Modality

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As well as what does happen, we are often concerned about what could have happened. When we are almost run over by a careless driver, we justifiably feel angry: even though no-one was hurt, someone easily could have been. When we make decisions, we choose between alternative actions that we think are possible. Politicians and artists are often more inspired by what could be than what is.

If possibility is important, so too is necessity. Some things, like the truths of pure mathematics, are often thought to be necessary: they are unchangeable, and it is hard to even imagine what it would be like for three plus four to equal anything except seven. Some of the things science discovers seem to have a necessity about them, like the fact that nothing continuously accelerates to faster than the speed of light, or that sodium chloride always dissolves in pure water at normal temperatures and pressures. These principles seem to have a different status to truths that seem like mere accidents: there was no necessity in Queen Elizabeth's first child being a boy, for example, or in a stock market crash happening on the day that it did, rather than one day earlier or one day later.

Judgements about what can happen and what must happen, what is possible and what is impossible, and so on are common in discussions of almost any topic. But outside philosophy, there is not much general investigation into what we are trying to capture when we talk and think this way. Some topics connected with possibility and necessity are of particularly interest in metaphysics. These include questions about laws of nature, dispositions, causation, and essence.

One thing that is not immediately obvious is why any of this should be called "modality". The explanation is historical: in medieval logic, possibility and necessity were considered *modes* of propositions, and so the study of possibility and necessity is

now known as the study of modality. That study obviously includes related matters, such as the study of impossibility, contingency, and what is expressed by words like "must", "should", "would", and others. The topic of modality does not have exact boundaries, nor would insisting on precise boundaries be very useful.

We seem to be able to inter-define a number of modal expressions. For example, starting with "could", we can say that something is *necessary* if it could not be otherwise (necessarily, 2+2=4); something is *impossible* if it could not happen (it is impossible for 2+2=6), and something is *contingent* if it could be, but also could be otherwise (it is contingent whether I have two arms and two legs). Something is *possible* if it could be (it is possible for me to go into outer space), but sometimes we use the word "possible" to suggest that while something could happen, it has not or does not: in such cases the relevant thing is only *merely possible*.

Deontic, Epistemic, Alethic

There seem to be several quite different uses of words like "can", "must", "might", "has to", and other expressions that are associated with possibility and necessity. Sometimes these words are apparently used to describe how the world is objectively: "Nothing can accelerate through the speed of light", "Everyone must die in the end.", "It is impossible for it to rain and not rain at the same place at the same time."

These uses of modal expressions are sometimes known as the "alethic modalities". Varieties of alethic necessity discussed include "logical necessity", "metaphysical necessity", "nomological necessity", "temporal necessity", and others. There are no entirely uncontroversial definitions for many of these. The core cases of logical necessity are the theorems of logic: for instance, it is logically necessary that it is not both raining and not raining. Some extend "logical necessity" to include analytic truths: they would usually hold that it is logically necessary that every bachelor is unmarried. It is also common to think that mathematical truths are logically necessary. And some would want to extend "logical necessity" to every claim they think is necessary in the strongest sense.

"Metaphysical necessity" is even more contested. Some do not want to draw a distinction between metaphysical necessity and logical necessity. Another view is

that metaphysical necessity is a special grade of necessity that many fundamental principles of metaphysics have: the sense in which it is necessary that a table can have squareness, but squareness cannot have a table, for example. The examples of logical necessity mentioned in the previous paragraph are usually treated as metaphysically necessary as well. Metaphysical necessities may include some truths that are only discovered to be necessary through empirical investigation: since Kripke 1980 and Putnam 1973, many philosophers have thought it is metaphysically necessary that water is H_2O, even though there does not seem to be any *a priori* guarantee that the nature of water would turn out that way.

