6 Inference and the extension of knowledge

As I sit reading, I hear knocking. I wonder whether someone is at the door. I then hear extended, very rapid knocking. It now occurs to me that it is a pecking sound, and I conclude that there is a woodpecker nearby. This way of coming to believe something differs from the way I came to believe there was a knocking in the first place. That belief was perceptual; it arose from my hearing the knocking. My belief that there is a woodpecker nearby is not perceptual. It arises not from, for instance, seeing the bird, but from a further belief, namely my belief that the rapid knocking sounds like the pecking of a woodpecker. I hear the rapid knocking, recognize its character, and come to believe that it sounds like the pecking of a woodpecker. On the basis of this belief, I naturally conclude that there is a woodpecker nearby.

Some beliefs, then, arise from other beliefs and are based on them, rather than directly on the sources described in Part One: perceptual, memorial, introspective, rational, and testimonial. This occurs with abstract matters as well as with perceptibles. Take mathematical proof; on the basis of knowledge of an axiom, we may infer a theorem. An *inference* – which we may think of as a kind of *reasoning* – may also proceed by way of something general to something quite specific. Studying a speech, one may determine that it is largely copied from someone else's article; given the general point that so representing someone else's work as one's own is plagiarism, one reluctantly concludes that this speech is an instance of that.

If we had only the beliefs arising from perception, memory, self-consciousness, reflection, and testimony, we could not – by ourselves, at least – build theories to explain our experience or our own view of the world. It is largely because we can inferentially build on what we already believe, that there is no limit to the richness and complexity of the ideas and theories we can construct.

The nature of the inferential processes in which one belief is formed on the basis of other beliefs is a major question in the philosophy of mind and the psychology of cognition. The way those processes can extend justification and knowledge is a major question in epistemology. Not just any inference that begins with truth ends with truth; some embody poor reasoning. We can best pursue the second, epistemological question – how inference extends knowledge and justification – by starting with the first, concerning what inferential belief is.

The process, content, and structure of inference

What sort of process is it by which my belief that there is a woodpecker arises from my belief that there is a knocking which sounds like its pecking? One clue is the naturalness of saying that on the *basis* of my belief that the knocking sounds like such a woodpecker's pecking, I *conclude* that there is a woodpecker nearby. I *infer* that there is one nearby from what I believe about the knocking: that it sounds like the pecking of a woodpecker. In inferring this, I conclude something on the basis of something else I believe. (Other propositions may also constitute premises for me; I cite the central or at least most salient one.)

What I conclude – the conclusion I draw – I in some sense *derive* from something else I believe. The concluding and the beliefs are mental. But neither what I conclude, nor what I believe from which I conclude it, is mental: these things are *contents* of my beliefs, as they might be of yours. They are not properties of anyone's mind, as in some sense beliefs themselves are. Such contents of beliefs – also called *objects* of beliefs – are commonly thought to be propositions (or statements, hypotheses, or something else that can be considered to be true or to be false, but is apparently not itself a mental entity).[1]

Two related senses of 'inference'

There are, then, two sorts of things involved when I draw a conclusion. One is the mental process of my concluding it on the basis of one or more of my beliefs or assumptions, as where I conclude that Alberto has been bitten by a deer tick on the basis of my belief (just acquired) that he has Lyme disease and my background belief that this is caused by deer tick bites. The other element in my drawing a conclusion is the set of two or more propositions which are my conclusion and my ground for it. Call the first element the *inferential process*; it is a mental episode of reasoning. Call the second its *inferential content*; it is abstract and not a process.

The inferential content indicates what is inferred from what, and it does this in a way that shows how my inferring that there is a woodpecker nearby is drawing the *same* inference as you would make if you inferred this from the proposition that there is knocking which sounds like that of a woodpecker. Our inferrings are two different processes, one in me and one in you. But their content is the same. Sometimes 'inference' is used for the content of the process. I want to talk about inference in both of these senses: as a process and as a structure consisting of propositions.

If inferring is a process corresponding to a conclusion and one or more premises for it, should we then suppose that in drawing my inference I *said* to myself something like, 'Those knocks sound like a woodpecker's; hence, there is a woodpecker nearby'? This might apply to someone just learning to recognize woodpecker knocking, but not to me. I do not need to concentrate

on the proposition that there are those sounds, much less to say to myself something like 'hence there is a woodpecker'. I quickly realize, through hearing the sounds – and knowing from memory how woodpeckers sound – that they are its sounds; and on the basis of believing this proposition, I draw my conclusion without signposting my doing so by a silent 'hence'.

Reasoned belief and belief for a reason

My *drawing* the inference is something I do; it is a kind of *reasoning*. But it is not necessarily self-conscious, as in some cases of engaging in reasoning with the aim of proving a theorem from axioms. We need not introspect or even be focally conscious of our reasoning. We may instead simply draw our conclusion when our ground for it registers in our consciousness in an appropriate way. Thus, in response to wondering what I hear, I conceive the sounds as a pecking, and I then infer that there is a woodpecker. My resulting belief that there is one is, then, arrived at by reasoning and based on it. The belief may on that ground be called a *reasoned belief*; but we should also speak of a reasoned belief where such a reasoning process becomes the same kind of basis for a *previously* held belief. A belief arising from intuition or even guesswork can later become reasoned.

Compare this with a case in which, as I am reading on an unusually still morning, a vehicle backfires in the distance. I go on reading without thinking about the noise, though I do have the thought that someone drove by. Have I *inferred*, while reading, that someone drove by, say on the basis of believing that I heard a vehicle backfire? Surely I *need* not have. I am not like someone who must think about whether the sound had certain qualities and, only after determining that it does, concludes that a vehicle passed. Being familiar with backfires, I might simply have recognized the sound as a backfire and, on the basis of this together with my standing belief that backfires are from (driven) vehicles, automatically formed the belief that someone drove by. The former belief (at least in relation to the two taken together) expresses my reason for holding the latter, which is thus a *belief for a reason*. It is not also a reasoned belief, however, because it is not arrived at by a process of reasoning. A reasoned belief is always *held* for a reason – one expressed by the premise(s) of the reasoning – but a belief (held) for a reason need not be a reasoned belief – one that is also arrived at by reasoning.[2]

This contrast between a belief for a reason and a reasoned belief may lead to the objection that I did not even form the belief that a vehicle backfired but only automatically believed, upon hearing the noise, that a vehicle passed. This is a possible case, and it lies at the other end of the spectrum from the case in which one cautiously forms the belief that the noise is a backfire, and then self-consciously infers that a vehicle passed. But my case is intermediate: I am neither so familiar with backfiring vehicles that I "just hear" vehicles pass when I hear those sounds, nor so unfamiliar with backfires that I must go through a process of inferring that conclusion when I hear the sounds.

Similarly, suppose we are presented with premises that obviously imply a conclusion and left to infer or, on the other hand, "just see" it, as the case may be. In Shakespeare's *Julius Caesar* we have the lines:

Yond Cassius has a lean and hungry look.
He thinks too much, such men are dangerous.

(Act 1, Scene ii)

If we just see the implication that Cassius is dangerous, we acquire a belief for a reason, but it is not reasoned; if we need to consider these premises and draw the conclusion as they lead one to it, we have a reasoned belief. In both cases one belief is based on another; but there are different ways this occurs, both for different people and for the same person at different times.

People differ in the background knowledge and belief they bring to their experiences, and this in turn influences how those experiences produce new beliefs in them, say directly versus inferentially. Thus, in the very same situation, one person's inference may be another's perception. In literary interpretation or in art criticism, for instance, what the novice must realize through drawing inferences, the professional can "just see." It is an important point in the psychology of cognition that what one person believes only inferentially another believes directly. For instance, what the first must arrive at by steps from one or more items of information to a conclusion from them, the other grasps as a whole, say perceptually. Both cases may occur almost instantaneously, and their difference is easily missed. It is in part the failure to distinguish the cases that apparently leads some people to think that perceptual belief as such is inferential.

