Indicative Conditionals as Strict Conditionals

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Abstract

This paper is intended to show that, at least in a considerably wide class of cases, indicative conditionals are adequately formalized as strict conditionals. The first part of the paper outlines three arguments that support the strict conditional view, that is, three reasons for thinking that an indicative conditional is true just in case it is impossible that its antecedent is true and its consequent is false. The second part of the paper develops the strict conditional view and defends it from some foreseeable objections.

Keywords: Indicative conditional, Strict conditional, Material conditional, Negation.

1. Preliminary Clarifications

Let us assume that > stands for 'if then' as used in indicative sentences, and that 1 and 0 designate truth and falsity. According to the strict conditional view, the truth conditions of $p > q$ are defined relative to a possible world w as follows:

Definition 1: $[p > q] = 1$ in w if and only if, for every w', either $[p] = 0$ in w' or $[q] = 1$ in w'.

As is natural to expect, the set of possible worlds over which 'every' ranges may vary from context to context, just as in any other quantified sentence. To say that $p > q$ is true simpliciter is to say that $p > q$ is true in the actual world.

As the initial assumption about > implies, this paper focuses on indicative conditionals. From now on we will take for granted that 'conditional' abbreviates 'indicative conditional'. This is not to suggest that the case of counterfactuals is essentially different. On the contrary, most of what will be said about conditionals can be extended, *mutatis mutandis*, to counterfactuals. But for the sake of simplicity we will not deal with such extension.[1]

Moreover, the symbol > is not intended to characterize a semantically homogeneous class of sentences. Conditionals may be used in more than one way,

[1] Iacona 2015 deals with counterfactuals.

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and it is reasonable to expect that different criteria of assessment are appropriate in different cases. In particular, we will take for granted that, although in some cases it is plausible to read $p > q$ as $p \supset q$, that is, as a material conditional, in other cases it is not. From now on, the label 'nonmaterial' will be used generically for any conditional that at least prima facie is not tractable as a material conditional. The literature on conditionals mostly focuses on nonmaterial conditionals, and we will do the same.

The next three sections outline three arguments that support the strict conditional view. The three arguments hinge on three observations that will be called 'facts'. This is not to say that they are truths written in stone. Perhaps there are no such truths. Or at least, the history of the debate on conditionals shows that everything—or almost everything—can be questioned. So, none of the three arguments is intended to provide a conclusive reason to accept definition 1. Still, each of them deserves attention.

2. First Argument

The first argument hinges on the following observation:

Fact 1: It seems that in some cases one can assert $p \wedge q$ but deny $p > q$.

Although in many cases $p \wedge q$ and $p > q$ are both assertable, it seems that nothing in principle prevents us from thinking that one can accept $p \wedge q$ but reject $p > q$. On the assumption that the rejection of $p > q$ justifies the acceptance of $\sim (p > q)$, this is to say that there are cases in which $p \wedge q$ and $\sim (p > q)$ are both assertable. Suppose that a coin is to be tossed twice and I bet that it will come up heads both times. Consider the following sentence, uttered just after the bet and before the first toss:

(1) If at least one head will come up, I will win.

In this case it seems correct to deny (1), and the appearance of correctness of this denial does not vanish if the coin comes up heads both times. Yet in that case it would be correct to say that the antecedent and the consequent of (1) were both true.[2]

Fact 1 raises a controversial issue. Some theorists of conditionals think that $\sim (p > q)$ is inconsistent with $p \wedge q$ because they believe in *conjunction conditionalization*, that is, they believe what follows:

(CC) $p \wedge q$ entails $p > q$.

For example, Edgington says:

> Establishing that the antecedent and consequent are true is surely one incontrovertible way of verifying a conditional.[3]

Clearly, if $p \wedge q$ entails $p > q$, then $p \wedge q$ and $\sim (p > q)$ form an inconsistent set. However, CC cannot be invoked to dismiss fact 1 unless it is independently justified. Presumably, if one takes fact 1 at face value, it is because one thinks that the assertability of $p > q$ requires that a certain relation obtains between p and q.

[2] The example is adapted from McDermott 2007.

[3] Edgington 1986: 24.

But if one thinks so, then one may coherently deny CC, because p and q may be assertable even if that relation does not obtain.