"Nomological necessity" is the grade of necessity given to things guaranteed by the laws of nature. Typical examples include the necessity that copper is a conductor of electricity, or that objects cannot accelerate through the speed of light. Of course, what is nomologically necessary depends on what the laws of nature are, so new discoveries in science might well cause us to revise our opinions about what is necessary in this sense. Everything metaphysically necessary and logically necessary is normally treated as being nomologically necessary as well: even if the laws of physics are silent about whether 7 is prime, still 7 is not composite in any nomological possibility. Nomological necessity is sometimes called "physical necessity", though sometimes "physical necessity" is reserved for the status of things that cannot be different without different laws of *physics*, in particular. Philosophers disagree about whether the laws of nature are *metaphysically* necessary: if they are, then nomological necessity may just be the same thing as metaphysical necessity, or maybe a special species of it. On the other hand, some other philosophers deny that there are really any laws of nature at all (or that they are only idealisations that do not often apply to real phenomena): if those philosophers are right, then very little will be nomologically necessary except, perhaps, for things that are logically or metaphysically necessary for other reasons. (For an example see Cartwright 1983.)

There are more restricted alethic modalities still. Arguably the sense in which the past is fixed gives us "temporal necessity": things that could have turned out otherwise, but now it is too late for them to be any way except the way they are. There seems to be a type of modality associated with ability or feasibility: there is a good sense in which I cannot run a three minute mile, or speak fluent Hungarian, even

though neither of those things is nomologically impossible. A lot of our talk about what is "impossible" or what "can happen" seems to invoke standards much less generous with possibility than the nomological standard: though perhaps some of these uses involve elements of non-alethic modalities too.

There are other uses of modal vocabulary besides the alethic ones above. There are epistemic uses, where what has to be or can be seems to depend on the state of knowledge or evidence. Consider a tracker who has just discovered that the remains of a fire are still warm, and says "They must have camped here last night." Presumably he is not saying that "they" were forced to camp there last night, or otherwise found it unavoidable: instead, he seems to be saying something to do with what follows from his evidence. Or consider someone who has been searching their bedroom for hours and then says "My glasses can't be in the bedroom." The "could not" there seems to be signalling a connection between her evidence, or what she knows, and the location of her glasses, rather than saying something about the alethic possibility of her glasses existing in her bedroom.

Other uses of modal vocabulary seem to relate to what is allowed and what is forbidden, by moral codes or other systems of norms like legal systems or codes of etiquette. Often it seems to be that something is possible if it is permitted, and necessary if it is required: "All tickets must be shown", "A gentleman cannot refuse a challenge", "The perpetrator has to be brought to justice", and so on. One interesting thing about these cases, usually labelled "deontic" modalities, is that deontic necessity does not imply truth. If something is logically necessary, or physically necessary, or epistemically necessary (at least in the sense of following from what is known), then it must also be true. But just because law, or morality, or honour, requires something, it does not follow it is true. Even when the law says that people cannot take things that do not belong to them, still some people do.

One interesting question is what these different uses of modal vocabulary have to do with each other. One plausible suggestion is that there is no genuine ambiguity here, rather words like "can" and "possible" and "must" and "has to" are context sensitive. Compare: "that", used as a demonstrative, can be used to pick out many different sorts of things - but this need not mean that "that" is ambiguous. Instead, the core

meaning of "that" seems to be associated with a function from acts of demonstration, or intentions to pick things out, to reference to objects. So "that" means the same in "That is a tiger.", "That is what I've been trying to tell you!", and "I want that for Christmas.", even though it refers to different things when each of these sentences is used. What is common is its being associated with a function from a demonstrative feature of context to an object.

Of course, even if we allow that modal expressions are context-dependent, this leaves us with the question of what it is about context that they are sensitive to. Perhaps it depends on what constraints a speaker has in mind, or are in play in a discourse. Perhaps modal operators signal whether something follows from some background assumptions, given by context: to say it must be that *p* would be to signal that *p* is a logical consequence of things taken for granted (this is the view explored in Quine 1966). Or perhaps the influence of context is best understood as restrictions on classes of possible worlds (see below). There are of course other options for explaining the role of context here, and it is safe to say this question remains disputed.

Possible Worlds

Philosophers have paid a lot of attention to "possible worlds" since the 1960s, even though using possible worlds in philosophy goes back at least as far as Leibniz. A possible world corresponds to a complete specification of an alternative way for the world to turn out: complete in the sense that for every proposition *p*, either *p* or its negation will follow from the specification. One complete possibility corresponds to how things in fact are: it is normally labelled the "actual world".

