are chosen to be open access at no cost, leading to a bias we acknowledge here: many citations to our own work or that of colleagues predominate because we had permission to make these freely available. If you cannot access one of the references we cited, please email atreves@wisc.edu and we can supply it. For permission to use this document for any purpose beyond education or public interest, please seek permission from the lead author by email atreves@wisc.edu.

[2] . Batavia, et al. 2021. https://www.ncbi.nlm.nih.gov/pubmed/33410227.

[3] Santiago-Ávila. 2020. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h, Treves, et al. 2021. https://doi.org/10.3389/fcosc.2021.631998 .

play – such things as cost, physical strain, food sources. Rocky is using reliable pre-existing information (topo maps) for their first decision about which path to use. This is analogous to choosing a method to attain one's goal (sometimes called an intervention, objective, or approach). Some of their information (topo maps) is considered highly accurate (close to reality) although not sensitive to changing conditions because it is static ort fixed at the time of mapping (data collection).

Fig. 1 Rocky deciding between two routes based on prior information [4].

Before embarking, Rocky checks with the Forest Service office to learn more about both possible routes: Are there any obstacles, have there been any reports of grizzly bears or forest fires, is water available on the higher elevation route? They are seeking more accurate information than the topo-maps can provide about recent changes to conditions [5].They are informed of a major windfall of tree trunks blocking part of the lower approach along the river. Obviously, a topo map cannot capture such recent, short-term obstacles, representing a lack of accuracy despite the precision of the maps showing where the paths go. Their friend, Shana, an outfitter says their group was able to pass the fallen trees but that slowed them down. Will they be as agile and be able to repeat Shama's method? The Forest Service also informs them that a spring that usually has water on the high-elevation path has been reported unpredictably dry by some hikers while other hikers had no problems. The Forest Service and Shana's information sources are analogous to local experience and anecdotal reports. But the unpredictability of the high-elevation spring would lead Rocky to pack an extra water bottle, further weighing them down. Therefore, the sources of uncertainty are accumulating and altering value-based priorities for Rocky. Rocky then checks the weather forecast. That forecast is analogous to a scientific model predicting future conditions. Everyone

[4] AI-assisted image generation with prompt: "Use ChatGPT to draw a realistic grayscale image of a silhouette backpacker with hair to their shoulders. On the left, draw a steep downhill path toward a river. Draw several fallen trees across the path. On the right, draw a steep, rocky uphill trail. In the background a thunderstorm brews". Accessed through Mac OS Sierra 15.4.1® Siri-assisted ChatGPT® tool.
[5] Treves and Santiago-Ávila. 2023. https://doi.org/10.20935/AcadBiol6099.

knows it may be slightly or drastically inaccurate (meaning very different from the eventual real condition). The forecast is for a storm front but only light precipitation and high winds – another (value-based) reason to take the low-elevation river route to avoid lightning strikes on the ridge tops. They pack their rain jacket just in case.

onsidering all the available information in light of their various values and goals, Rocky makes a partially subjective assessment of their options and decides in favor of the longer, safer but still uncertain river-side route. How do decision-makers weigh information and handle uncertainty? And do scientists also use value judgments?

Some decision-makers and scientists claim they are being objective, but a more appropriate view is their partially subjective decision is based on values that are informed by evidence of various qualities which are weighed impartially and transparently [6]. Hopefully, Rocky weighed those diverse sources of evidence impartially and transparently [7], i.e., Rocky did not prefer one source of evidence because of who provided it [8] or other extraneous information [9], but rather because they transparently weighed their values against an estimate of the probabilities of success and failure and relative strengths of the different sources of information [10]. Missing that ideal does not mean the decision-maker (or scientist) is incurably biased or a failure, just that the particular decision contains a potential bias that should be considered as we discuss further below.

The next day, the thunderstorm over Rocky's head is worse than forecast (the inaccuracy of the weather forecast is analogous to a scientific model under- or over-estimating a predicted outcome) they consult their map and determine that they can backtrack a few miles before dark, to a dry place where they can camp for the night. Rocky's reversal of course is analogous to adaptive management based on new information, emphasizing the need for planners and actors to continuously collect information on progress and obstacles. Such adaptive management should always include the option of halting, reversing course, or choosing a third option that may not have been considered previously [11].

As the thunder crashes and lightning strikes high trees, Rocky feels they made the right decision because their secondary value is safety from lightning, a value that had not been considered above. But they acknowledge that they discounted their colleague's concern with speed because the storm and tree-falls have slowed them down more than they expected. As safety becomes more of a concern, Rocky adapts and adds a step.