In seeing the difference between reasoned belief and (non-reasoned) belief for a reason, it may help to notice that the *contexts* of the backfire and woodpecker noises differ significantly. The backfire is a kind of noise that can make it obvious that someone is driving by, whereas the pecking, far from coinciding with a flutter of wings that clearly mark the presence of a bird, is an isolated stream of sounds in the quiet of the afternoon, and it can be associated with many sources, natural and mechanical. Certainly there is an event of *belief formation* when I hear the bang and come to believe that someone drove by. The point is that such a belief need not be reasoned: one need not form it by drawing an inference.

The contrast between a reasoned belief and a belief for a reason must not be allowed to obscure something important that is shared by the two kinds of belief formation. In both cases, I believe one thing on the *basis* of another thing I believe; for instance, I believe that someone drove by on the basis of believing that a vehicle backfired. In both instances, then, there is an inferential (roughly, argumental) *structure* corresponding to my beliefs. It consists of a proposition we might think of as a conclusion and at least one we might think of as a premise on which the conclusion is based. This similarity helps to explain why there is an inclination to regard my coming to believe that someone drove by as somehow inferential.[3]

Two ways beliefs may be inferential

There is a way to describe our two examples that helps to remind us of both their similarities and their differences. Call my reasoned belief that there is a woodpecker nearby – considered at the time I form it – *episodically inferential*, since (at the time) it arises from a process or episode of inferring, of explicitly drawing a conclusion from something one believes. Call my belief that someone drove by (also considered at the time I form it) *structurally inferential*, since, as a belief for a reason, it is *based on* another belief in much the *way* one belief is based on a second when the first does arise from the second by inference, but is not episodically inferential. Being so based implies (among other things) that my holding the second belief, the basis (or premise) belief, is at least part of what explains why I hold the first (presumably in a causal sense of 'explain'). Yet my belief that someone drove by is not at the time episodically inferential, because it is arises, not from my drawing an inference, but in an automatic way not requiring a process of reasoning.

In short, episodically inferential beliefs – which are at the time reasoned – are beliefs for a reason and hence are inferential, but not every belief for a reason is episodically inferential. Beliefs for a reason are, however, roughly equivalent to those that are structurally inferential. Reasons, one might say, can lead to inferential belief by two different paths, one requiring reason*ing*, the other not.[4]

In both instances there is an inferential structure (which is no doubt reflected in the brain) corresponding to my beliefs: I believe the conclusion *because* I believe the premise(s), even though the beliefs are related by an inferential episode in one case and by an automatic process of belief formation in the other. In the first case, I *do* something – I infer a conclusion. In the second, something *happens* in me – a belief arises on the basis of one or more other beliefs I hold. The resulting structure is much the same. Hence, a belief that is episodically inferential at the time it is formed will become structurally inferential when it is retained after the inference is drawn *if*, as is common, it remains based on the reason expressed by the premise(s). The difference is that the two beliefs arise in different ways. Only the belief that there is a woodpecker nearby is (at the time it is formed) episodically inferential.[5]

The basing relation: direct and indirect belief

We can also see how a belief can be inferentially based on a second without being episodically inferential if we consider a case – a kind especially important in understanding knowledge and justification – in which one *first* believes something perceptually and then the belief comes to be based on a premise. Suppose you see someone you take to be Alasdair. You do not get a good look, but believe in any case that it is Alasdair. When a friend says that she has just met Alasdair's wife at the train station, you now

believe (in part) on the *basis* of her information that you saw him. But you need not, at any point, have inferred this from her information. The testimony-based belief – or indeed any new belief you form that expresses evidence that it was Alasdair you saw – can become a structurally inferential basis of your belief without your *using* it as a premise by drawing an inference. It is like an additional pillar placed beneath a porch after it is built: the pillar adds support but otherwise leaves the porch as it is. The addition of this support can justify the belief it supports. If that belief is already justified, it is now doubly so. If the belief is not previously justified, it may now be justified or even constitute knowledge.

Another way to bring out what the two kinds of inferential belief have in common is to call them *indirect*. For in each case we believe one thing on the basis of, and so in a sense *through*, believing another. Indirect beliefs are *mediated* by other beliefs, whether through inference or not. I refer, of course, to particular beliefs held by specific people at particular times. People differ in their inferential patterns, and these may change over time. Like backfires, woodpecker knocks could become so familiar that when one hears them, one just believes (non-inferentially) that they are occurring, rather as, on seeing green grass in good light, I may just believe, perceptually, that there is grass before me.

Such effects of increased familiarity show that one person's indirect belief may be another's direct belief, just as one person's conclusion may be another's premise. Similarly, my conclusion at one time can later become a basic premise, or vice versa: a proposition I believe indirectly at one time I may believe directly at another, as where I forget the premise I originally had, but I retain the proposition in memory.

There is a wide-ranging point illustrated here that is important for epistemology, psychology, and the philosophy of mind: we cannot in general specify propositions which can be believed only inferentially or only non-inferentially. Nor can we determine whether a person's belief is inferential by considering just the proposition believed.[6] To be sure, it would be *abnormal* to believe (wholly) indirectly that if some dogs are pets, then some pets are dogs – in part because one does not normally believe, on the basis of a premise, what is luminously self-evident – or to believe (by sight) directly that there are seventeen cats eating scraps of beef in the backyard, since normally one would have to arrive at this on the basis of counting.[7] But strange cases like these are possible.

Inference and the growth of knowledge

The examples I have given represent one way in which we learn through using our senses in combination with our rational powers. Through making inferences and through forming beliefs that are reason-based but not episodically inferential, we acquire not only new beliefs, but new justified beliefs and new knowledge. Indeed, much of our knowledge and a great many of

our justified beliefs arise in this way. The woodpecker case illustrates how this process works. In a single moment I come to believe, among other things, that no one is at the door and that there is a woodpecker nearby. I also acquire situational justification for these beliefs (justification *for* holding them, whether I do or not), I justifiedly hold them, and I know the truths which, in holding them, I believe.

Much of life is like this: through the joint work of perception and our rational powers, particularly our inferential capacities, we acquire new beliefs, our justification is extended, and we gain new knowledge. We also forget, cease to be justified in believing certain things when we acquire evidence to the contrary, and sometimes infer conclusions we are not entitled to infer. But let us first concentrate on the way belief, justification, and knowledge develop.

Confirmatory versus generative inferences

Inference is typically a source of new beliefs. But as we have seen, it need not be. Recall the backfire, and suppose I am so familiar with such sounds that no categorization of them is necessary for me to recognize them. Then I may well *directly* – i.e., *non-inferentially* – believe that a vehicle backfired. But now imagine that, realizing firecrackers have lately been set off nearby in honor of Guy Fawkes Night, I wonder whether the sound might perhaps have been that of a firecracker, though I do not give up, but only reconsider, my belief that it was a backfire. I recall the sound, remember that it had a muffled, not a popping, quality, and infer from its having that quality that it was indeed a backfire. Here I infer something I already believe. It is as if you arrived at a place without noticing your route and, wanting to be sure you are where you think you are, consider what route you must have taken there. Finding a plausible route can confirm our sense that all is well, whether or not it is the route we in fact took.

My inference, then, is not a *source* of new belief, though it does in a way *alter* my belief that the sound was a backfire; the belief now becomes inferential. This is not a change in its *content*, but in its *basis*. The inference does not produce a new belief but instead adds to my belief system a new ground for something I already believe. The inference is *confirmatory*, but not, as in typical cases, *generative*. Like an inference drawn in doing certain logic book exercises, it is not a *belief-forming inference*; but unlike many such cases (which often concern fictitious people or places), it has a conclusion that is already believed.