Possible worlds have been invoked in a range of areas in philosophy. One important early use was in understanding modal logic. Systems of logic had been worked out that added logical symbols for "necessarily..." and "possibly..." to propositional logic and predicate calculus. The initial development of modal logic was through proposing systems of axioms, but there were difficulties in understanding the relationships between the different systems, and determining the meta-logical properties of such systems, such as whether the different systems were complete. (A

logical system is complete when every sentence that is true in every model of the logic is provable in that logic.)

A breakthrough in the understanding of these logics came when it was realised that they are modelled well by a system that have a number of "worlds" at which propositions can take different truth values, together with an accessibility relation to tell you which worlds are possible from which others. For a proposition to be necessary at one world (call it w_1) is for it to be true at all the worlds *accessible* from w_1. For a proposition to be possible at w_1 is for it to be true at at least one world accessible from w_1. Different modal logics can then be modelled by putting different accessibility relations on worlds. For example, it seems very reasonable to insist that if a proposition is necessary at a world it is true at that world, and if it is true at that world then it is possible at that world, too. This amounts to insisting that the accessibility relation is *reflexive*: that every world is accessible from itself. More controversially, some people think that a proposition can be possibly possible without being possible. This makes most sense when dealing with restricted modalities: perhaps something is not feasible, but there is something feasible we can do to *make* it feasible: then we might want to say it is possibly possible, but not currently possible. This can be represented with an accessibility relation that is not *transitive*. If *p* is true at world 1, which is accessible from world 2, and world 2 is accessible from world 3, then *p* is possibly possible at world 3. If world 1 is not accessible from world 3, and no other *p*-world is accessible from world 3, however, "possibly p" will be false at world 3.

A family of modal logics now called "normal" modal logics can all be represented by varying conditions on an accessibility relation, and many more modal logics can be represented by similar techniques. Insofar as this is only modelling, we do not have to take the "possible worlds" seriously: they are just indexes in a model that stand in a function from sentences to truth-values. But the fact that these models were so illuminating is suggestive, as noted by David Lewis (Lewis 1986 pp 17-20). "Necessarily..." seems to function like "In all possible worlds...", and "Possibly..." like "In some possible world...". Maybe talk about what is necessary and what is possible is just talk about what is going on in all possibilities, or in some possibility? Some philosophers have thought that this gives us a way to understand, or to analyse,

modal discourse – we can see modal talk as a way of generalising about possible worlds.

Of course, if we do this, we need to find a place for the modal talk we engage in that does not seem to involve *every* possible world, such as the restricted modalities discussed above. (The sense in which it is not possible for me to become a billionaire by the end of the year, for example.) One way to understand them is that they correspond to some restricted subset of all possible worlds: the worlds that obey the same laws of nature (for nomological necessity), or the same current financial situation (for the claim about becoming a billionaire), and so on. Another, similar, approach is the one modelled above on which there is an "accessibility relation" between worlds, so that a world is possible relative to another if it is accessible from it. This more naturally allows us to interpret cases corresponding to failures of transitivity, where something is necessary but not necessarily necessary, or possibly possible but not possible (see above). If these moves improve our understanding of the relationships between different uses of modal vocabulary, they provide another example where philosophising about possible worlds has been useful.

References to possible worlds can be found all over the philosophical literature. They are used to provide models for claims about chance and probability. They are used to distinguish important varieties of supervenience claims. They have a very important role in theories of the meanings of sentences in natural language: they are the foundation of Montague grammar, for example, an important tradition in contemporary linguistics. They are employed to illuminate the logic of "if... then..." sentences. They are usefully employed to model mental content, especially what beliefs and desires are "about" (Stalnaker 1984). Many contemporary philosophers would concede that, some way or other, we need to make sense of talk about possible worlds. But exactly what are we talking about?

What are Possible Worlds?

Once a number of philosophers started to find it useful to talk about possible worlds, the metaphysical question of what possible worlds *are* was not far behind. Notoriously, David Lewis (see especially Lewis 1986) defended the view that

possible worlds were alternative concrete universes, the same sort of thing as our own cosmos. Other philosophers argued that possible worlds should be seen as abstract objects of some sort: perhaps as collections of sentences or propositions (Carnap 1956, Adams 1974), perhaps as maximal properties, or ways, that an entire cosmos could be (Forrest 1986), perhaps as uninstantiated maximal states of affairs: a total state of the universe, albeit one that the universe in fact does not have (van Inwagen 1986) or perhaps as a special sort of abstract object in their own right (which I think is Robert Stalnaker's view, though it is hard to tell: see the discussions in Stalnaker 2003).

