DOUBLE CONDITIONALS

By ADAM MORTON

MANY if-sentences have two antecedents. Some have one antecedent nested in another, apparently of the form *if p then if q then r*. For example 'if James had come to the party then if Mary had been drunk there would have been trouble' or 'if the pound sinks any further then if interest rates do not rise then we will have serious inflation'. And others have two conjoined antecedents before a consequent, apparently of the form *if (p & q) then r*. For example 'if James had come to the party and Mary had been drunk there would have been trouble'.

I am concerned with a class of two-antecedent conditionals which are often expressed with the 'if p then if q then r' syntax, and sometimes with the 'if (p&q) then r' syntax. All the examples just given could, given suitable contexts, express conditionals of this class. In spoken English they are often expressed as 'if p and then if q then r', as in 'if James had come to the party and then if Mary had been drunk there would have been trouble'. I shall call them double conditionals, and write them *if p/q then r*. The *if* involved seems clearly to be of the family of counterfactual or subjunctive conditionals. (In fact, they are all of V. H. Dudman's third class of conditionals, those using the conditional form to ascribe a disposition or potentiality to an object or system of objects.) But — this is the central claim — if *if* is taken in accordance with the now-dominant analysis of conditionals, then double conditionals cannot be interpreted either as 'if p then (if q then r)' nor as 'if (p&q) then r'.

My orthodoxy about conditionals is the Lewis–Stalnaker possible worlds analysis as modified by Jonathan Bennett. That is, 'if p then q' is true in world w iff q is true in the nearest p-world to w. (A p-world is just a world in which p is true.) Bennett's point is that it is often not overall nearness or similarity of worlds that is needed, but nearness relative to the antecedent p. In his examples the relevant fact about the antecedent is the time it indicates, so that for example 'if there had been a nuclear war in 1980 then few would have survived' is true because the nearest worlds to actuality up to the end of 1980 which have nuclear wars continue with very few survivors, although in their later history they are very unlike actuality (for a decade, at any rate). The time indicated by the antecedent is only one relevant factor, though, so a more exact definition would therefore be: 'if p then q' is true iff q is true in all p-nearest p-worlds to w'.

Given just this machinery, we can see how double conditionals differ from various embedded conditionals. Taking *if* as just defined (and abbreviating 'p-nearest to actuality' as just 'p-nearest') three possibilities are:

(A) Embedded *if:* 'if p then (if q then r)' is true when the q-worlds q-nearest to the p-nearest p-worlds are r-worlds.
(B) Embedded *and:* 'if (p&q) then r' is true when the (p&q)-nearest (p&q)-worlds are r-worlds.
(C) Double *if:* 'if p/q then r' is true when the (p&q)-worlds q-nearest to the nearest p-worlds are r-worlds.

The difference between double *if* and embedded *if* lies in the weight given to the first antecedent, p. 'If p then (if q then r)' says: go to the nearest p-worlds and then find the nearest q-worlds to them and see if r holds. But 'if p/q then r' says: go to the nearest p-worlds and then find the nearest q-worlds which are still p-worlds and see if r holds. So in the double conditional the antecedent p still holds in the worlds in which q and r hold.

Here is a simple example in which the double conditional is true but the embedded conditions is false. I have bought a expensive and supposedly shockproof watch and I say, 'if I drop it then if it breaks I shall want my money back'. Taken as a double conditional this is surely true: in not-too-remote situations in which I have dropped the watch, if then the watch develops a fault I will be enraged and return it for a refund. But taken as an embedded conditional it can easily be false: in many of the nearest worlds in which I drop the watch it is unbroken so that the nearest worlds to them in which it is broken are worlds in which it is not dropped at all but run over by a train or melted in a crucible. And of course in those worlds I have no grounds for asking for my money back. So it is not true that if I drop the watch it will be the case that if it were to be broken I would want a refund.