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[6] Treves. 2019. https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/fee.2091.
[7] Treves. 2023. https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1002/fee.2676.,
[8] Karns, et al. 2018. https://cwbm.ca/wp-content/uploads/2018/05/3-Karns-et-al.-7-1.pdf.
[9] Treves and Santiago-Ávila. 2020.
[10] Treves. 2022. https://doi.org/10.1002/fee.2568.
[11] Salafsky, et al. 2019. https://conbio.onlinelibrary.wiley.com/doi/10.1111/csp2.27.

Rocky radios back to Shana, informing them what path they followed and where they camped in case anyone has to repeat the route to rescue Rocky That decision is analogous to creating the conditions for replication [12]. By sharing their methods with Shana, their team can retrace Rocky's steps and find them if their plan proves unreliable and Rocky gets into trouble.

Here we end Rocky's story to turn to broader, more common decision-making by organizations. Rocky's decisions were simplified because they had only their own values to consider. Most organizations have to contend with their many members' values.

2. 2. Organizational decision based on information

Pluralistic decision processes are informed by diverse values and opinions where all perspectives and interests are considered [13]. This also pertains to diverse views of what is considered reliable or persuasive evidence. We turn to the values underlying the collection of reliable evidence after we discuss how organizations balance plural values.

Any organization must be clear about its constitutive process for deliberation to decide whether one or more interventions are more valuable than inaction and to decide what sources of information they deem more reliable than others. Not all organizations are clear internally or externally on that constitutive process, e.g., [14]. One of the most common symptoms of unclear handling of values occurs when an organization claims its decisions are science-driven or based on science [15].

Regarding diverse values within organizations with many persons. One should keep in mind that these values are rarely permanent. Values can change and certainly the holders of those values may alter priorities, especially over time as conditions change. Therefore, a decision-making authority should re-evaluate the balance of plural value judgments. This need not be paralyzing.

A pragmatic approach is to revisit decisions at regular intervals when new information accumulates or when interim steps have been accomplished (e.g., it is rarely too late to reverse course as Rocky did). Also, the priority of values changes once action is taken. Once underway, the importance of efficiency, safety, unforeseen consequences, etc. rise in priority naturally. That is when secondary concerns, such as Rocky's concerns about safety, food, the weight of

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[12] Goodman, et al. 2016. https://www.science.org/doi/10.1126/scitranslmed.aaf5027. Treves. 2022. https://doi.org/10.1002/fee.2568..

[13] Lynn. 2010. https://www.wellbeingintlstudiesrepository.org/acwp_habr/13/, Lynn. 2018. http://www.williamlynn.net/pdf/lynn-2018-bringing-ethics-to-wild-lives.pdf.

[14] Clark and Milloy. 2014. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h.

[15] Santiago-Ávila. 2020. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h, Lynn. 2010. https://www.wellbeingintlstudiesrepository.org/acwp_habr/13/, Kassiola. 2008. https://www.environmentandsociety.org/sites/default/files/key_docs/ev_12no.4_kassiola_joel_j.pdf, Lynn. 2006. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h.

their pack, etc. begin to deserve focused attention and new sources of information might be required to continue steady progress or reverse course. Now let's assume an organizational authority has made value judgments using good governance principles such as one would ideally like in a constitutional democracy governed by the rule of law. The goal has been set by values, secondary values have come into play, and new information is coming in about progress, likelihood of success, etc. Now it is time to evaluate the quality of that evidence.

Not all information sets provided to decision-makers are equally reliable. There is misinformation (unintentionally wrong) and disinformation (intentionally false) [16] to avoid, versus reliable observations and measurements, followed by strong inference to seek. Note that at this point we have not defined or assumed terms such as science, inference, etc., we're simply paving the way for the smorgasbord of potential information confronting decision-makers [17]. Part of our task is to define a subset of information as reliable evidence. How does one distinguish poor from good evidence from better evidence, meaning more reliable, information? How do we identify gaps in the evidence that will require specific, particular information-gathering? Here too, values interpose themselves because humans as individuals may weigh different sources of evidence somewhat differently.

In the USA context, many government agencies are charged with a legal duty to use the best available science [18]. But the public may value different sources of information than do decision-makers. Observers may want to know if the decision-making authority is discharging that duty conscientiously and thoroughly, or members of the public may wish to know if the best available science includes indigenous knowledge, particular lines of evidence. Exploring the legal arguments for compelling decision-makers to use the best available evidence is also beyond our scope but we want to make clear the minimum (or basement) level of evidence that decision-makers should have at hand to make reasonable decisions to intervene, change course, or not to act.