One way to see that CC is dubious is to think that CC entails *conjunction biconditionalization*, that is:

(CB) $p \wedge q$ entails $(p > q) \wedge (q > p)$.

CB can be derived from CC by using the standard rules of *conjunction introduction* (CI) and *conjunction elimination* (CE):

1 [1] $p \wedge q$	A
1 [2] $p > q$	CC1
1 [3] q	CE1
1 [4] p	CE1
1 [5] $q \wedge p$	CI 3,4
1 [6] $q > p$	CC 5
1 [7] $(p > q) \wedge (q > p)$	CI 2,6

But it is easy to see that CB has implausible instances. For example, the following sentence seems to differ from (1) because it is clearly true:

(2) If I will win, then at least one head will come up.

However, according to CB there is no difference between (1) and (2), because (1) and (2) are both true, assuming that their constituents are true. Here is another example. I always use my bicycle to move around, and I cycle to work whenever I can. When it is a beautiful sunny day, of course, riding my bicycle is especially enjoyable. But also when it is cold, cloudy, or raining, I still prefer cycling than walking. I refrain from cycling only in case of ice or snow storm. Now suppose that I am in my office, and that two colleagues of mine, who have not looked out of the window since their arrival, utter the following conditionals:

(3) If it is a beautiful sunny day, then he came by bicycle

(4) If he came by bicycle, then it is a beautiful sunny day

In this situation it seems that one of them is right and the other is wrong. However, if it is actually a beautiful sunny day and I came by bicycle, CB entails that (3) and (4) are both true.[4]

The first argument rests on the assumption that fact 1 is a datum that deserves an explanation, so it is an argument for those who do not have a strong faith in CC. On this assumption, it turns out that the strict conditional view is more credible than other theories of conditionals, because it provides a better account of fact 1.

The strict conditional view explains fact 1 as follows: in some cases it seems that one can assert $p \wedge q$ but deny $p > q$ because in those cases the former is true but the latter is false. If $[p] = 1$ in w and $[q] = 1$ in w but there is a w' such that $[p] = 1$ in w' and $[q] = 0$ in w', $[p \wedge q] = 1$ in w but $[p > q] = 0$ in w. For example, in the case of the coin one can say that (1) is false, because there are possible worlds in which at least one head comes up and I do not win.

Now we will examine four well known alternatives to the strict conditional view, in order to show that none of them can explain fact 1. The first is the truth-functional view, the view that we find in every logic textbook:

Definition 2: $[p > q] = 1$ if and only if either $[p] = 0$ or $[q] = 1$.

[4] Butcher 1983: 89-90, takes the fact that CC entails CB as a reason against CC.

As long as assertability conditions are understood as truth conditions, the truth-functional view is patently inadequate to explain fact 1. Since definition 2 entails that $[p > q] = 0$ if and only if $[p] = 1$ and $[q] = 0$, it turns out that one cannot assert $p \wedge q$ but deny $p > q$.

Of course, it is not essential to the truth-functional view that assertability conditions are understood as truth conditions. If one draws a distinction between truth and assertability, one can maintain definition 2 and claim that fact 1 is to be explained in terms of assertability rather than in terms of truth. But then the question to be addressed concerns the account of the assertability conditions of $p > q$ rather than the truth-functional view itself.[5]

The second alternative is the probabilistic view, which is based on Adams's idea that the assertability of $p > q$ can be described in terms of conditional probability. If $P(p)$ is the probability of p and $P(q \mid p)$ is the probability of q given p, then $P(p > q) = P(q \mid p)$. So, $p > q$ has an epistemic value defined as follows:

Definition 3: $[p > q] = P(q \mid p)$.

Here it is assumed that $P(q \mid p) = P(p \wedge q)/P(p)$ for $P(p) > 0$. The values 1 and 0 correspond to the maximum and the minimum degree of belief. Although Adams does not provide a semantics for compound sentences with conditionals as parts, it is consistent with his idea to assume that definition 3 can be combined with the following principle:

(N) $[\sim (p > q)] = 1 - [p > q]$.

