From the preface and Chapter 0 of the <u>draft</u> of Adam Morton *Acting to Know: the epistemology of experiment*.

In this book I develop and defend a novel account of evidence. Evidence supports a hypothesis, on this account, by putting on the path to knowledge. It applies best to evidence derived from experiment, and it is indeed intended to express what is special about this source of evidence. It applies ideas from contemporary epistemology to a complex of problems that are usually the concern of statistics and the philosophy of science, centering on the support that scientific practices give to hypotheses. There are three main themes, which can only be defended, and perhaps only stated, by combining ideas from several sources in un-traditional ways. They are:

– a general description of nearness to knowledge that applies in a number of areas well beyond that of known claims, conclusions, theories, propositions and the like.

– the use of this to say what evidence is, and how it supports claims.

- a discussion of statistical tests that draws on ideas about possibility and combines them with ideas about probability

- a concept of knowledge, or something knowledge-like, that comes in degrees of strength, at the weak end so weak that satisfying it would never justify a normal ascription of knowledge

As I shall develop these ideas they are in conflict with several dominant views in epistemology and the philosophy of science. Chapter 0 gives a foretaste of this and chapter 8 puts the pieces together into a single coherent position. Each of the chapters in

between discusses a single topic in isolation in a form that I hope will stand on its own, avoiding a house of cards construction where a single failure can bring down the whole business and allowing readers who are unconvinced by some claims to be persuaded by others.

Fasten a pair of calipers tightly around an object. You can then read how wide and often how solid it is. If you come to think that your measurement was wrong you know how to go about repeating it, if need be with an improved tool. This gives a model of a   certain kind of information-gathering. We interact causally with things, in a way that allows us to change, correct, and expand our information. The information doesn't just pile up, as a storehouse of items that can be true or false of their objects. Rather, the causal process that provides information also gives us ways of correcting, improving, and extending it. And the capacity to do this is in some respects more important than the accumulation. …… [several paragraphs omitted]…...

This mini-chapter introduces a distinction about evidence that will underlie what follows. The subsequent chapters refine it and defend its usefulness. But they aim at a number of component issues, which are not put together until the final chapter 7. So to give some perspective here is a glance ahead. The chapter is constructed around an example illustrating the distinction. It contrasts two general strategies for supporting a hypothesis. One strategy understands the relation between a hypothesis and evidence for it as similar to the relation between states of mind and the environment when one has knowledge.[1] The other strategy understands it in terms of norms or standard procedures of rational belief-formation. Various forms of this second strategy are usually taken for granted in discussions of evidence, but I am defending the first one and contrasting the two. Its advantages are greatest when evidence is collected by experiment

the train case

Two passengers, Sophia and Norm, are on a train that has gone through a series of branching junctions. They fall asleep and wake feeling that they have slept for a long time and with doubts about whether they are on the right train. Their aim had been to get to one destination (D1) but they fear that they are by mistake on a train heading for another (D2). So they look out the windows, consider the landscape, and compare it to what they know about the route. They see near mountains and further away a large lake. This could fit a number of places along the way (see the diagram).

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1   Vaguely "environment" to avoid building propositions or facts into the ontology. Complexes of possible worlds would probably do but I want a minimum of orthogonal issues in this connection. Propositional attitudes such as belief are hard enough to understand in relational terms, but factive attitudes such as knowledge, which require a really existing "object" are even more puzzling.
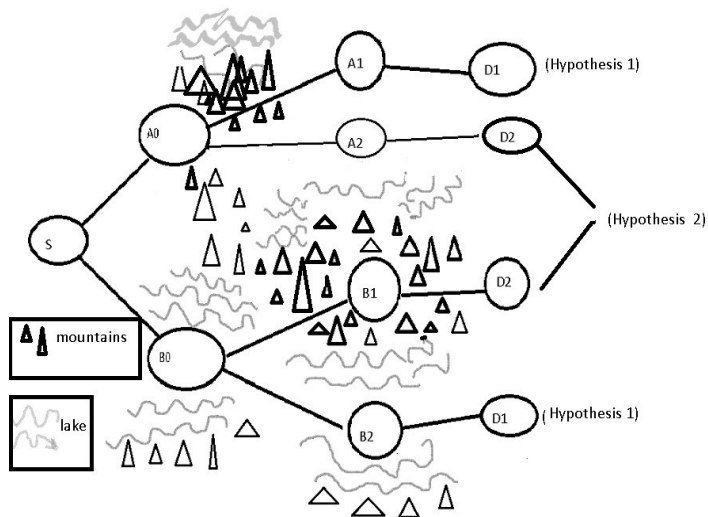
Assuming that they have slept for a good while the superficially best fit is with B1, which would mean that S and N are headed for D2. But in fact, what they thought was a long sleep was just a nap and they are leaving A0, so headed for D1. Here are two ways of deciding where they think they are, and for each a corresponding way of evaluating the resulting belief.