Decision-makers should understand quite a bit about the immediate past that led to the present state of affairs. This does not mean deep historical analysis is necessarily always needed. But the commonsense saying that 'forgetting history, we are destined to repeat it' gives some guidance about the potential errors of ignoring the past. Decision-makers should also understand the predicted future outcomes of each intervention before choosing it compared to the consequences of inaction. Much ink has been spilt over the predictive power of forecast

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[16] Bode and Vraga. 2021. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h, Lewandowsky, et al. 2012. https://journals.sagepub.com/doi/10.1177/1529100612451018, Walter and Tukachinsky. 2020. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h.

[17] Bode and Vraga. 2021. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h, Lewandowsky, et al. 2012. https://journals.sagepub.com/doi/10.1177/1529100612451018, Walter and Tukachinsky. 2020. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h.

[18] Doremus. 2004. https://escholarship.org/uc/item/3md016kg.

models and also the 'quick-and-dirty' models being sufficient for reasoned action. That is beyond our scope here but suffice it to say that a systematic comparison of predicted outcomes, potential side-effects, and relative investments in different actions [19] seems wise, as we tried to illustrate with Part 1 and Rocky's dilemma (Fig. 1). Finally, current conditions demand highly reliable information because misjudging one's starting point raises the risks of losing one's way.

Sources of information are sifted by value judgments

A major point of controversy in US government decision-making about the environment has been how to balance Western science with indigenous knowledge and how to balance both with special interest expertise (or industry research) [20].

Different individuals will weigh different sources of information differently, which is another example of where values interpose themselves in the handling of evidence. In addition to the major institutions of Western science, indigenous knowledge, and interest-group research, many decision processes are also characterized by personal observations, opinions, anecdotes, and minority views of past, present, or future conditions. Rocky grappled with all of these in the form of topo-maps, weather forecasts, recent anecdotes about trails, self-assessment and third-party assessments of their ability to cross fallen trees, etc. Although weighing these many sources is beyond our scope, we believe it is useful to explain why western science has enjoyed so much favor – with the good and the bad this entails – in US government decision-making.

The principles of science in its ideal form that deserve our confidence have been articulated and argued by Naomi Oreskes (2019) in her book Why Trust Science? [21] among others for centuries. Her treatment is highly useful today because she forewarns us of interest groups that wish to disinform the public, the ideal processes that resist such self-interested influences, and the necessary ingredients for trustworthy information in today's policy arenas. Building on these principles, the 21st century scientific community has been grappling with trust in science and the reliability of research findings [22]. Understanding the reproducibility crisis in Western science helps us discern between poor, good, and better science.

As evidence accumulated that many splashy scientific findings could not be repeated -- (defined as qualified researchers failed to replicate the findings by following the published methods assiduously), attention focused on every step in the research process from the value-based

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[19] Treves, et al. 2009. https://faculty.nelson.wisc.edu/treves/pubs/2009_Treves_A_Wallace_R_B_White_S.pdf.
[20] Oreskes. 2019. https://uwmadison.box.com/s/i2oiky9t8yqec7fww0ywdeuxduxj4m68. Waller and Reo. 2018. https://doi.org/10.5751/ES-09865-230145. Eichler and Baumeister. 2018. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h. Wood. 2014. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h.
[21] Oreskes. 2019. https://uwmadison.box.com/s/i2oiky9t8yqec7fww0ywdeuxduxj4m68.
[22] Baker and Brandon. 2016. https://www.nature.com/articles/533452a.

decision of what scientific question to try to answer, to the methods for observation and measurement (jointly: data collection), limits to inference, all the way through to the publication process and replication efforts [23].

For the purposes of the current work, several fundamental principles, often called Open Science, have surfaced as supremely important for reliable science: (a) transparency throughout the research process accompanied by (b) rigorous and unbiased observation and inference [24].and (c) independent review and replication, most of which happens during and after publication.

a. Transparency is often cited as the most important element of Open Science because it should expose all researchers' assumptions, values, methods of observation and inference, statistical analyses, and the publication process to scrutiny. That scrutiny is often public (e.g., data sharing, disclosures of competing interests) or sometimes restricted to a few qualified researchers called peer reviewers, who are often anonymous and whose judgments of the quality of research are adjudicated by editors and publishers of scientific journals. Transparency fails when methods are omitted, researchers' own biases are not exposed to light, or when findings are treated as proprietary or classified.

b. Reliability of evidence tells us whether we can use it to understand past or current conditions, or. perhaps predict the outcomes of our interventions consistently. Collecting information starts with observation or measurement of select phenomena or features of the world around us. That is why Western science is not the only approach to reliable evidence (see below).