One way to try to work out the metaphysics of possible worlds is to start from a job-description. Possible worlds should have either sentences or propositions true at them: a possible world where some swans are blue must be able to endorse "Some swans are blue.". This true-at relation is called by some, following David Lewis, "representation" (Lewis 1986 p 137). But do not be misled by using the term "representation" here. Lewis, for example, thought that a possible world represents claims like "some swans are blue" by containing blue swans as parts of it, not by any sort of reference or meaning.

Different theories of possible worlds handle this true-at or representation differently. Lewis, who believed possible worlds were universes like this one, has one obvious story. Those who think possible worlds are sentences or propositions think that "representation" in this technical sense is *representation* in the more usual sense: a possible world with "some swans are blue" true at it is a proposition that says that some swans are blue, or implies it. Theories of possible worlds as states of affairs might hold that "some swans are blue" is true at a world *w* if necessarily, *were* w *to obtain*, some swans would be blue. Those who think possible worlds are not analysable in other terms might think the true-at relation is not analysable as well, or they might offer an account of the connection. Even though Robert Stalnaker tends to treat possible worlds as not further analysable (Stalnaker 2003, especially chapters 1 and 2), he does give an analysis of the "true-at" relation: he claims possible worlds are sets of propositions, and for a proposition to be true at a world is for that world to be a member of the proposition (i.e. the set). Because all of these candidate worlds,

in their own way, would be able to perform the role that possible worlds are supposed to play, they are all so far viable options.

Whether one of these candidates is better than the others depends in part on what other things possible worlds are supposed to do. For example, some people want a theory of possible worlds to provide an *analysis* of modality, and so require that we be able to specify which things are the possible worlds without relying on other modal notions. (Lewis 1986 pp 150-157, 167-170, 176 criticises rival theories for not being able to do this.) To give another example, a theory of possible worlds should provide *enough* possible worlds for all the possibilities there are, and Lewis 1986 pp 157-163 charges that some of his rivals cannot do that, especially when it comes to possibilities of individuals and properties that do not exist but could. Nolan 2004 offers another sort of argument that many theories of possible worlds do not allow for enough possibilities. Of course there are many other things you could argue possible worlds should do that rule out one or more of the usual options.

There may be other ways to narrow down the list of candidates to be possible worlds besides the demands of the role possible worlds are to play. Perhaps arguments can be given that some of these candidates just do not exist: many people would want to say this about Lewis's concrete alternative universes, and there are some who might worry about various different sorts of abstract objects offered as candidates to be possible worlds. Or perhaps, if several groups of objects met all the criteria to be possible worlds, we might think the expression "possible world" was indeterminate between them, or alternatively sometimes picked out one group and sometimes another.

What should we do if no proposed ontology plays all the roles we want for possible worlds? We could decide that possible worlds are not quite as we thought they were. Or we could decide that talking about possible worlds was a mistake. Or we could treat talk about possible worlds as engaging in a "useful fiction". Rosen 1990 is a well-known presentation of a "modal fictionalist" theory.

What Are Possibilities?

The question of what possibilities are is less discussed. Presumably, a possibility does not need to be *complete* like a possible world: when I discuss a possibility of a US president of recent Arab descent, that possibility need not represent anything one way or another about e.g. the exact facts about what every American has for breakfast. You could think that possible worlds were just a special sort of possibility: the complete ones. A common approach to these incomplete possibilities is to identify them with *sets* of possible worlds: where what is true according to a possibility is what all the possible worlds in the set agree upon. Even if we do not identify possibilities with sets of possible worlds, those sets provide a good way of modelling many aspects of possibilities.

Treating incomplete possibilities as sets of possible worlds does have some intuitive drawbacks. One is that possible worlds all agree on necessary truths: so if we model possibilities as sets of possible worlds in the way described, then every possibility will endorse every necessary truth. The idea of possibilities as incomplete, though, may make this unappealing: why should the possibility of a US president of Arab descent incorporate the whole of mathematics, for example? Those who want to treat possibilities as not incorporating all logical truths, let alone all necessary truths, often call these possibilities *situations*. See Barwise and Perry 1983.