Inference as a dependent source of justification and knowledge

Even when inference is not generative and hence is not a source of belief, it may still be a source of both justification and knowledge. Again, suppose I know that lately there have been firecrackers exploding nearby. I now

might *not* know, or be justified in believing, that there was a vehicle backfire, *until* I recall the quality of the sound, rule out its being that of a firecracker, and infer in this light that a vehicle backfired. I might thus have neither justification for believing a vehicle backfired, nor knowledge that it did, until I draw the inference. Similarly, scientists who believe a hypothesis might not come to know it until, through investigating and ruling out certain alternatives, they reason their way to it, thereby inferring it, from new premises.

On the other hand, suppose I am *un*justified, in believing that the muffled sound in question represents a backfire. My situation might be this: in my whole life I have heard only one backfire; I have, however, heard many firecrackers with that sort of sound; and my belief that this sound represents a backfire is based on testimony from someone I think is usually unreliable. Here I do not become justified, inferentially or testimonially, in believing that there was a vehicle backfire. For a crucial premise of my inference – that this kind of noise represents a backfire – is one I am unjustified in believing. The same would hold if I had been unjustified in believing my other premise: that there was a muffled sound.

Now imagine a different case, this time regarding knowledge. Suppose I *am* justified in believing my premise that the muffled sound is from a backfire, since my previous experience adequately justifies my believing this. But suppose that, through no fault of my own, I have somehow failed to discover that there are common firecrackers which sound precisely the same. Then, although I am still correct in believing my conclusion – that there is a backfire – I am mistaken in believing, and so do not *know*, my *premise* that this muffled sound *represents* a vehicle backfire. For it might just as well represent a firecracker. Thus, I infer a true conclusion, but using a premise which, though I justifiedly believe it, is false. This example shows something important (which will be considered from a different point of view in Chapter 8): that I may be justified (and even correct) in believing that there was a vehicle backfire, yet not *know* that. My would-be knowledge that there was a backfire is defeated by my false premise, though my justification for believing this is not defeated.

This last case is not typical. Perhaps more often than not, inference on the part of rational persons is a source of beliefs that are both justified and constitute knowledge. If inference is often a source of justification and of knowledge, is it a *basic* source? Our example suggests it is not. If, for instance, I am not justified in believing my premises that there was a muffled sound, and that such a sound represents a backfire, then my inferring that there was a backfire does not yield justification for my believing this conclusion, and I do not justifiedly believe it. Apparently, my inference justifies me in believing my conclusion only if I am justified in believing its premise (or premises). And apparently (though this is a controversial point to be examined in Chapter 7) that belief is justified only if it is grounded directly or indirectly in a basic source.

Inference as an extender of justification and knowledge

Points like this suggest that inference is not a basic source of justification or knowledge, but rather *transmits* and thereby *extends* them, in appropriate circumstances, from one or more premises to the conclusion inferred from them. We can extend our justification and knowledge by inference, but it appears that if we have none to start with, inference, unlike, say, perception, can give us none. Even careful and amply justified inferences – roughly, inferences one is justified in drawing *given* the assumption of the truth of the premise(s) – do not *create* justification or knowledge where there is none to start with, because one neither knows nor has justification for one's premise(s).[8]

Our examples show two kinds of inferential extension of knowledge and justification. The first is acquisition of *new* knowledge and new justified beliefs, say the knowledge that Cassius is dangerous; the second is *increase* in our justification for believing something we already hold or a buttressing of our knowledge of it, as where we infer that a vehicle backfired from a newly discovered premise to the effect that no firecrackers were used. The first kind of inferential extension yields an increase in the *content* of what we know or are justified in believing. The second yields an increase in the *quantity* of our justification regarding the *same* content, or in the strength of our grounds for knowledge regarding the same content. (This second case may also, and perhaps better, be considered strengthening rather than extending knowledge.)

There is a third kind of extension of justification and knowledge that can be a variant of either sort. Consider a belief that arises by inference from two or more *independent* sets of premises, such as evidence of Cassius's being dangerous presented at the same time by two independent observers. Here we get new content by two or more pathways. In the same way, we may also acquire more justification (or stronger grounds) for what we already believe or know, as where we believe a vehicle backfired. Thus, we may have better justification for believing (or better grounds for our knowledge of) what the witnesses jointly attest to than we have for believing that on the basis of the evidence of any one of them alone.

Moreover, our experience often leads to inferential extension of all three sorts without our making any particular effort to draw inferences. For the formation of structurally inferential beliefs, and even of many episodically inferential beliefs, occurs quite often and spontaneously. As a timber can be silently and unobtrusively placed beneath a porch in a way that supports it, one belief can, without our noticing it, provide support for another that is already in place, or even lead to the formation of a belief one did not previously hold.

Source conditions and transmission conditions for inferential knowledge and justification

If inference is not a basic source of justification and knowledge, but transmits it, it must meet two kinds of conditions. One kind concerns the

premise(s) of the inference – its foundations, so to speak – the other concerns the relation of the premise(s) to the conclusion – how well those evidential pillars support what is built on them, for instance whether or not they express strong evidence for believing it. Let us take these in turn.

First, there are *source conditions*, as our examples show: one needs justification or knowledge in the first place. To see what the second kind of condition is, suppose I do know that the muffled sound I hear represents a vehicle backfire and I infer that a *truck* backfired. But imagine that I really cannot tell the difference between car and truck backfires. Then I do not know, in virtue of my inference, that a truck backfired. I started with knowledge, but it was not transmitted to my belief of my conclusion, since I drew a conclusion from it which it did not justify. There was, we might say, no evidentially adequate pillar to ground my conclusion in my premises.

There are, then, *transmission conditions*, as well as source conditions, that an inference must satisfy in order to yield knowledge of its conclusion. Chapters 1 through to 5 in effect deal with source conditions in some detail, for example with how perception yields non-inferential knowledge that can provide premises for inference. Thus, I say little about source conditions here and concentrate on transmission conditions.

Deductive and inductive inference

We can best understand transmission conditions if, as is common in discussions of logic, we divide inferences into two categories, deductive and inductive. The usual basis of this division is an interpretation of the character of the inferential structure underlying the process of inference, or at least a choice of the kind of standard appropriate for assessing that structure. We can simplify matters by calling these structures *arguments*, even though they need not represent anyone's actually arguing *for* something or *with* anyone.

In this abstract sense of 'argument,' an argument is discernible even where, simply to assure myself that I was correct in believing that there was a vehicle backfire rather than a firecracker blast, I inferred, from reconsidering the kind of noise I heard, that there was indeed a backfire. I relied on the argument from propositions about the character of the noise to the conclusion that a backfire occurred, even though I was not trying to convince anyone, even myself, of anything. Instead, I was trying to justify something I believed. I did this by tapping a justified source that transmitted its justification to my belief that a vehicle backfired. A natural interpretation of the case is this: I *reasoned* from the premises that (1) the noise represented a backfire and (2) if it did represent that, then there was a backfire, to the conclusion that (3) there was a backfire.

My argument here, and hence my reasoning – from the premises of the argument to its conclusion – is (deductively) *valid*; that is, it is absolutely impossible (in a logical sense) for the premises, (1) and (2), to be true and

the conclusion, (3), false. For short, the premises of a valid argument, or of valid reasoning (logically) *entail* its conclusion. It is of course not in general impossible for the *premises* of valid deductive arguments to be false, and many of these premises are. But it is absolutely impossible that the premises be true *and* the conclusion false.[9]

In the most careful terminology, 'valid' applies only to deductive arguments and, correspondingly, to valid deductive reasoning (the kind of reasoning whose essential content *is* a valid argument). We might think of deductive reasoning as the sort that "aims" at validity, in the sense that it is of a kind best evaluated as valid or invalid. Thus, even though the argument from hallucination (discussed in Chapter 1) is invalid, the philosophical reasoning that employs it seems meant to be valid and is appropriately assessed as deductive.