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[23] Goodman, et al. 2016. https://www.science.org/doi/10.1126/scitranslmed.aaf5027, Allison, et al. 2016. https://www-nature-com.ezproxy.library.wisc.edu/news/polopoly_fs/1.19264!/menu/main/topColumns/topLeftColumn/pdf/530027a.pdf, Benjamin, et al. 2018. , Colquhoun. 2017. http://dx.doi.org/10.1098/rsos.171085, Iqbal, et al. 2016. https://doi.org/10.1371/journal.pbio.1002333, Kretser, et al. 2019. https://pmc.ncbi.nlm.nih.gov/articles/PMC6450850/, Mejlgaard, et al. 2020. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h, Open Science Collaboration. 2015. https://osf.io/447b3/download, Webster and Rutz. 2020. , Ioannidis. 2005. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h.

[24] Treves. 2022. https://doi.org/10.1002/fee.2568, Iqbal, et al. 2016. https://doi.org/10.1371/journal.pbio.1002333, Kretser, et al. 2019. https://pmc.ncbi.nlm.nih.gov/articles/PMC6450850/, Mejlgaard, et al. 2020. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h, Clark and Alvino. 2018. https://everyone.plos.org/2018/08/06/arrive-rct/, de Haas. 2021. https://www.nature.com/articles/d41586-021-00073-4, Gernsbacher. 2018. https://doi.org/10.1177/2515245918754485, Gernsbacher. 2020. http://teachpsych.org/ebooks/howweteachnow-transformative.

We know the attributes of reliable observation and measurement. These are (a) accurate: close to the real value [25], (b) precise: not excessively variable in outcomes when repeated, (c) sensitive to changing conditions: they generate changing estimates correlated to the real values even if those change, and (d) reproducible: methods can be repeated and yield very similar findings [26]. Reliable observations, measurements, and inferences are replicable, i.e., someone following the prior methods should get approximately the same result.

The more complex and changeable the phenomena we wish to describe the greater the demand on our methods of observation. Therefore, in some simple conditions such as Rocky's hike, we do not need Open Science and may rely on anecdotes, personal experience, or other kinds of information, before we decide to act.

Inference refers to drawing conclusions about unobservable phenomena or those phenomena that are very hard to or impossible to measure directly, e.g., x-ray crystallography was needed to infer the structure of the double helix of DNA, so Watson and Crick could never have won the Nobel Prize without the x ray crystallography done by Rosalind Franklin (1920-1958). Together, observations and measurements generate the data used by researchers to make inferences about phenomena they cannot directly observe. Careful disentanglement of inference from data collection is important to ethical communication about evidence. Take as an example, the weather forecast Rocky relied on in section 1. The inaccurate forecast of the thunderstorm seems to call for a better model of the weather for future decisions. Weather forecasts are an example of predictive models or inference drawn from past patterns. If one blurs the line between what one can observe and measure about current conditions and by contrast, what one infers about unobservable phenomena, the first step to misleading one's audience has been taken. That is why most careful researchers use past and future tense carefully (e.g., 'x was observed so we predict y will come to be', rather than 'x is the current condition leading to y'). Or put another way, no matter how accurately and precisely we have measured a phenomenon, by the time we report it, or someone tries to replicate our observations, conditions may have changed. Therefore, it is safer to report what was the condition when we measured it. Likewise, we should always treat our predictions with humility because we may have erred, or conditions may have changed.

Returning to indigenous knowledge and Western science, when it comes to observation and measurement, the two sources of information may be in conflict or may be concordant; it is entirely determined case by case based on methods and strength of inference, not as a matter of reputations, ideologies, or politics. The scrutiny of methods in their broadest sense is an exercise in self0-scrutiny for scientists followed by independent review by qualified experts. That

[25] We understand there is an academic debate about truth and whether we can ever measure a 'real' value, but we ascribe to the view that humans can approximate true or real values by perfecting reliable observation and measurement using the processes we discuss here.

[26] Treves and Santiago-Ávila. 2023. https://doi.org/10.20935/AcadBiol6099.

is why independent review is a critical second step in science and particularly important to the Open Science movement.

c. independent review requires transparency but also attempts to integrate a different process to improve the reliability of that evidence. Ideally, independent review and replication should bring Oreskes'[27] diverse community of qualified experts to bear on particular research finding. Independent review at its best allows qualified experts with different worldviews, values, and expertise to strengthen a finding or point out the failures of an unreliable finding. Independent review fails when the community of researchers is not diverse enough, independent enough from each other (or decision-makers), or unqualified to scrutinize and skeptically test and replicate findings. We encourage the interested reader to explore Oreskes to understand what qualified, diverse, scrutiny, skepticism, independence, and replication mean in our context.