If we do not construct possibilities out of possible worlds, we are left with the metaphysical question about the nature of possibilities, or situations themselves. But the options for possibilities are quite similar to the options for possible worlds: and any theory of the nature of possible worlds can usually be modified slightly to yield a theory of the nature of possibilities or situations. For example, the theory of possible worlds as maximal consistent sets of sentences (sets that, for each sentence *S*, either contains *S* or the negation of *S*) has as a close cousin the theory that possibilities are consistent sets of sentences that need not be maximal. Possible worlds can often be construed as just a particular sort of possibility – the possibilities that are maximally specific.

Modality De Re

The possibilities for a given object or person are often called the possibilities *de re* ("of the object") for that object or person. This is contrasted with *de dicto* ("of the expression") possibility and necessity, which concerns the possibility or necessity of the proposition involved (at least when the expressions were developed). Questions about modality *de re* are particularly thorny ones, and have attracted a lot of interest from metaphysicians.

Our judgements about what can, and what cannot, happen to an object seem to depend on what kind of object it is. The number 2 can be eternal and lack any physical properties: but can my table? A lump of gold perhaps can survive being flattened out, but a cat cannot: change the relationships between a cat's parts sufficiently, and the cat has been destroyed. There is a lot of controversy about what sorts of changes are possible for people: completely destroying my mind and body presumably kills me, but what if everything except my brain is destroyed and the brain is kept functioning on life-support? What about if my psychology is copied into another human body, or a computer program? Is it possible that I could survive that process, or would we just be left with someone (or something) else psychologically similar?

Many philosophers believe that this is because some kinds of things have *essences* associated with them, and that they have some properties essentially and others only accidentally. Sometimes what it is to have a property essentially is defined modally: for b to have a property G essentially is for it to be the case that necessarily, if b exists, b has G. So if my cup is essentially a physical thing, then each possible world either lacks my cup or alternatively represents that my cup exists and is physical. Properties had accidentally are all the other properties a thing has: presumably my cup containing tea is accidental to it. Some philosophers (following Fine 1994) think that we can understand the essential/accidental distinction in non-modal terms, but by and large they would agree that if a property is essential, it meets the modal condition just mentioned, though this may not be sufficient for a property to be essential.

One problem that arises here for a theory of modality *de re* is that it seems like one and the same object can belong to more than one kind: thought about one way, one answer seems correct, but thought about another, a different answer seems right. Prior to worrying about philosophical issues, you might be inclined to think that a certain lump of gold is *identical* to a certain statue. (The statue is just the lump shaped in a certain way with certain intentions.) But the lump of gold can survive being flattened, while flattening the statue would destroy it. Another modal difference is presumably that the lump of gold could have existed without ever having been made into a statue - but it is much less clear the statue could have existed without being a statue.

There are several responses available here. One is to try to find a privileged kind for each thing to be (Burke 1994): perhaps, despite appearances, only one of the kinds of the statue/lump is relevant. Or a multiple occupancy view could be endorsed, according to which the statue and the lump are distinct, but they happen to occupy the same space and be made up of the same parts. (see for example Wiggins 1980). Versions of multiple occupancy views seem to be the most popular. Or perhaps a strongly anti-essentialist stance could be adopted that claims that a lot of our intuitions about essential properties are mistaken, and in fact all sorts of things are possible for all sorts of objects.

A final option is to accept what is sometimes called *inconstancy de re* (Lewis 1986 248-263). On this view, which *de re* predications are true depends not just on which object is at stake, but other things about how it is thought of or referred to. The most famous approach along these lines is *counterpart theory*, as developed by David Lewis and others (Lewis 1968, Hazen 1979, Forbes 1989). In counterpart theory, I am represented in possible worlds other than the actual one by *counterparts* - things related to me by a *counterpart relation*. But which counterpart relation should be used in evaluating a claim of *de re* necessity can depend on context. Ask about what can happen to a statue, *using a statue counterpart relation*, and you might be told that it could have its limbs somewhat rearranged, but could not be flattened. (That is, it has counterparts with different limb arrangements, but no flattened counterparts.) But ask about the same thing *using a lump counterpart relation*, then it has counterparts that are flattened.