(a) realist, Sophia's strategy: look out the train window, use the observation to decide between two previously chosen alternatives. Count the result a success if it gives a true belief, and in circumstances where you would have chosen its alternative that alternative would have been true instead.

(b) norm-based, Norm's strategy: look out of the train window and use what you see in reasoning leading to whichever hypothesis it makes more probable given your

background information, notably about probabilities. Count the result a success if it gives a true belief in this and other probable situations.

The relevant difference between (a) and (b) is that on (a) possibilities that are nearer to actuality (in this case, require fewer branchings away from the actual history) are central while on (b) one prioritizes the more probable possibilities, given what else one believes.

There are obviously other ways to form beliefs in situations like this and other ways to evaluate the results. My interest in these is as contrasting two evaluations of the force of evidence. The realist method will in this case deliver hypothesis 1, and will count this as a success. For in fact we have just passed A0 and are thus on the way to D1, as hypothesis 1 asserts. Moreover in the nearest alternative situation where the method would have given the alternative conclusion, that we were headed for D2, hypothesis 2 would have been true, since we would be around B1.

The norm-based method will fail in this case; Norm's conclusion is false and Sophia's is true We think it most probable that we have slept for a while, and the most likely mountains-then-lake scenery given this is along the central two routes, suggesting the false hypothesis 2.

The reason for the failure of the norm-based method is its use of wrong probabilities. (We think that we have probably slept for a long time.) The reasons for the success of the realist method are that it centres on the actual situation, whether or not the person can describe its relevant features, and compares the two alternatives in terms of their treatment in the nearest situations where they would be chosen, in this case those that

are least distant and involve fewest branchings from the starting point. These are possible situations that require changing causal features of the actual situation least, so that the result is evaluated in terms of its treatment of objectively similar situations.

knowledge and evidence

A main aim of this book is to make a case for ways of evaluating evidence generally like Sophia's objective method above. A single example does not show much, as the method might have been specially fitted to fit the example. A general justification is needed. Experiment is closely related to it, and gives some of the clearest and most convincing cases. I described it as if our travellers were accepting one hypothesis or the other on the basis of what they saw from the train window. The criterion for knowledge was along the lines of what are standardly called "safety" considerations.[2] But we might more generally be concerned with which hypothesis the evidence supported best, even if neither was supported well enough to be a candidate for knowledge. In the example the similarity between full knowledge and the situation of the hypothesis given data is not hard to describe. Substitute "prefer" for "accept" throughout, "would have been nearer to truth (in the nearest situation)" for "would have been true" in the realist method and "more often true" (in similar situations) in the norm-based method: the result is not a criterion of knowledge but one of evidence. This is what I shall call *K-evidence* and slowly characterize, contrasting it with the norm-based *R-evidence.[3]* Then the pieces are assembled in the conclusion chapter.

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2   Contrasted with "sensitivity" considerations. The contrast between the two is however minimal when we are choosing between two incompatible hypotheses. See Chapters 6 and 7.
3   Part of the wider importance of the norms/knowledge contrast is the fact that statistical ways of collecting and evaluating evidence seem arbitrary and alien to many. Why defer to *these*? Objective standards of evidence allow the beginnings of answers. But issues about the public perception of science are not central to this project.

Two contrasts between the strategies are particularly important (for my purposes, at any rate). The first is that K-evidence is independent of the agents' beliefs, prior knowledge, and the like, and of what is rational for or according to agents. Indeed, one can have this kind of evidence without knowing that one has it, and without knowing how it compares to the evidence one has or would have for another hypothesis or given different data. This is so for generally the same reasons that one can know or fail to know without realizing that what one has is or is not knowledge, and that one will usually not assess the extent of one's knowledge or ignorance accurately. The second contrast is between possibility and probability. As I am construing K-evidence it makes essential use of what can or might happen or be the case, understanding this as a generally speaking causal notion — what can occur given that the world works the way it does — and moreover of degrees of possibility as expressed in terms of nearer and more remote situations or possible worlds. The versions of the norm view that will concern me most, in contrast, make essential use of the concept of probability. I shall argue that this has to be understood as itself a generally causal concept.

A connection between the two: K-evidence indicates the range of similar circumstances a hypothesis holds, and in which action based on the hypothesis will usually succeed. N-evidence indicates factors normally but not necessarily correlated with this range and typically useful as inputs to standard patterns of reasoning, whose reliability can vary according to features of the situation of which the person may not be aware.