By contrast, much reasoning that is not valid is simply not meant to be deductive in the first place. Suppose, for instance, that my reasoning had run: (a) the noise sounds like that of a backfire; (b) the likeliest explanation of the noise is that a vehicle backfired; probably, then, (c) a vehicle backfired. As 'probably' signals, I do not take my reasoning to be valid or to be deductive at all: I simply take its premises to provide some reason to believe its conclusion. Even if I had not used 'probably,' it would not be appropriate to consider this reasoning deductive. For obviously even the likeliest explanation *need* not be true or even considered true; it would thus be a mistake to regard such reasoning – or the person using it – as aiming at validity.

We *could* call such probabilistic reasoning "inductively valid," meaning roughly that relative to its premises there is a high probability that its conclusion is true, where high probability is usually taken to be such that it is reasonable to accept a proposition having it. But to avoid confusion I simply term reasoning of that sort 'inductively good' (or 'inductively strong').

Moreover, it is reasoning processes and not abstract structures that I call deductive or inductive. I do not take arguments, as abstract structures, to be intrinsically of either kind, though we *speak* of them as deductive or inductive so far as they seem best assessed by deductive or inductive standards. (The intentions of those presenting them are one among many other factors determining the appropriate standards for classifying reasoning processes.)

I want to stress in passing that we should not conceive deductive and inductive reasoning as they have often been characterized. Deductive reasoning has been described as "going" from the general to the particular, say from (a) all human beings are mortal and (b) Socrates is a human being to (c) Socrates is mortal. But our deductive backfire case, embodying the valid argument from (1) and (2) to (3), is different; it is about only particular things. Even in the classical example about Socrates, one premise is particular, in the sense that it concerns a single individual.

Subsumptive and analogical inference

Even those who take deductive reasoning to go from the general to the particular should recognize that the reasoning from (1) all humans have fears and (2) all who have fears are vulnerable to (3) all humans are vulnerable is deductive (and valid). Perhaps they focus on cases in which we draw a conclusion about something or someone, say Socrates, by *subsuming* the person or thing under a generalization about similar entities, say people. Call such inference *subsumptive reasoning* – or *instantial reasoning*, since Socrates is supposed to instantiate the truth that all humans are mortal. Not all deductive reasoning is subsumptive.

As for inductive reasoning, it has often been said to "go from" the particular to the general, as where one infers the conclusion that everyone has fears from the enumerative premises that Abe does, Beatrice does, Carl does, Donna does, and so on. This characterization is good so far as it goes. But it does not apply to reasoning – sometimes called *abductive* – from a premise stating the likeliest explanation of a presumed fact, to the conclusion that the proposition expressing that explanation is true; for instance, from the premise that the noise is best explained by a vehicle's backfiring, to the conclusion that the noise represents such a backfire. Nor does the characterization do justice to certain reasoning by *analogy*, such as my concluding that a plant probably has a property, say hardiness, because it is much like (highly analogous to) another plant that has that property.

It is better, then, to think of inductive reasoning as reasoning that, first, "aims" at providing good grounds for its conclusion, but not at validity, and, second, is best evaluated in terms of the degree of probability of its conclusion relative to its premises. This conception has the further advantage of applying to all three main kinds of inductive reasoning: generalizational, explanational (abductive), and analogical.

The inferential transmission of justification and knowledge

We are now in a position to explore the conditions for transmission of justification and knowledge.

Clearly the success of transmission is partly a matter of the status of the underlying argument: the one whose premise or premises are one's basis for the belief in question. The natural thing to say initially is that justification and knowledge are transmitted in deductive inference *only if* the underlying argument is valid and, in inductive inference, *only if* the underlying argument is (inductively) good (I use 'inference' rather than 'reasoning' here because the former is preferable for the wide range of contexts we are exploring). But these principles, though probably correct, need clarification. Let us consider the cases of inductive and deductive transmission separately.

Suppose Luigi hastily infers from the propositions (1) all opera lovers appreciate *The Magic Flute* and (2) Wilhelm appreciates *The Magic Flute* that

(3) Wilhelm is an opera lover. This is invalid deductive reasoning, and even with true premises Luigi is justified in believing it would not transmit either justification or knowledge from his beliefs of them to his belief of its conclusion. Bad reasoning cannot realize the evidential potential of good premises.

Suppose Luigi then produces the better argument from (1) all opera lovers appreciate *The Magic Flute* and (2) Wilhelm appreciates it in the way one would expect of an opera lover, to (3) Wilhelm is an opera lover. Suppose we conceive his reasoning as deductive, say because Luigi's *underlying* principle – roughly, the one by which his reasoning is actually guided – is not the expected inductive one – that if all As are Bs and x is an A of a kind that might well be expected to be a B then *probably* x is a B – but the false principle that if all As are Bs, and x is an A of a kind that might be expected to be a B, then x *is* (definitely) a B. *Then* we must also say that transmission is blocked because his reasoning is invalid. He adheres to a mistaken (deductive) logical standard and hence does not acquire a justified belief through his inference.

Apparently, then, *deductive transmission requires validity*. Specifically, the argument *underlying* an inferential belief – i.e., the argument whose premise(s) constitute(s) what that belief is inferentially based on – must be valid if knowledge or justification is to be deductively transmitted to that belief from the premise belief(s) it is based on. To be sure, I could have independent grounds, such as testimony about Wilhelm, on which I know my conclusion. But if I do not have such grounds, then I cannot come to know this conclusion *through* deductive transmission of my knowledge from premises I have for it if those premises do not entail it, and hence the argument from them to it is invalid. We cannot build anything solid on weak supports, even if they themselves rest on a good foundation; the structure is still defective.

Inductive transmission and probabilistic inference

The case with inductive reasoning is more complicated. For one thing, the notion of good inductive reasoning is highly vague. It might seem that we could simply define it as reasoning with premises that render its conclusion more likely than not to be true. But this will not do, though such reasoning may be called *probable* to indicate that it has this specific merit. Two points are important here.

First, a probability of just over .50 (indicating just over a fifty-fifty chance of truth) allows that even given the truth of the premises, the falsehood of the conclusion is almost as likely as its truth (since probabilities range from 0 to 1, with .50 (taken to represent 1/2) indicating the same likelihood of truth as of falsehood on the part of the proposition in question). One would not want to describe reasoning as good when its premises give its conclusion a probability of truth of just over 50 percent.

Second, judging how good a piece of inductive reasoning is may require assessing one's justification for the conclusion in relation to more than the premises from which one infers it. This holds, at least, where we are viewing the reasoning as occurring in a context in which various kinds of information are accessible to the reasoner. Relative just to the premise that Dave has a certain kind of cancer, the probability of the conclusion that he will die of it may be .60, since 60 percent of its victims do; but relative to his youth, vigor, and good medical treatment, the probability of his death from it may be .08. Thus, the inductive reasoning from the premise that he has the particular cancer to the conclusion that he will die of it ignores relevant evidence and is not good, even though the conclusion does have a probability of more than .50 relative to its premise.