Counterpart theory is not the only way to implement inconstancy *de re*. Another approach is to accept straightforward contingent identity. Suppose there are no worlds where a statue, S, survives being squashed, but there are plenty of worlds where a lump L survives being squashed. If S=L in this world, then that object (the thing which is identical to S and also identical to L) can possibly survive squashing (because it is L), but necessarily does not survive squashing (because it is S). Care has to be taken to set up contingent identity theories so as to avoid contradictions: and indeed my statement of the modal features of the thing which is S and also L will already look contradictory to some. Another way for a theory to endorse inconstancy *de re* is if modal predicates are *Abelardian* (Noonan 1991). If modal attributions mean something different depending on the kind of thing they are applied to, then we can have apparently contradictory *de re* modal predications both being true. If we say that S cannot survive flattening, but L can survive flattening, this looks inconsistent if S=L. But if all we mean is that it has a lump-kind-of-possibility of surviving flattening but no statue-kind-of-possibility of surviving flattening, then this is not inconsistent.

There are other kinds of puzzles for modality *de re*. As well as the cross-kind puzzles discussed above, there are same-kind puzzles. People can survive the complete destruction of one hemisphere of their brain, with the right medical care. They also can survive the loss of a lot of their body. Someone who had the left side of their body (including their brain), might conceivably survive if they received enough medical assistance and the right kinds of prosthetics or transplants were available. (Maybe not with today's medical technology, but we can easily imagine a life support system that could keep someone alive and functioning even with such horrific 50% injuries.)

Now consider a possible world where someone (say, me) is bisected vertically and each half is attached to sophisticated life-support. "Lefty" regains consciousness in one room, while "Righty" regains consciousness in another. Just as head-trauma victims today can be rehabilitated even with the loss of a lot of brain tissue, let us suppose Lefty and Righty both are rehabilitated. They both remember my earlier life, they both have my personality, they both care about the people I cared about, and so

on. Where have I gone in this example? Have I disappeared? Well, that does not seem right: if I could survive losing my right half, then I could have survived in no worse shape than Lefty is right now. Am I Lefty? That seems plausible until we remember that we could just as well identify me with Righty. Am I both Lefty, and also Righty? Well, Lefty is distinct from Righty, so if I am identical with Lefty I had better be distinct from Righty, it seems. Am I Lefty and Righty put together? Maybe, but then in that world I would be a very odd thing, with two sets of memories and experiences, and no unified sense of self. (See Parfit 1971 for a classic discussion.)

This example mixes issues of modal properties with issues about identity over time (since we would also be puzzled about what to say if such a fission case happened in the actual world). But we can construct purely modal cases too. (See Chisholm 1967 and Chandler 1976 for examples). The interesting thing about these same-kind cases is that a lot of the options in the cross-time cases look less appealing. A multiple occupancy view, where there are two people where I am right now (the one that would be Lefty and the one that would be Righty), seems more odd than the multiple occupancy view about statues and clay. Dominant kind views like Burke 1994 do not help us. *De re* inconstancy might do better: perhaps both Lefty and Righty are my counterparts, or perhaps I am identical to each of them even though they are distinct from each other in the operation world.

Cases like Lefty/Righty also raise issues about whether there can be differences in *de re* possibility without differences in the qualitative description of possible worlds. Is there a possible world, just like the one described, where I am identical only to Lefty after the operation, for example? Imagine, for example, the situation where you wake up from an accident and find yourself only with the left side of your original body, and then you are told that such a bisection has been carried out and someone very like you, nicknamed “Righty”, is in the next room with the right side of your pre-accident body. Is that a possible situation?

There are other ways of asking questions about possible worlds that are the same qualitatively but differ in what objects exist in them. Could there be a world just like this, except that one of the actual electrons is replaced by a merely possible electron that does the same thing as the replaced electron does? Consider a world with two

qualitatively identical iron spheres and nothing else. Can there be a world with just the first sphere? If so, would it be any different from the world with just the second sphere?

Views where possible worlds can differ in the identity of the objects in them without there being any other differences are called *haecceitistic* views, and views that say there is no difference in identities of objects without some difference in qualitative arrangements are called *anti-haecceitistic*. (The terminology goes back to the medieval philosopher Duns Scotus.) The debate between these two camps points up a deep divide in how to think about the relation between possibilities for objects and possibilities for arrangements of qualitative features.

How Do We Discover Modal Truths?