Each way of understanding evidence has its advantages. My job is to sing those of the underappreciated objective approach. A disadvantage of the norm-based approach is the potential indefiniteness of its targets, and the associated endless list of norms that would

have to be considered. Consider the variety of factors that one could rationally take account of. The most immediate is available data that is easily understood and already rich and varied. But beyond this there is evidence of further data not in one's possession. This comes in a number of forms, which are relevant to belief in a number of ways.[4] Further beyond there are reasons to think that more information can be got from the available data than one has managed to extract. And often there is reason to take account of one's own likely failures to interpret data.[5] In quite a different direction there are principles of not wasting time and thinking power and not over-scrutinizing evidence (understanding and following which can waste a lot of time and thinking power). Which of these constitute norms of reasonable evidence? In what ways are they similar? It seems that even beginning to think in this way one is being led into a labyrinth.

experiment

Both kinds of evidence are available to both Sophia and Norm, though each will use just one to shape their beliefs. Norm may not be aware of the force of the available objective evidence. Indeed Sophia may be ignorant or mistaken about it also. Some degree of inaccuracy is almost inevitable, and to that extent her grasp of the force of her evidence and the reaction to it is likely to be somewhat rough.

When the source of objective evidence is experiment, though, this problem is much diminished. Experiments are deliberate and carefully controlled processes, designed to give results of particular kinds for particular reasons. So when you run an experiment

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4 Christensen (2010), Tal and Comesaña (2017)

5 In Morton (2012) I develop an attitude to issues of human fallibility and finiteness, based on the concept of an epistemic virtue. These topics will feature very little in this book. A simple connection between epistemic virtues and K-evidence is that sensitivity to K-evidence of some kind, including evidence one is not conscious of having, is an epistemic virtue in that it is disposes one towards corresponding true beliefs.

you know what evidence has been produced. The lake or the mountain may be too far away for Sophia to see them, so she may use binoculars; it may be dark, so she may shine a light to see if there is a reflective twinkle from the water. Then she will combine the advantages of objective and norm based evidence.

Experiment has other advantages also. The planning and control will make it easier for two or more people to cooperate in producing and assessing the evidence. It will thus allow them to combine their practical and thinking powers. Indeed an experiment often requires the efforts of several or many people. Norm may help Sophia construct and operate her experiment, perhaps because she has designed it she is not good at operating apparatus. Then he is likely to appreciate the reasons supporting her conclusion.

The result is that experiment often leads to knowledge. Of course there is non-shared knowledge also. But experiments often lead to *better* knowledge, knowledge that has its defining features to a greater degree. The evidence it uses will have more of these advantages than evidence that leads to more marginal knowledge.

modality

As the train navigation example suggests, objective accounts rely on ideas about what can or would occur, particularly what beliefs someone would have in different circumstances and which of these would be true. These are to be understood as real objective facts about a person and her environment, which like all such facts can be very different from what we think they are. The most important modal facts concern causation, and I shall refer to the whole category of concepts as causal. While some

philosophers resist the idea that facts about causation and what might occur under various circumstances are independent of our opinions, it would be very bad news for human decision-making if they were not so independent. We often plan in terms of them: if I do this the following will occur; an action of this type would cause a result of this other kind. We obviously need our opinions about these to correspond to what will actually occur, and if they fail too often the cruel world will take its penalty. So there ought to be a presumption in favour of objectivity. The use of causal ideas in decision-making also suggests that they are important in belief formation, since a primary function of our beliefs is to guide our actions.

Causal and modal concepts will play important roles throughout. My way of organizing them will be standard and unoriginal: the possible worlds orthodoxy of propositions, sentences, beliefs and the like, true or false (or holding) in possible worlds (or situations, or possibilities — simply stylistic variations here). This will often be represented using Lewis's spheres of proximity or in some other way. And I shall assume that there is a relation of nearness between worlds, in particular to the actual world. (The inverse of nearness is remoteness.) The immediate application of nearness is in the standard definition of a counterfactual, or better subjunctive, conditional, which I shall stick to unless otherwise signalled, as true in a world w when the consequent holds in the nearest world or worlds to w where the antecedent holds. Then we can define "the nearest world where p is true is nearer than the nearest world where q is true", as

$((p \vee q) \ \& \sim(p \ \& \ q)) \rightarrow p$, where $\rightarrow$ is the counterfactual (if exactly one of them is true it is p). I take it that an intuitive concept of the nearness of possibilities is implicit in our

everyday use of the counterfactual, and in idioms such as "if, and it is a big if,…" and "just possibly" or "it is remotely possible that…".[6]

And, possibly most contentious but not defended here, I shall assume that the truth values of counterfactuals are matters of objective fact, at any rate as much as most of our truth-value-receiving claims. "If the incision had been a millimetre to either side she would have died" says that in situations where there is a tiny change in the actual history, such as a tremor in the surgeon's hands, making the incision just different enough, she does not survive. She really would not have; it is a medical fact that might be the basis for legal action and might be explained by some true medical theory. It does not mean that she would have died in more "remote" situations like that where the surgeon hiccups but a force field from outside the operating theatre manoeuvres her organs out of the way.[7]

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6 Some idioms for evoking degrees of possibility are also associated with probability. When discussing what would happen if humans colonized Mars we say they would have long term food production problems, partly because their being wiped out by indigenous intelligence Martians is *less likely* than their confronting a hostile planet with at most primitive life. A common framework for possibility and probability is highly desirable, but I am not offering it.

7 I require only that nearness/remoteness be a partial ordering.