Given the way in which such inductive reasoning can be negatively affected by new information it is sometimes called *defeasible reasoning*. By contrast, the entailment relation between the premise(s) of valid (deductive) reasoning and its conclusion is fixed: no additional information affects the entailment. In the language of probability, the probability of its conclusion given its premises must be 1 even if further information is added, whereas adding new information to the premise(s) of inductive reasoning can render its conclusion improbable relative to the new set of premises, hence defeat the original reasoning in the way the cancer case illustrates.[10]

Suppose we assume for a moment that good inductive reasoning has premises taking account of *all* the relevant evidence. May we then conclude that justification and knowledge are inductively transmitted only by inductive reasoning good in this comprehensive sense? This view is too strong. For it may often happen that some of the relevant evidence is not needed for such inductive justification of one's belief because one's premises already contain sufficient evidence. Evidence may be relevant to a belief without being *needed* for its justification, as where testimony from a twelfth witness who agrees with the rest is unnecessary though perfectly relevant. The point is important; for even if we can understand the notion of *all* the relevant evidence, we at best rarely have all the evidence relevant to a belief and we may not need it all if we do.

Is good inductive reasoning simply the kind of inductive reasoning that is *sufficient* to transmit justification? This is a promising characterization for single pieces of inductive reasoning, those using a set of premises directly for one conclusion. But inductive reasoning can occur in *chains*, with the conclusion of the first piece of reasoning serving as a premise in the second piece, and the conclusion of that serving as a premise in the third, and so on. Unfortunately, in an inductive chain extended through many inferences, justification may not be transmitted from the conclusion of the first to the conclusion of the last, even if each piece of reasoning has premises giving high probability to *its* conclusion. To see why, notice first that the *degree* of justification inductively transmitted from one's premises to one's conclusion may drop, even if nothing new enters the picture, such as someone's challenging one's conclusion the moment one draws it.

If the degree of probability repeatedly drops, the degree of justification may drop drastically. To see this, notice that even if one starts with excellent justification for one's premises, if they give a probability of only, say, 0.75 to one's conclusion, one will have much weaker justification for the conclusion than for the premises, if they are one's *only* basis for it. (I am assuming, somewhat artificially, that justification admits of degrees in the way probability does.) Roughly, one should take the chance that the conclusion is true to be only 75 percent of the chance that the premises are true. Suppose that I know that Tom said that the weather forecaster predicted rain. If the chance that Tom (who is biased by optimism and may have misheard the forecast) is right is only 75 percent and the chance that the forecaster's prediction is right is, say, 60 percent, then my warrant for believing it will rain is presumably just 75 percent of 60, i.e., 45 percent. (The idea is that the probability that the forecast was even made is only 75 percent, and we would then have a 60 percent chance of rain; the multiplication takes account of both probabilities.) Such chains of inference can be indefinitely long, as where I must rely on still other people for my belief that Tom said the forecaster predicted rain. This allows for the occurrence of even more reduction of one's justification for believing one's conclusion.

These points should make it apparent how it is possible for good inductive reasoning, carried out through a series of inferences, to fail to transmit justification from its initial premises to its final conclusion. Even if the probability that the initial premises give to the first conclusion is 0.9, if one went on inferring further conclusions, each being a premise for the next conclusion, then even with the same degree of probability in each case, one could eventually infer a conclusion for which one has less justification than 0.5. With each case, the likelihood that one's conclusion is true would be 10 percent less than (90 percent of) the likelihood of the truth of one's previous conclusion, which is serving as one's premise.

In some respects, *knowledge* differs from justification in relation to transmission conditions. Since knowledge does not admit of degrees (at least not in the way justification does), it might be transmitted across an inductive inference without diminution in degree even if such transmission does imply some reduction in one's justification (other things being equal). If, for instance, you know that the weather is bad and you inductively infer that Jane, who is driving, will be late, presumably you could know the latter proposition on the basis of the former even though there is *some* chance that she left early and compensated for the weather: the probability of this is above zero. Your *grounds* for your conclusion may not be as good as your grounds for your premise, which may render the conclusion only very probable, rather than entailing it; but you may still unqualifiedly know your conclusion. This knowledge may not be as good, say as securely grounded, as your knowledge of the premises; for instance, it might not be as nearly certain. But it *can* still be knowledge. Although there are kinds

of knowledge, apparently a belief either constitutes knowledge or falls short of that, as opposed to constituting knowledge to a degree.

It can happen, however, that knowledge is not transmitted even across an inductive inference whose premises give its conclusion extremely high probability. For example, you might know that you hold just one out of a million coupons in a fair sweepstakes, which will have one winner. You may inductively infer, with very high probability, 0.999999, that you will lose, since 999,999 of the million coupons will lose. But you do not *know* you will lose. You might be lucky. Moreover, you have as good a chance to be lucky as any other holder of a single coupon – including the possessor of the winning one. If we said, on this basis alone, that you know you will lose, how could we avoid having to say it of everyone else – in which case we would be wrong, since *someone* wins in this kind of fair lottery? Your knowledge of your premises, then, is not inductively transmitted to your conclusion. (If we change the example so that you *deduce* the qualified statement that the probability of your losing is 0.999999, you may know *that*. But that is a very different conclusion.)[11]

Some inferential transmission principles

We have seen some important points. Inference transmits justification and knowledge; it is not a basic source of them. It can generate them only derivatively, by transmission, from knowledge and justification already possessed. Inference can originate knowledge or justified belief in the sense that the beliefs in question are new to the believer, but not – as the basic sources of knowledge and justification can – from something other than belief, such as perception. Deductive transmission apparently requires validity; and inductive transmission apparently requires an inductive counterpart of validity, something like a strong relation of support between premises and conclusion. But even where the support is strong, the degree of justification may drop in a way that it need not drop in the deductive case.

As our examples show, to understand the transmission of justification and knowledge we must consider two sorts of conditions: *necessary conditions* for transmission of knowledge and justification, conditions such that transmission occurs *only if* they are met by an inference; and *sufficient conditions*, those such that *if* they are met by an inference, then transmission occurs.

It is by and large even harder to specify sufficient conditions than necessary ones. For a sufficient condition must "cover" all the necessary ones: if it does not imply that each of them holds, it leaves out something necessary, and so is not sufficient.[12] Let me simply suggest the sort of thing we must add to what we so far have in order to arrive at sufficient conditions for inferential transmission.

It will help to take inductive cases first. Might we accept the following *inductive transmission principle*: If, by good inductive reasoning, one infers

something from premises which take account of all the relevant evidence, then if one is justified in believing those premises, one is justified in believing the conclusion? Even in the sweepstakes case, where one holds only one of a million coupons, this condition is plausible for justification. For instance, one may be justified in believing one will lose. Knowledge, however, is different in this respect. For as the sweepstakes example shows, even when the probability is very high, the counterpart of this condition, with knowledge substituted for justification, does not hold.

A different example will show something else about the inductive transmission of justification, and here I return to the case of a chain of two or more instances of inductive reasoning. Imagine that I enter my house and find evidence of a burglary, such as ransacked drawers. I infer that valuables have been stolen. From that I infer that the $20 in my daughter's piggy bank is missing. And from that in turn I infer that my daughter will be upset. At each point I am justified in believing my premise and, it would seem, make a good inductive inference from it. In most such cases, my justification would carry right down the inductive chain from my initial premise to my final conclusion. But it need not. There is a chance that the bank was overlooked and a chance that my daughter will be calm, if only because she is so grateful that important things, like the teddy bears, are undisturbed. Could it not be that at each step my justification for my conclusion drops in such a way that, unlike my inference that I will lose the sweepstakes, my last inference fails to produce a justified conclusion?

The general point here is that as inductive inference proceeds, the crucially relevant evidence, the evidence one must take into account, may mount up or at least change. For instance, by the time I get to the question of whether my daughter will be upset about the piggy bank, it becomes relevant to note that the teddy bears are unharmed before inferring that she will be upset, whereas this information would not have been relevant if the disappearance of the piggy bank were the only potential disturbance in the house. We find, then, that the appraisal of inductive chains cannot be accomplished by any simple application of the single inference standard.