This example also shows how unnatural the sense of 'if p then (if q then r)' is. People very rarely need to say things of this kind. A slight change in the example shows how the embedded conditional can be true when the double conditional is false. This time imagine that it is a very cheap and fragile watch, and I, standing on a concrete floor, say 'if I drop it then if it continues to work I will not be surprised'. This is true taken as an embedded conditional, since from the nearest worlds in which I drop it, the nearest worlds in which it continues to work are ones in which it was never dropped and I am thus not surprised. But taken as a double conditional it is false. For from the nearest worlds in which it is dropped the nearest worlds in which it has been dropped and continues to work are very remote and unexpected ones in which for example it lands in such a way that two kinds of impact cancel one another's effects, to my surprise. (Note the implicit use of Bennett's modification of the Lewis–Stalnaker condition: the worlds in which the watch is dropped and then lands gently are dropped-nearest but not overall very near to actuality. But they are the works-nearest worlds to the dropped-nearest worlds in which the watch is both dropped and continues to work. Note also how the idiom 'if I drop it and then if it continues to work then I

will not be surprised', leads one on to a series of points of time structuring Bennett's modification.)

This example can be developed to show how the double conditional can be true while embedded *and* is false. Suppose that the nearest worlds in which 'I drop the watch and it continues to work' is true are those in which I first put my coat on the floor so that the watch when dropped lands on the coat. Then 'if (I drop the watch and it continues to work) then I will be surprised' is false. But the double conditional 'if I drop the watch and it continues to work then I will be surprised' is true, since the nearest worlds in which I drop the watch are not ones in which I first put my coat on the floor. (And generally, the (p&q)-worlds q-nearest to the p-nearest p-worlds need not be the same as the (p&q)-nearest (p&q)-worlds.)

The example can also be developed to show how the double conditional can be true while another embedding, 'if p then (q ⊃ r)', is false. For there might be a very far-out possibility in which the watch's dropping and breaking would lead to my surprise. Perhaps after I drop it a bat swoops down and gently rescues it before it hits the ground, but it breaks anyway. So then 'if I drop the watch then (it breaks ⊃ I am surprised)' is false. But the double conditional is still true, since the bat-swooping world is not the nearest to the dropping world in which the watch breaks.

Similar examples can show that 'if p/q then r' can be false while 'if (p&q) then r' is true, and while 'if p then (q ⊃ r)' is true.

All these examples should work without the semantical props. That is, it should be possible to dispense with talk of possible worlds and just by giving the examples to show that in English *if* can take a meaning making 'if p then if q then r' (and 'if p and q then r', and 'if p and then if q, then r') not an instance of 'if A then B'. In fact, if you take the props away some of the examples sway a bit. The reason is that *if* can take so many other meanings besides the Stalnaker–Lewis counterfactual and the double conditional. So one thing the props do is to substitute for the effect of a full linguistic context, which narrows the range of senses a conditional can have. (And this is potentially a test for a semantical theory. Can it synthesize the expressive power of the language's use of context? It is not at all obvious whether possible worlds semantics passes this test.)

So what? One reason for being interested in double conditionals comes from issues about laws of nature. Take it to be a fairly superficial law of nature that objects released near the surface of the earth accelerate downwards at 32 feet per second per second. The law is superficial because if the history of the earth had been slightly different then things wouldn't fall at that rate but at another. The earth could easily have been a little less massive — for example if more water had evaporated into space in the past few million years or if a tiny perturbation during the formation of the earth from a disk of matter surrounding the sun had resulted in

just a little less iron in the core. The objects released near its surface would accelerate downwards at a lesser rate. So the 32 feet per second law is just an amalgam of an accidental fact and a more fundamental law. Perhaps the more fundamental law is Newton's law. But that is at best an approximation to a more general truth expressed by the general theory of relativity. And that itself contains a gravitational constant whose value seems rather arbitrary. There are conjectures that its value may change with time or be determined during the early life of the universe by more fundamental factors. So we have laws beneath laws, potentially reaching down beyond our ability to make sense of them.

There are two connections with double conditionals here. One arises when we try to specify what things would be like if the laws of nature were different. For example, 'if falling things accelerated downwards at 35 ft per second per second then if there were flying machines they would need more powerful engines'. Suppose this is true. To suppose this is clearly to suppose that it is a double rather than an embedded conditional. For it could be that in the nearest situations in which gravity is just that much stronger flying machines would never have been invented. In fact, the nearest worlds to those greater-gravity worlds in which there are flying machines may be worlds in which gravity is just as it is in our world, so that more powerful engines are *not* needed. yet taken as a double conditional the assertion is true, as long as in all greater-gravity worlds flying machines can only be had, without tinkering with the force of gravity, by using more powerful engines. The conclusion is that if we wish to talk about more and less fundamental laws of nature we will need to pay attention to the kinds of conditional we use.