A final topic to discuss is the question of how we discover what is necessary and what is possible. When we are dealing with restricted necessities and possibilities, an important part of the story will be a story about how we discover facts about the constraints in play. When I want to know what is financially possible for me, for example, I should look at my bank balance and credit card statements, talk to the bank about what loans they are prepared to make, and so on. A different sort of question arises when we consider unrestricted alethic modality: how can we find out what is possible at all, or what is necessary in the strongest sense?

Some of the answers will be piecemeal. When I want to know whether a formula is a logical necessity, for example, one thing I can try to do is *prove* it from axioms. Likewise for mathematical formula, of course - the first step in telling whether a mathematical formula is necessary is often looking for a proof or disproof of it. But these epistemic stories are only partial. What about the axioms in logic or mathematics, for example? Or other necessary truths, like the truth that all bachelors are unmarried, or that nothing is both a sphere and a cube at the same time?

The logical positivists thought that all of these necessary truths were analytic: knowing the meanings of expressions put you in a position to tell that they were true. According to this line of thinking, the axioms of logic and mathematics were all

analytic, and establishing whether a truth was necessary was something that could be done *a priori*.

It may well be that some necessary truths are analytic, such as well-worn examples like "all bachelors are unmarried". But Kripke 1980 and Putnam 197 3 have argued that not all of them are, and that a significant range of necessary truths are *a posteriori*. Kripke, for example, argued that when objects were identical, they were necessarily identical. Furthermore, he argued that proper names were *rigid designators*, always picking out the same object in each possible world. But then it would follow that true identity statements using only proper names would be necessary: "Bob Dylan is Robert Zimmerman", for example. But many such identity statements are only discoverable *a posteriori*: if the Sheriff of Nottingham wants to know whether Robin of Locksley is identical to Robin Hood, he has to investigate, and cannot tell *a priori*.

Kripke and Putnam wanted to extend this idea to so-called natural kind terms as well. "Water" and "H_2O", according to them, refer to the same natural kind, and do so rigidly. So an identity statement like "Water is H_2O" would then be necessary. But of course it required considerable chemical investigation to reveal that water is H_2O: that claim is definitely not *a priori*.

The epistemology of modality continues to excite a lot of controversy. Some philosophers continue to maintain that conceivability has an important role in determining whether something is possible, though with caveats to handle Kripkean cases. (See Gendler and Hawthorne 2002 for many examples.) Other philosophers think that many necessary truths reflect truths about the essences of things, truths that can often only be discovered through investigation of the world. One common approach to justifying theories of modality and possible worlds is to point to their usefulness in an overall theory. David Lewis offers a justification of this sort for his theory of possible worlds (Lewis 1986 pp 3-5). This style of argument has parallels with the use of so-called "indispensability arguments" for the existence of mathematical objects, and "inference to the best explanation" for theoretical posits more generally. (See Colyvan 2001 for a general discussion of indispensability

arguments in mathematics, and Lipton 2004 for a general discussion of inference to the best explanation.)

The epistemology of modality is not done in a vacuum: it has close connections to more general questions about the epistemology of metaphysics, the epistemology of mathematics and logic, and even the epistemology of science insofar as science is supposed to deliver *a posteriori* necessary truths.

Further Reading

As well as works referred to above, there are a number of good recent introductions to the philosophy of modality. These include Girle 2003 and Melia 2005. Divers 2002 is perhaps the best systematic survey of issues in the metaphysics of possible worlds.

An important part of philosophy of modality in the twentieth century was concerned with understanding and applying modal logics. Two classic and very informative introductions to modal logic are Chellas 1980 and Hughes and Cresswell (1968 if you can find it is a better introduction, I think, otherwise 1996). Three excellent, and recent, presentations of modal logic are Beall and van Fraassen 2003, Girle 2000, and Priest 2001.

Loux 1979 is a collection of classic papers on modality and possible worlds. One of the best collections to start with when investigating statue/lump cases like the ones discussed above is Rea 1996.

Finally, no list of recommended further reading would not be complete without mention of two of the great classics of later-twentieth century philosophy, both of which have modality as a central theme: Saul Kripke's *Naming and Necessity* (Kripke 1980) and David Lewis's *On the Plurality of Worlds* (Lewis 1986).

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