Definition 3 and (N) entail that $[\sim (p > q)] = 1 - P(q \mid p)$. Since $1 - P(q \mid p) = P(\sim q \mid p)$, given that $P(q \mid p) + P(\sim q \mid p) = 1$, it follows that $[\sim (p > q)] = [p > \sim q]$.[6]

The probabilistic view can be phrased in at least two ways. The simplest way—perhaps the closest to Adams's proposal—is to say that a sentence is assertable when its value is greater than the value of its negation, that is, when its probability is greater than 0.5. This version of the view squares ill with fact 1, as it entails that $p \wedge q$ and $\sim (p > q)$ cannot both be assertable. Suppose that (a) $[\sim (p > q)] > 0.5$ and (b) $[p \wedge q] > 0.5$. From (a) and (N) we get that $1 - [p > q] > 0.5$. By definition 3, this means that $1 - P(q \mid p) > 0.5$. Since $P(\sim q \mid p) = 1 - P(q \mid p)$, we get that $P(\sim q \mid p) > 0.5$. It follows that $P(q \mid p) \leq 0.5$. But $P(q \mid p) = P(p \wedge q)/P(p)$, so $P(p) = P(p \wedge q)/P(q \mid p)$. From this and (b) we get that $P(p) > 1$, which is absurd.

The second way to phrase the probabilistic view is slightly more sophisticated, in that it leaves room for contextual variation: $p > q$ is assertable in a context if and only if the conditional probability of q given p is greater than a number n fixed by the context, where $n > 0.5$. This second version of the view makes no significant advance as far as fact 1 is concerned. An inconsistency result can still be obtained by generalizing the reductio outlined above. Suppose that (a) $[\sim (p > q)] > n$ and (b) $[p \wedge q] > n$. From (a) and (N) we get that $1 - [p > q] > n$. By definition 3, this means that $1 - P(q \mid p) > n$. Since $P(\sim q \mid p) = 1 - P(q \mid p)$, we

[5] Lewis 1976, Jackson 1979, and others endorse definition 2 but claim that the assertability of $p > q$ can be measured in terms of probability. So the discussion of the second alternative applies also to such proposals.

[6] Adams 1965 outlines the view. Adams explicitly claims that $\sim (p > q)$ is equivalent to $p > \sim q$. In particular, Adams 1968: 271 presents a metalinguistic definition of $\sim (p > q)$ as an abbreviation of $p > \sim q$. Stalnaker 1970 also outlines a probabilistic semantics which combines definition 3 with (N).

get that $P(\sim q|p) > n$. It follows that $P(q|p) \leq n$. But $P(q|p) = P(p \wedge q)/P(p)$, so $P(p) = P(p \wedge q)/P(q|p)$. From this and (b) we get that $P(p) > 1$, which is absurd.[7]

The third alternative is the belief revision view, which has been elaborated by Gärdenfors and others. On this view, conditionals are defined as acceptable relative to belief states, understood as deductively closed sets of sentences. Let f be a belief revision function, that is, a function that, for a belief state K and a sentence p, gives us a revised belief state $f(K, p)$. The acceptability conditions of $p > q$ are given as follows:

Definition 4: $[p > q] = 1$ relative to K if and only if $q \in f(K, p)$.

Here 1 indicates acceptance, while 0 indicates non-acceptance or rejection: $[p > q] = 0$ relative to K if and only if it is not the case that $q \in (K, p)$. Since (N) holds, we get that $[\sim (p > q)] = 1$ relative to K if and only if $[p > q] = 0$ relative to K. To say that $[p > q] = 1$ relative to K is to say that there is a deductively closed set of sentences $s(K)$ which includes K and $p > q \in s(K)$. $s(K)$ is understood as a support set, that is, as a set whose acceptability is grounded on the adoption of K. The distinction between K and $s(K)$ matters only for conditionals, as it is assumed that membership in K means full belief while the acceptance of a conditional does not amount to full belief. For any p that does not contain >, if $p \in s(K)$ then $p \in K$. In this framework, a conditional can be defined as assertable for a speaker when it is acceptable relative to the speaker's belief state.[8]

The belief revision view does not explain fact 1. Given any two sentences p and q in which > does not occur, suppose that $[p \wedge q] = 1$ relative to K. Then (a) $p \in K$ and (b) $q \in K$. On any reasonable understanding of f, (a) entails that $f(K, p) = K$. From this and (b) we get that $q \in f(K, p)$, so by definition 4 $[p > q] = 1$ relative to K. This is to say that $p \wedge q$ is inconsistent with $\sim (p > q)$.