In brief, we s**hould trust information when the observations and inferences of qualified experts are subjected to rigorous scrutiny and skepticism by a diverse community of independent qualified experts who have and continue to subject the information to repeated test and replication**. Note: information is never reliable from a single source, but requires that full, plural, diverse process before it can be considered reliable.

Many sources of information fail that test immediately. New information captured in a unique, first-of-its-kind study will not meet the criterion of reliability. That does not mean we discard it, but rather we adopt a mindset that the information is not yet reliable evidence, no matter the reputation, authority, or insistence of its sources. The process described by Oreskes in boldface above bears zero relationship to who collected the information beyond that they are deemed qualified by years of devotion to the rigors of impartial collection and interpretation of evidence. In other words, identity of qualified researchers is irrelevant, only the methods they used. Stated in this way, any human endeavor that meets the criteria should gain our trust. Those criteria establish what counts as reliable evidence, regardless if it is western, regardless if we call it science, and regardless of who is involved in those methods and interpretations. This marks the transition from information to evidence because scientific data when collected, scrutinized, and replicated becomes more reliable than other information.

We also consider it helpful to mention the many synonyms for the terms we have used here.

[27] [27] Oreskes. 2019. https://uwmadison.box.com/s/i2oiky9t8yqec7fww0ywdeuxduxj4m68.

Why we prefer the phrase "science-informed" and why synonyms may not convey what you want.

Why prefer science-informed? We prefer 'science-informed' because science demarcates the process we described here) as opposed to evidence-informed which leaves open the possibility that someone's preferred evidence will take the place of the science as we have defined it here following Oreskes (2019).

Synonyms: Different persons use different words for our topic, e.g., reasoned, rational, planned, science-based, science-driven, evidence-informed, data-informed, scientific, etc. Also, one can attach science-informed to stages in the policy process including management, rules, regulations, intervention, governance, and of course policy. Likewise, action or inaction and interventions are synonyms for some aspects of policy, management, or even disciplinary fields, e.g., 'evidence-informed medicine'.

Often choosing between one synonym or another will reflect tradition, culture, individual preferences, or subtle differences in meaning that can vary from jurisdiction to jurisdiction and time to time (i.e., with values). Although words have power, one may be forced to follow the local norms and not change how others use terms such as science-based or science-driven. Hopefully our dissection of science-informed decision-making will allow the public to engage in reasoned debate regardless of which words are used.

Many observers' negative reactions to science used to inform government actions may reflect a reaction to evidence that was not open, not emanating from a diverse set of scientists, not reproducible, or poorly measured in the ways we described above. That brings us to bias, which all humans have. All humans have bias in its evidentiary sense, because we all have a viewpoint [28]. Observer bias is a real and ever-present problem no matter which source of evidence you prefer. Bias among researchers is ever-present because researchers are humans.

Bias can be analogized to an accent in spoken language. You may not hear your own, but people with different ears will hear your accent. Bias is obvious to those who hold different views yet inconspicuous to those with the same view. The trick is to make the bias transparent, then we may overcome it to achieve a better approximation of reality. Just like accents, which the best narrators can add or drop at will, the best scientists (western or not) can add or drop a bias at will, so they can see the effect of each bias.

[28] Ioannidis. 2005. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h. Nagel. 1986. https://uwmadison.box.com/s/5qo4boom2r606spyxz2vsi7w835ouq7h. Treves. 2019. https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/fee.2091, Treves. 2024.

Unlike accents in speech, bias can be concealed in speech or writing. Bias only becomes a problem when it is concealed, because when it is transparent, made clear, and accounted for, we can overcome the slant it produces in our observations and inferences. Examples of bias that deserve special mention in our current context are those that affect the assumptions, viewpoints, or worldviews of researchers and decision-makers. For example, if Rocky stated as a starting assumption ‘I want to fish during my hike’, then they had a presupposition (bias) about how to attain their goal. If that bias is unstated, it cannot be countered as easily as a transparently stated bias. It is not wrong or problematic unless it remains unstated. Unstated, Rocky’s value placed on fishing could slant their preferred action without allowing rebuttal or further information-gathering. We can imagine a hypothetical decision-maker following the poor parenting practice of saying ‘because I said so’ about their unstated preference. This is anathema to science-informed decision-making. It is a symptom of authoritarianism instead. Rocky’s bias for hiking rather than helicopter foreclosed several options but they were transparent about it. The transparency allowed their colleagues to persuade them otherwise if they saw strong reasons to do so. It may be difficult to persuade a decision-maker whose worldview is narrowly constrained or hidden from view.