But how should we decide what is relevant to drawing a conclusion? And how is one's justification for believing a conclusion affected by ignoring only some of what is relevant? These are hard questions, which I can only partially answer. One positive point is this: whether we are inferentially justified in holding a conclusion we draw depends on many factors, including some *not* expressed in our premises.

My believing the premises of an inference may be the origin of my belief and a source of my justification. But there are other relevant factors – such as what I know, or should know, about what will preoccupy the child upon discovering the burglary. My justification ultimately depends on complex relations among all the relevant factors. We might say that although justification may emerge from a straight inferential line, it will do so only if the line figures in the right kind of *pattern* of related beliefs and available rele-

vant information. Some patterns contain obstacles on the would-be path to justification; others have clear, straight passageways.

By contrast with deduction, then, induction is less straightforward: if p entails q (i.e., q is deducible from p) and q entails r, then p entails r; but if we put 'probabilistically implies' in place of 'entails,' we do not get a principle that is invariably true. This is not in the least to say that non-entailing grounds for a proposition can never render it highly probable or yield a justified belief of it. The point simply expresses a limitation on inductive chains.

Deductive transmission of justification and knowledge

Let us turn now to deductive transmission. One might think that valid deductive inference is sufficient as well as necessary for transmitting justification and knowledge. Certainly it commonly does transmit them, for instance when we learn theorems by validly deducing them in doing geometrical proofs.

I do not mean that whenever, in the abstract, there *is* a valid inference, in the sense of 'a set of propositions constituting a valid argument,' from something one believes to a conclusion, then one "implicitly" knows the conclusion, or even has situational justification for believing it. If that were so, then simply by knowing the axioms of Euclidean geometry (which, like the parallel axiom – that for any line and any point not on that line, there is exactly one line parallel to the first and passing through the point – are quite simple), one might implicitly know, and be justified in believing, all its theorems. (This assumes that these theorems are all within one's comprehension, since one cannot believe or, at the time, even be justified in believing, a theorem too complex for one to understand.) The main issue here is the transmission of justification and knowledge in two ways: first, from justified beliefs, or from beliefs constituting knowledge, to other beliefs *arrived at* by inference; second, from such beliefs to situational justification for propositions that we *could* infer from those we know or are justified in believing.

Even if we restrict our concern to transmission of knowledge across inference processes, it is at least not obvious that knowledge is always transmitted across valid deductive inferences.[13] Recall the backfire. Suppose I am sufficiently acquainted with the sound to *know* that it is a backfire. Then, from what I know, it follows that it is not the sound of a firecracker with a similar muffled sound. Imagine that, aware that this follows, I infer that the sound is not that of a firecracker. Do I know that it is not? What if I have no evidence that there is no one around setting off such firecrackers? Perhaps I then do not know this. It may well be that from my general experience, the most I am justified in believing is that this alternative explanation of the sound is so improbable that it is irrelevant. But it is still not clear that I know there is no one around setting off such firecrackers.[14]

Thus, it is not clear that we should accept what might be called *the simple deductive transmission principle for knowledge*: that if you validly infer a proposition from an inferential ground you know, then you know this proposition (say that the sound is not that of a firecracker with a similar muffled quality). One might now say that if I do *not* know my inferred conclusion here, this just shows that I did not know in the first place that a vehicle backfired (my premise). But must we say this? It may be equally plausible to say that because one *now* realizes that one's basis for believing this might not have been decisive, one *no longer* knows it, yet did know it in the first place. *If* that is so, it shows something important: that sometimes reflection on our grounds can bring into our purview considerations that weaken them or at least weaken their power to support inferences.

Degrees and kinds of deductive transmission

Consider a different case. I add a column of fifteen figures, check my results twice, and thereby come to know, and to be justified in believing, that the sum is 10,952. As it happens, I sometimes make mistakes, and my wife (whom I justifiedly believe to be a better arithmetician) sometimes corrects me. Suppose that, feeling unusually confident this time, I now infer that if my wife says this is not the sum, she is wrong. From the truth that the sum is 10,952, it certainly follows that if she says it is not, she is wrong. If it *is* the sum, then if she denies that, she is wrong. But even though I know and am justified in believing that this is the sum, can I, on the basis of my grounds for this belief, *automatically* know or be justified in believing that if she says it is not the sum, she is wrong? (I am assuming that I have no other basis for holding this belief, such as a calculator result that coincides with mine.) That is far from self-evident. To see why, let us focus mainly on the principle as applied to justification – call this the *simple deductive transmission principle for justification*: If one is justified in believing *p*, then one is also justified in believing any proposition that follows from it.[15]

The force of the case is best appreciated if we suppose that my checking just twice is enough to give me only the *minimum* basis for justified belief and knowledge here. Surely I would then not have sufficient grounds for believing that if she says the answer is wrong, she is wrong. Given my background justification for believing that she is the better arithmetician, the justification-threatening prospect this proposition puts before me seems to demand that I have *more* justification than the minimum I do have if I am to be justified in believing that if she says the sum is not 10,952, she is wrong.

One way to interpret the example is this. To be justified in believing the proposition that if she says the sum is not 10,952, she is wrong, or to know or justifiedly believe this about her, I need grounds for believing this proposition that are good enough not to be outweighed by the supposition that she (the better arithmetician) says that 10,952 is not the sum. In inferring that if she says this is not the sum, she is wrong, I *am* making the supposi-

tion that she says it. Of course, I need not *believe* she will say it; but because I am supposing she will (and in a sense envisaging this in considering the proposition that if she says it, she is wrong), I am justified in believing that if she does, she is wrong, *only* if my justification for believing that the sum is 10,952 is good enough to withstand the supposition that she denies it is the sum. My supposing this may also be regarded as implicit in my holding the belief that if she says this, she is wrong, whether I form that belief by inference or not. In either case, under the supposed conditions, her justification seems good enough to reduce mine below the threshold which it just barely reaches.

One might now object that I really do not have justification in the first place for believing that the sum is 10,952. Depending on my arithmetic skills, that might be true if I have checked my sum only twice. But suppose that carefully checking three or four times is required to reach the threshold of justification and that I have done this. For *any* reasonable standard of justification or knowledge, there will be a point where I *just* meet, and do not exceed, that standard, and (again assuming I am justified in believing her to be the better arithmetician) I will then not know or be justified in believing the proposition that if she says the sum is wrong, then she is wrong. (This point concerns situational justification. It is also true that if I infer this further proposition without first getting *additional* grounds for my answer, I would not know it or justifiedly believe it, i.e., have a justified belief of it.)[16]

The example can be varied to make the same point in a different way. If the sum is 10,952, then even if there are two mistakes in the calculations I made to get it, it is *still* 10,952. This may sound strange, but the mistakes could cancel each other, say because one mistake yields a 9 instead of the correct 7, and the other yields a 6 instead of the correct 8 (so an excess of 2 is offset by a shortage of 2).

Now imagine that I again justifiedly believe that the sum is 10,952 and know this. I have been careful enough and have not actually made errors. Still, I have checked only the minimum amount necessary for justification. Perhaps simply to test my intuitions about deductive transmission, I might infer that (even) if there are two errors in my calculation, the sum is 10,952. Surely I am not justified in believing this and – assuming that the same minimum of checking is sufficient for knowledge – I do not know it (if more checking is required, then the same point will hold for knowledge if we build in the assumption that I just reached the required minimum). My original, minimal justification does not give me situational justification for believing what I infer or adequate grounds for knowledge of that proposition. If I had done *extra* checking, say enough to be adequately justified in believing (or to know) that I made no mistakes, it might be otherwise; but that is not my case.