The fourth alternative is the possible worlds view advocated by Stalnaker. On this view, to ask whether $p > q$ is true is to ask whether q is true in a possible world that makes p is true—a p-world—and otherwise differs minimally from the actual world. More precisely, the truth conditions of $p > q$ relative to a possible world w are given in terms of a selection function f that assigns a possible world to the pair formed by p and w:

Definition 5: $[p > q] = 1$ in w if and only if $[q] = 1$ in $f(p, w)$.

Here $f(p, w)$ is understood as the most similar world to w in which p is true. From definition 5 we get that $p > q$ is true simpliciter if and only if it is true in the p-world that is most similar to the actual world.[9]

The possible worlds view does not explain fact 1. Stalnaker assumes that the p-world that is most similar to w is w itself, so that $f(p, w) = w$ when $[p] = 1$ in w. On this assumption, known as *strong centering*, definition 5 entails that if $[p] = 1$ in w, $p > q] = 1$ in w if and only if $[q] = 1$ in w. The selection function does substantive work only when the antecedent is false. Therefore, if $[p \wedge q] = 1$ in w, then $[p > q] = 1$ in w. This is to say that $p \wedge q$ is inconsistent with $\sim (p > q)$.

The foregoing considerations show that, as far as the explanation of fact 1 is concerned, definition 1 is definitely better than definitions 2-5. This is not to

[7] I owe this argument to Vincenzo Crupi.
[8] An account along these lines was initially suggested in Gärdenfors 1978 and then developed in other works such as Gärdenfors 1988, Levi 1988, and Arlo-Costa 1955.
[9] This is the view defended in Stalnaker 1991. See also Davis 1979.

say that the strict conditional view is the only view that can explain fact 1. If one adopts a variant of the possible worlds view in which $f(p, w)$ is a class of p-worlds rather than a single p-world, and the condition imposed on f is that, if $[p] = 1$ in w, then $w \in f(p, w)$—the assumption known as *weak centering*—one does not get that $p \wedge q$ is inconsistent with $\sim (p > q)$. But the point remains that the strict conditional view has a clear advantage over the four theories of conditionals considered.[10]

3. Second Argument

The second argument hinges on the following observation:

Fact 2: It seems that in some cases one can assert $\sim (p > q)$ but not $p > \sim q$.

To assert $\sim (p > q)$ is to deny that a certain relation holds between p and q. But this is not quite the same thing as to affirm that that relation holds between p and $\sim q$. So it seems that, although in many cases $\sim (p > q)$ and $p > \sim q$ are both assertable, $\sim (p > q)$ does not entail $p > \sim q$. Imagine that a detective and his assistant investigate a murder in a mansion. The three suspects are the butler, the driver, and the gardener. The butler belongs to the house staff, while the driver and the gardener belong to the grounds staff. Once some clues are collected, it turns out that the butler has an airtight alibi. Then the assistant utters the following sentence:

(5) If a member of the grounds staff did it, then it was the driver.

In this case it is reasonable for the detective to deny (5). But his denial of (5) does not imply that if a member of the grounds staff did it, then it was the gardener. Just as there is no reason to assert (5), there is no reason to assert such conditional.[11]

Fact 2 raises another controversial issue. Some theorists of conditionals hold that $\sim (p > q)$ entails $p > \sim q$ simply because they believe that $\sim (p > q)$ *means* $p > \sim q$. For example, Adams is quite explicit on this point:

> the ordinary meaning of the denial 'It is not the case that if p then q' is just to assert 'if p then not q'.[12]

However, fact 2 can hardly be dismissed by appealing to the meaning of >, given that the whole debate on conditionals stems precisely from the fact that it is not obvious what > means. Presumably, if one takes fact 2 at face value, it is because one thinks that the assertability of a conditional requires that a certain relation obtains between its antecedent and its consequent, so that $p > q$ and $p > \sim q$ can both be denied. This divergence has direct implications on the relation between *excluded middle* (EM) and *conditional excluded middle* (CEM). If one assumes that $\sim (p > q)$ entails $p > \sim q$, one will expect that $(p > q) \vee \sim (p > q)$ entails $(p > q) \vee$

[10] This variant of the possible worlds view is in line with the account of counterfactuals sketched in Lewis 1973: 26-31, although that account is not intended to apply to conditionals. Nolan 2003 defends a version of the possible worlds view that seems to go in this direction, as it takes fact 1 into account.
[11] This example is drawn from Gillies 2004: 589.
[12] Adams 1965: 181.