The other connection with double conditionals lies in the failure of an attractive idea. If we want to define 'law of nature' it is tempting to identify a law with the set of conditionals that, given the contingent facts in different worlds, it entails. Then, to make a law a proposition like any other it would have to be the case that the set of possible worlds in which a law holds is identical to the set of worlds in which a set of embedded *if*s hold, those of the form 'if F then if q then r' where F is the fact about a particular world that 'triggers' the conditional 'if q then r'. (E.g. F might be 'The earth has mass m' and 'if p then q' might be 'if *o* is dropped it will accelerate downwards at 32 ft/sec/sec'.) For a very superficial law like the 32 ft/sec/sec law the F will be redundant, and for a very profound law the r will itself be a conditional. The interesting point is that this idea does not work.

It does not work because a conditional can fail to be true in a world although the world is subject to the relevant law. And the reason for this is the same as the reason that the double conditional is not the same as an embedded conditional. Thus it is a law of our world that objects dropped near the surface of the earth

accelerate towards the earth at 32 feet per second per second, but some conditionals of the form 'if *o* were dropped it would fall at 32 ft/sec/sec' are false because the nearest world in which *o* is dropped is one in which the earth has a different gravity. (And, similarly, a law can apply to a world even though the corresponding conditionals are false in it.) So a law is not a proposition true in all worlds in which a set of conditionals is true.

That is a purely negative result, though an interesting one. (Perhaps it is one of the reasons that David Lewis, when giving an account of laws in terms of possible worlds, takes a completely different line.) But there may be a positive result lurking here. The counterexamples show that the conditionals 'if p then q' that it is natural to associate with a law of nature L are not all true, taken as isolated subjunctive conditionals. But the associated double conditionals 'if L/p then q' *are* true. This suggests a criterion of lawfulness: a law of nature is a proposition L associated with a set of conditionals S, such that the set of worlds in which all of the double conditionals 'if L/p then q' are true (for all 'if p then q' in S) meets two conditions. (i) It includes the actual world and (ii) it is identical to the set of worlds in which L is true.

Standard examples of laws of nature apparently pass this test, and traditional examples of accidental generalizations, such as 'all the coins in my pocket are copper', apparently do not. So we have an interesting open question: are there plausible examples of laws or non-laws which, given reasonable intuitions about the structure of possible worlds, provide counterexamples to this conjecture?[1]

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[1] This paper is an expansion of a fragment from a much larger draft by Fabrizio Mondadori and me. I am grateful for Mondadori's advice (and some of the ideas are his). The Editor of *Analysis* found, again, a serious mistake in an earlier draft. For the orthodoxy about counterfactional conditionals see David Lewis, *Counterfactuals* (Oxford: Blackwell, 1977), and Jonathan Bennett's 'Counterfactuals and Possible Worlds', *Canadian Journal of Philosophy* 5 (1974) 381–402. For Lewis' treatment of laws of nature see *Counterfactuals* and also his *On the Plurality of Worlds* (Oxford: Oxford University Press, 1987). Among the many papers in *Analysis* on conditionals the following are particularly relevant: Michael Clarke 'Ifs and Hooks' *Analysis* 34 (1973) 72–83; J. S. Edwards 'A confusion about "if ... then"' *Analysis* 34 (1973) 84–90; A. J. Dale, 'A defence of material implication', *Analysis* 34 (1973) 91–5; and V. H. Dudman, 'Parsing "if" sentences', *Analysis* 47 (1987) 193–9. Dale argues that 'if p then (if q then r)' is equivalent to 'if (p and q) then r'. Since the 'shockproof watch' example above is a counterexample to this, it might be reasonable to suppose that Dale's claim holds for at most Dudman's first category of conditionals.

Some related points about embedded conditionals are found in Adam Morton 'Would cause', *Proc. Aristotelian Soc.* 81 (1980/1) 139–51. A more complete working out of the suggestion about laws of nature made at the end of the paper would have to incorporate the related points made in Adam Morton 'If I were a dry well-made match', *Dialogue* 12 (1973) 322–4, and Peter van Inwagen 'Laws and Counterfactuals', *Noûs* 13 (1979) 439–453.