Still another way to conceive the example is this. One might think of (1) 'If she says the sum is not 10,952, then she is wrong' as equivalent to (2)

'Either she doesn't say this or she says it and is wrong'. Thus, if I am justi-fied in believing (or I know) (2), I am (arguably) justified in believing (or I know) (1). It may seem that I would be justified in believing (2), since such justification can occur in any of these three cases: through my being justified in believing (a) that she will not say this, or (b) that she says it and is wrong, or (c) that at least one of those two things is true. Am I, however, justified in believing any of (a)–(c)? Let us consider them in order.

My justification for believing the sum is 10,952 is (chiefly) my reason-ably careful calculations' indicating this. *That* justification does not extend to justifying my believing that (a) my wife will not say this is false, and it surely does not extend to my believing that (b) she (whom I justifiedly believe to be the better arithmetician) says it is false and is wrong. Thus, it seems at best unlikely that I should be justified in believing that (c) at least one of these two things is the case. Nothing I have said requires denying that in the imagined case I may also have *some* reason to believe that if she says the sum is not 10,952, she is wrong. But the point is that I would not have *enough* justification for this to know or have a justified belief of it, as I did know and have a justified belief that the sum is 10,952.[17]

Cases of this sort strongly argue for at least two points. First, justification and knowledge *need* not be transmitted through valid inference from known or justifiedly believed premises to belief of a conclusion inferred on the basis of them. Second, situational justification is not automatically transmitted even to propositions clearly entailed by those we are justified in believing – hence the deductive transmission of justification principle is not true.

These negative points should be balanced by another. *Some* degree of (situ-ational) justification – what we might call some *reason for believing* – may automatically transmit: it is not as though I have *nothing* in the way of reason to believe that if she says the sum is not 10,952, then she is wrong (for instance, I did check my sum with some care). Still, merely having some reason to believe does not imply being justified *in* believing, any more than one piece of evidence for a proposition is sufficient for knowledge of it.

The sort of failure of transmission I have noted is probably not common for inferences rational persons normally draw, and I stress it because such failure has often been held to be impossible (and is important in dealing with skepticism, as Chapter 10 will show). A *qualified deductive transmission principle for justification* apparently holds: typically, valid reasoning from justified beliefs transmits justification to its conclusion belief (this holds for overall justification as well as for some degree of justification, though it allows that there be some degree of diminution in justification across the inference). Similarly, we may apparently affirm a *qualified deductive transmis-sion principle for knowledge*: typically valid reasoning from known premises transmits knowledge to its conclusion (where the conclusion belief is *based on* the premise belief(s), as would be normal). These principles are of major importance in epistemology. It is difficult to say under just what conditions deductive transmission does not occur, but one can see what some of them

are from the points that have emerged here. The general conclusion to draw, however, is that whether one is justified in believing something, or knows it, depends not only on one's specific evidence for it but also on a pattern of factors including one's relation to the proposition itself and one's particular circumstances.

Memorial preservation of inferential justification and inferential knowledge

Let me conclude by introducing a further point that applies to both deduc-tive and inductive inferential transmission. Imagine that you learn something, say a theorem, by validly inferring it from something you know, say a set of axioms. You may remember the axioms *as* your grounds; then your memory preserves both your premises and your conclusion. But eventu-ally you may forget your grounds, for instance how you proved, and even how *to* prove, a theorem. Similarly, you may forget the testimony or book from which you learned (perhaps by inductive inference partly based on the premise that the book is reliable) that the Battle of Hastings was in 1066. Can you still know and justifiedly believe these now premise-less proposi-tions?

The answer in both cases is surely that you can. Memory can retain beliefs *as* knowledge, and as justified beliefs, even if it does not retain the original grounds of the relevant beliefs. But because in these instances it does not retain the inferential grounds, and no new grounds need be added, it does not necessarily retain the beliefs *as* inferential. Moreover, where the grounds are not retained and none are added, one might find it at best difficult to indicate *how* one knows, beyond insisting that, say, one is sure one remem-bers, perhaps adding that one certainly did have grounds in the past. But so long as one did have adequate grounds and *does* remember the proposition, surely one can know that proposition. One can also justifiedly believe it, provided one has an appropriate memory of it, say the sense of memorial familiarity that goes with many of the beliefs memory preserves.

This example is another illustration of the point that a belief which is inferential at one time may be non-inferential at another. This may happen repeatedly with the same belief. Long after a belief – for instance, of a theorem – has ceased to be inferential, one could acquire new grounds for it, such as that one has a clear recollection of a mathematical friend's affirming the theorem. One could later forget the new grounds also, and simply remember the theorem or indeed find an altogether new proof of it.

Suppose, however, that one's memory of the theorem is very weak and one has no confidence that one has it right. The result might be that one has merely a belief which not only does not constitute knowledge but also is only weakly justified, if justified at all. It will certainly not be justified if one acquires new evidence that clearly counts strongly against it and nothing happens, such as one's getting new information, to neutralize this

hostile evidence. Often, however, the new beliefs, justification, and knowledge we acquire through inference may be retained even when their inferential grounds are long forgotten.

At any given moment in waking life, we have some operative basic source of belief, if only the stream of our own consciousness. As we experience the world around us and our own interactions with it, new beliefs arise, both directly from basic sources and inferentially. As rational beings, we are almost constantly forming beliefs on the basis of other beliefs, whether through a process of inference or only through acquiring beliefs that are only structurally inferential: based on other beliefs and so held for a reason, but not arising from them (or grounded in them) by a process of inference and so not reasoned. Both deductive and inductive inference are common. Both transmit justification and knowledge when they give rise to beliefs on the basis of inference which meets the appropriate deductive, inductive, and evidential standards.

Among the *transmission principles* that have emerged as plausible are these two broad ones. First, knowledge and justification are inferentially transmitted only if the underlying argument is good. If we start with false or unjustified premises *or* we unreasonably infer a conclusion from them (i.e., infer it invalidly or in an inductively inadmissible way), it is not to be expected that a belief based on the argument in question constitutes knowledge or is even justified. (This does not, of course, prevent it from having an independent sound basis.) Second, at least typically, if the argument *is* good, (1) situational justification is transmitted and (2) belief justification and knowledge are transmitted provided the subject believes the proposition in question (the conclusion of the inference) on the basis of its premises (the underlying ones).

The kinds of transmission described in the second principle seem to occur quite often, and abnormal conditions such as those described in the column of figures case are surely not common. Given a normally retentive memory, we have not only a vast store of direct (non-inferential) knowledge and directly justified belief, but also a huge variety of indirect knowledge and indirectly justified beliefs. False and unwarranted beliefs arise from some inferences. But from many inferences we learn something new; and in making inferences to propositions that we think best explain something that we take ourselves to know already, we sometimes learn truths that are both new and important. Through inference, then, we often enlarge, strengthen, and develop our body of knowledge and justified beliefs.

Notes

1 Two points may add clarity here. (1) I am talking about beliefs *that* (propositional, not objectual, beliefs). (2) It is perhaps misleading to call propositions objects of beliefs, if only because they can express the *content* of beliefs – their primary role here – whether or not believing is a relation to a proposition conceived as an object. It could instead be something like a "contentful" property of persons.

2 Two points deserve emphasis here. First, I take a belief arrived at by reasoning to be at the time *grounded* in that reasoning; but it should be noted that the belief can be retained in memory after the premises of the reasoning are forgotten, and in that case we should speak of a belief that is only a *formerly reasoned belief*. (It is also possible for a belief not arrived at through reasoning to be later grounded in it, as where one at last finds premises to support what one has believed on the basis of a "hunch.") Second, one might object to my main distinction here that, from my recognition of the backfire, I *must* have inferred, hence *reasoned* to the conclusion, that someone drove by. Granted, this recognition is a ground of my belief that someone drove by. Still, I need not *do* anything that qualifies as drawing a conclusion from the recognition. I did not even stop reading to think about the noise, whereas, in the case of the woodpecker, I focused on the question of whether someone was at the door and, on hearing the distinctive rapid knocking, inferred that it was that of a woodpecker.