$(p > \sim q)$. Instead, if one does not make that assumption, one will regard CEM as more dubious than EM.

Fact 1 and fact 2 are related. There is a straightforward argument to the effect that, if $p \wedge q$ is consistent with $\sim (p > q)$, then $\sim (p > q)$ does not entail $p > \sim q$. Let us call * the assumption that $\sim (p > q)$ entails $p > \sim q$. If * holds, then one can derive $\sim\sim (p > q)$ from $p \wedge q$ by CE, *modus ponens* (MP) and *reductio ad absurdum* (RAA):

1	[1] $p \wedge q$	A
1	[2] p	CE1
1	[3] q	CE1
3	[4] $\sim (p > q)$	A
3	[5] $p > \sim q$	*4
1,3	[6] $\sim q$	MP 5,2
1	[7] $\sim\sim (p > q)$	RAA 4,3,6

So it turns out that $p \wedge q$ is inconsistent with $\sim (p > q)$ because it entails $\sim\sim (p > q)$. The converse conditional, instead, is harder to justify: it is not obvious that, if $\sim (p > q)$ does not entail $p > \sim q$, then $p \wedge q$ is consistent with $\sim (p > q)$. From the premise that $p \wedge q$ is inconsistent with $\sim (p > q)$ one cannot draw the conclusion that $\sim (p > q)$ entails $p > \sim q$. Certainly, that conclusion can be obtained by means of *conditional proof* (CP):

1	[1] $\sim (p > q)$	A
2	[2] p	A
3	[3] q	A
3	[4] $p > q$	CP 2,3
1	[5] $\sim q$	RAA 3,4,1
1	[6] $p > \sim q$	CP 2,5

But not all theories of conditionals validate CP, so here it cannot be taken for granted that CP holds for >. Therefore, facts 1 and 2 deserve separate consideration: while there is a direct route from fact 1 to fact 2, there is no such route from fact 2 to fact 1.

On the assumption that fact 2 is a datum that deserves an explanation, it turns out that the strict conditional view is more credible than other theories of conditionals. The strict conditional view explains fact 2 as follows: in some cases it seems that one can assert $\sim (p > q)$ but not $p > \sim q$ because in those cases the former is true but the latter is false. It may happen that $[\sim (p > q)] = 1$ in w, in that there is a w' such that $[p] = 1$ in w' and $[q] = 0$ in w', but that $[p > \sim q] = 0$ in w, in that there is a w'' such that $[p] = 1$ in w'' and $[q] = 1$ in w''. For example, in the case of the detective one can say that (5) is false, because there are possible worlds in which its antecedent is true and its consequent is false, but that the same goes for the conditional obtained from (5) by adding 'not' in the consequent.

The truth-functional view, instead, does not explain fact 2. According to definition 2, if $[\sim (p > q)] = 1$, then $[p] = 1$ and $[\sim q] = 1$, so $[p > \sim q] = 1$. This means that, as long as assertability conditions are understood as truth conditions, $p > \sim q$ is assertable whenever $\sim (p > q)$ is assertable. Of course, one may distinguish assertability from truth and claim that fact 2 is to be explained in terms of assertability. But again, the explanatory problem then moves from the truth-functional view to the favoured account of assertability.

The probabilistic view is also unable to explain fact 2. As it turns out from section 2, on this view $[\sim (p > q)] = [p > \sim q]$. Therefore, $\sim (p > q)$ entails $p > \sim q$. This holds no matter which of the two versions of the view one choses.

Similar considerations hold for the possible worlds view. Suppose that $[\sim (p > q)] = 1$ in w. Then $[p > q] = 0$ in w, which means that $[q] = 0$ in $f(p, w)$. It follows that $[\sim q] = 1$ in $f(p, w)$, so that $[p > \sim q] = 1$ in w. This is to say that $\sim (p > q)$ entails $p > \sim q$, contrary to fact 2.

The belief revision view does not have this problem. The assumption that $[\sim (p > q)] = 1$ relative to a belief state K does not entail that $[p > \sim q] = 1$ relative to K. Since belief sets are not required to be maximal, it may be the case that neither q nor $\sim q$ belong to $f(K, p)$. By definition 4, this means that $[p > q] = 0$ and $[p > \sim q] = 0$ relative to K. So it may be the case that $\sim (p > q)$ is assertable while $p > \sim q$ is not.

Thus, the strict conditional view is not the only view that can explain fact 2. Nonetheless, as far as fact 2 is concerned, definition 1 is better than definitions 2, 3, and 5. Therefore, insofar as one thinks that fact 2 deserves an explanation, and is unwilling to take for granted that EM and CEM are equivalent, one will find that the strict conditional view has some virtue.

4. Third Argument

The third argument hinges on the following observation:

Fact 3: In some cases, $\sim (p > q)$ is paraphrased as 'It is possible that p but not q'.

This is simply a fact about ordinary language. The negation of a conditional is often expressed by using modal vocabulary. For example, the detective could easily reply to his assistant "No, it might be the gardener". Another example is the following. A philosophy teacher gives a lecture on theological matters and mentions benevolence among the properties traditionally ascribed to God. One of the students is puzzled by the very concept of divine benevolence, and utters the following sentence:

(6) If God exists, then the prayers of evil men will be answered.

In this case it is natural for the teacher to deny (6), and explain that the hypothesis that God exists does not entail that the prayers of evil men will be answered. In other words, the existence of God is consistent with the possibility that the prayers of evil men will not be answered.[13]

The issue that arises in connection with fact 3 is how can we make sense of the use of modal expressions in cases such as those just described. As is well known, modal expressions can be construed in more than one way. So it would be patently unreasonable to require that the word 'possible' in the modal paraphrase of $\sim (p > q)$ is read literally. What will be assumed here is rather that an account of conditionals explains fact 3 as long as it explains the apparent correctness of the modal paraphrase of $\sim (p > q)$ in terms of the notions it employs. As we shall see, this leaves room for a meaningful distinction between explaining and not explaining fact 3.

The strict conditional view provides the most obvious explanation of fact 3: $\sim (p > q)$ may be paraphrased as 'It is possible that p but not q' because it means

[13] This example is adapted from Stevenson 1970: 28.

precisely that it is possible that p but not q. So it makes perfect sense for the philosophy teacher to deny (6) by affirming the possibility that its antecedent is true and its consequent is false.

The truth-functional view, instead, does not explain fact 3. Definition 2 entails that it is wrong to paraphrase $\sim (p > q)$ as 'It is possible that p but not q', for it makes $\sim (p > q)$ equivalent to $p \wedge \sim q$. The implausibility of this equivalence is hardly deniable. For example, the philosophy teacher does not want to say that God actually exists.[14]

The first version of the probability view is also unable to explain fact 3. If assertability is defined in the first of the two ways suggested in section 2, then it is wrong to paraphrase $\sim (p > q)$ as 'It is possible that p but not q'. Certainly, if $\sim (p > q)$ is assertable, because $[p > q] \leq 0.5$, then it is possible that p and not q. But even if $\sim (p > q)$ is not assertable, because $[p > q] > 0.5$, it is still possible that p and not q. Since 'It is possible that p and not q' is consistent both with $\sim (p > q)$ and with $p > q$, it cannot be equivalent to the former. The point is that a conditional is often denied in virtue of the mere possibility—no matter how probable—that its consequent does not hold on the supposition that its antecedent holds. Even if it were highly probable that the driver is the murderer, the detective could still deny (5) in virtue of the possibility that the gardener is the murderer. Similarly, when the philosophy teacher corrects the student, she clearly does not intend to say that, on the supposition that God exists, is unlikely that the prayers of evil men will be answered.