3 Granted, the notion of a process of inference is not sharp; sometimes we cannot get enough information about how a belief was formed even to make an educated guess about whether or not it arose from an inference.

4 The notion of a reason is here understood broadly, so that even a "bad reason" counts. Thus, one could have a belief for a reason even if the reason is a false proposition or one the person is unjustified in believing. Anyone who finds this usage too broad can substitute the notion or a reason *or* apparent reason. A defense of the broad terminology is given in Chapter 2 of my *Architecture of Reason* (Oxford and New York: Oxford University Press, 2001). *If* the terminology is too broad, then an episodically inferential belief need not be one held for a reason; for people *can* draw inferences from propositions that, in the narrow terminology, provide at best an apparent rather than a "real" reason for believing what they believe on the basis of them.

5 The distinction between episodically and structurally inferential beliefs and the notion of one belief's being based on another are discussed in detail in my 'Belief, Reason, and Inference,' in my collection, *The Structure of Justification* (Cambridge and New York: Cambridge University Press, 1993).

6 Bertrand Russell is among a number of philosophers who have at least implicitly denied this: "our knowledge of the physical world is not at first inferential, but that is because we take our percepts [roughly sense-data] to *be* the physical world ... adults have got used to the idea that what is really there can only be *inferred* from what they see ..." See *An Outline of Philosophy* (London: Allen & Unwin, 1927), Chapters XII–XIII. This is the kind of view criticized by J.L. Austin in *Sense and Sensibilia* (Oxford: Oxford University Press, 1962), esp. Chapter X. Austin subjects A.J. Ayer to criticism on similar counts, especially in the passages reprinted in Huemer, op. cit. Chapter 7 will show that the foundationalism introduced there need not deny the point.

7 There is no one way to arrive at a suitable premise, but a typical way would be to count the cats individually up to seventeen, checking to be sure of overlooking none, and to believe on that basis that one has arrived at a total of seventeen cats. There may be ways, however, of passing non-inferentially from counting n things of a kind K to the belief that there are n Ks. There are certain premises from which one may infer that if some pets are dogs, then some dogs are pets, e.g. that if, for any A and B, if some As are Bs, then some Bs are As; but no one who can reason thus would find it natural to believe the former on the basis of the latter. On the plausible view we might call *epistemic particularism*, moreover, the former kind of proposition is *epistemically prior* to the latter, at least in the sense that justification for the former kind is presupposed by justification for the latter kind, but not conversely.

8 I say this appears to be so because it is controversial. The issue will be discussed in Chapter 7.

9 This is a permissive sense of 'valid' and 'entail,' because both apply where the premise set is contradictory or the conclusion is a necessary truth (a truth whose falsity is impossible). For it is impossible that a contradiction be true, hence impossible for a

contradictory premise set to be true *and* the conclusion false; and this is also impossible if the conclusion is a necessary truth and so cannot be false. Usually, we deal with arguments valid in a narrower sense, their premises being both mutually consistent and relevant in subject matter to their conclusion. But nothing said in this book should turn on our using the wider notion of validity that is standard in formal logic.

10 The language of probability seems preferable here to that of defeasibility. For the latter normally implies a liability to loss of justification or knowledge or both, and on that point deductive and inductive reasoning do not differ. If we conjoin to a premise in a valid deductive argument the negation of that premise, the argument and the reasoning expressing it are still valid (*logically* indefeasible, one might say); but its premises cannot all be known nor (presumably) justifiedly believed, and in any case they cannot provide good reason to believe the conclusion. They would be *further* from doing so than in the case of a weak inductive argument. (I thank Claudio de Almeida for questioning the text in a way that brought out this kind of problem.)

11 The point here is associated with what is called the *lottery paradox*, introduced into the literature by Henry E. Kyburg, Jr. and widely discussed. See his *Epistemology and Inference* (Minneapolis: University of Minnesota Press, 1983).

12 Since a sufficient condition implies *all* of the conditions that are minimally necessary, i.e., are *the* (possibly complex) conditions individually necessary and jointly sufficient for the phenomenon to occur, some have wondered how a sufficient condition can fail to be a necessary one as well. The answer is that it can imply something more that is *not* necessary, as taking a letter to the postbox by car, although sufficient for getting it there, is not necessary for this, since it implies something not necessary for getting it there, namely driving it there.

13 I mean, of course, the non-trivial kind, having consistent premises none of which is equivalent to the conclusion. From inconsistent premises anything may be validly derived. If, for example, we start with a premise consisting of (1) some proposition, *p*, *and* its negation, not-*p* (with a contradiction), we may infer that (2) either *p* or *q*, for any proposition *q* we like (on the ground that if *p* holds, then *either* it or anything whatever holds). But we may now bring in (3) not-*p* (since we have it as well as *p* in our premise); and not-*p*, together with (2), entails *q*. Our arbitrarily chosen proposition, *q*, is thus validly derived.

14 On some views, a central feature of knowledge *is* that the belief in question is justified in a way that allows one to rule out, or itself in some way rules out, relevant alternatives. For a valuable discussion of this issue see Alvin I. Goldman, 'Discrimination and Perceptual Knowledge,' *Journal of Philosophy* 73 (1976), 771–91. The issue is addressed, sometimes indirectly, in Chapter 8.

15 This principle should be qualified if the idea is to be maximally plausible. It is not obvious what the best formulation might be, but we should at least specify that the person in question can understand the entailment from *p* to the proposition for which the person has transmitted justification. There is no reason to think that because I am justified in believing *p* I should be justified in believing *q*, which it entails, when I cannot for the life of me understand *how* the former entails the latter. I am also for the most part simplifying by speaking only of transmission of situational justification as opposed to belief justification. For transmission of that, as of knowledge, it is presumably required that the person believe the entailed proposition *on the basis of* the entailing one.

16 This column of figures example has generated considerable discussion in the literature. For detailed critical discussion of my case see Catherine Canary and Douglas Odegard, 'Deductive Justification,' *Dialogue* 28 (1989); Richard Feldman, 'In Defense of Closure,' *Philosophical Quarterly* 45 (1995); and Peter D. Klein, 'Skepticism and Closure: Why the Evil Demon Argument Fails,' *Philosophical Topics* 23, 1 (1995), 213–36. For my replies published to date see 'Justification, Deductive Closure, and Skepticism,' *Dialogue* 30 (1991), 77–84; and 'Deductive Closure, Defeasibility, and Skepticism: A Reply to Feldman,' *Philosophical Quarterly* 45 (1995), 494–9. (This paper discussed the example

construed as appealing to a subjunctive such as 'If she were to say the sum is not *n*, she would be wrong'.) For related treatments of the transmission problem see Fred Dretske, 'Epistemic Operators,' *Journal of Philosophy* 67 (1970); Robert Nozick, *Philosophical Explanations* (Cambridge, Mass.: Harvard University Press, 1981), Chapter 3; and Gilbert Harman, *Change in View* (Cambridge, Mass.: MIT Press, 1986), esp. Chapters 1–4.

17 No precise notion of justified belief fits all the contexts in which we speak of it; but when we speak of justification unqualifiedly we usually have in mind a kind and degree such that it is reasonable, overall, for the person to hold the belief. This is perhaps a kind and degree such that, if the proposition in question is true (and there are no special problems of the kind to be considered in Chapter 8), then the belief constitutes knowledge. Even this high degree of justification, of course, is still best conceived as prima facie rather than indefeasible or in any sense absolute.