The second version of the probability view improves the first in that it explains why $p > q$ may be rejected even if $P(\mathrm{q} \mid \mathrm{p}) > 0.5$. The case in which the detective rejects (5) although it is highly probable that the driver is the murderer can be described as one in which the value of (5) is still below the threshold fixed by the context: if $P(\mathrm{q} \mid \mathrm{p}) = 0.8$ but $n = 0.9$, $p > q$ is not assertable. More drastically, the case in which the philosophy teacher rejects (6) can be described as one in which the threshold fixed by the context is 1, so no lower value will do. On the other hand, this is only half of the story. We have seen that the cases in which $p > q$ can be denied are plausibly described as cases in which $\sim (p > q)$ can be asserted, and this is not what we get. Insofar as (N) holds, the second version implies that the non-assertability of $p > q$ does not amount to the assertability of $\sim (p > q)$. For example, if $n = 0.9$ and $P(\mathrm{q} \mid \mathrm{p}) = 0.8$, $p > q$ is not assertable, but the same goes for $\sim (p > q)$, given that it gets 0.2.

The belief revision view is no better. Even assuming that possibilities are understood as belief states, it is hard to see how definition 4 can account for the modal paraphrase of $\sim (p > q)$, given that the evaluation of $p > q$ depends on what happens in a single belief state, $f(\mathrm{K}, p)$, so the same goes for $\sim (p > q)$. In other words, 'It is possible that p but not q' cannot be read as 'There is a belief state in which p and not q', for the view implies that $\sim (p > q)$ is assertable when the unique belief state obtained from the revision of our original state is such that p and not q.

A similar problem affects the possible worlds view. As long as it is assumed that the evaluation of $p > q$ in w depends on whether q is true in a single possible world, $f(p, w)$, what is said by uttering $\sim (p > q)$ in w is that q is false in that

[14] Stevenson 1970 uses this example to show that the truth-functional view is unable to handle negated conditionals.

world. Therefore, $\sim (p > q)$ is not correctly paraphrased as 'It is possible that p but not q', for the latter sentence means that there is at least one possible world in which p and not q.

Again, this is not to say that the strict conditional view is the only view that can explain fact 3. The problem that affects the possible worlds view disappears if one adopts the variant considered in section 2, because in that case $p > q$ turns out to be false when q is false in at least one of the worlds that belong to $f(p, w)$. Nonetheless, as far as fact 3 is concerned, definition 1 is better than definitions 2-5. So the strict conditional view has an advantage over the four theories of conditionals considered.

5. Invalid Argument Forms

The arguments outlined in sections 2-4 provide some reasons for thinking that a conditional is true just in case it is impossible that its antecedent is true and its consequent is false. Although these arguments are not conclusive, given that facts 1-3 might be questioned, they suggest that there may be something right in the strict conditional view. The rest of the paper discusses two foreseeable objections to the strict conditional view, in order to show that they are not compelling.

The first objection, which goes back to Adams, concerns the examples of apparently invalid inferences that are typically used to show that nonmaterial conditionals are nonmaterial. In his paper *The Logic of Conditionals*, Adams offers nine arguments as initial evidence against the truth-functional view:

A1

(7) John will arrive at 10

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(8) If John does not arrive at 10, he will arrive at 11

A2

(7) John will arrive at 10

---

(9) If John misses his plane in New York, he will arrive at 10

A3

(10) If Brown wins the election, Smith will retire

---

(11) If Smith dies before the election and Brown wins it, Smith will retire

A4

(10) If Brown wins the election, Smith will retire
(12) If Smith dies before the election, Brown will win it

---

(13) If Smith dies before the election, he will retire

A5

(10) If Brown wins the election, Smith will retire
(14) If Brown wins the election, Smith will not retire

---

(15) Brown will not win

A6

(16) Either Dr. A or Dr. B will attend the patient
(17) Dr. B will not attend the patient

---

(18) If Dr. A does not attend the patient, Dr. B will

A7

(19) It is not the case that if John passes history, he will graduate

---

(20) John will pass history

A8

(21) If you throw switches S and T, it will start

(22) Either if you throw switch S it will start or if you throw switch T it will start

A9

(23) If John will graduate only if he passes history, then he won't graduate

(24) If John passes history, he won't graduate

Adams's point is that A1-A9 are apparently invalid. Since the truth-functional view entails that A1-A9 instantiate valid argument forms, he takes this to show that the truth-functional view is seriously limited. A further claim he makes, which concerns us here, is that A1-A9 speak against the strict conditional view as well. When he comments on A4, which instantiates the principle of hypothetical syllogism, he says:

> A closely related principle is taken as a postulate in C.I. Lewis' theory of strict implication. It is unlikely, therefore, that fallacies of the kind given here can be entirely avoided by going over to formal analysis in terms of strict implication or related systems.[15]

Here Adams seems to claim that if A4 were formalized in accordance with the strict conditional view, it would be described as an instance of a valid argument form, that is:

F4

$\Box(p \supset q)$

$\Box(r \supset p)$

$\Box(r \supset q)$

So the problem of explaining its apparent invalidity would still be there. Similar considerations might be applied to some of the other examples provided by Adams. In particular, it might be contended that, if A3 and A5 were formalized in accordance with the strict conditional view, they would be described as instances of valid argument forms:

F3

$\Box(p \supset q)$

$\Box((p \wedge r) \supset q)$

F5

$\Box(p \supset q)$

$\Box(p \supset \sim q)$

$\sim p$

More generally, the objection may be phrased as follows: some arguments involving nonmaterial conditionals are apparently invalid, but according to the strict conditional view they instantiate valid argument forms; so there is something wrong with the strict conditional view.

The flaw of this objection lies in the assumption that A3-A5 instantiate valid argument forms according to the strict conditional view. Definition 1 does not

[15] Adams 1965: 168-69.

fix a unique method of formalization, that is, it does not determine a unique way to assign formulas of a modal language to conditionals. So it is not obvious that A3-A5 are to be formalized in the way suggested by Adams. In particular, as we shall see, it is consistent with the strict conditional view to claim that A3-A5 instantiate invalid argument forms that differ from F3-F5.

Let us start from the very notion of adequate formalization. One way to understand adequate formalization, which is consistent with the strict conditional view, is to assume that a formula adequately formalizes a sentence if and only if it provides a logically perspicuous representation of what is said by uttering the sentence. Since an adequate formalization of a sentence shows its logical form, this is to assume that sentences have logical form in virtue of the content they express. So the implied notion of logical form significantly differs from a syntactically oriented notion such as that adopted, among others, by Lycan, Gillies, and Kratzer. Even though a syntactically oriented notion of logical form is perfectly respectable in that it suits certain theoretical purposes, its suitability for those purposes does not prevent other notions of logical form from being equally respectable for other reasons. All that is needed here is that there is at least one coherent notion of logical form according to which logical form depends on what is said.[16]

On this understanding of adequate formalization, there are essentially two ways to formalize conditionals in accordance with definition 1, depending on how contextual restrictions on possibility are expressed at the level of logical form. One option is to incorporate such restrictions in the antecedent: $p > q$ as uttered in a context c may be represented as $\Box(p_c \supset q)$, where pc is a formula that differs from p in that it expresses a stricter condition fixed by c. That is, p_c may be read as ‘p and things are like in the actual world according to c’. The other option is to incorporate such restrictions in the necessity operator: $p > q$ as uttered in c may be represented as $\Box_c(p \supset q)$, where $\Box_c$ expresses quantification over a restricted set of worlds. That is, $\Box_c$ is to be read as ‘in every world that is similar to the actual world relative to c’. This second option is often associated with the idea that contexts are sets of worlds that vary as a function of the antecedent, so that any difference in the antecedent determines a difference in the intended context.[17]

No matter which of these two options one chooses, one can deny that A3-A5 instantiate F3-F5. Consider the first option. According to this option, the logical form of $p > q$ as uttered in c is $\Box(r \supset q)$, where r stands for ‘p and things are relevantly like in the actual world’ as understood in c. This entails that A3-A5 are adequately formalized as follows:

F3′

$$\frac{\Box(p \supset q)}{\Box(r \supset q)}$$

[16] Lycan 2001, Gillies 2009, Kratzer 2012. Iacona 2018 distinguishes a notion of logical form based on content from a syntactically oriented notion of logical form, and illustrates some significant implications of the distinction

[17] In the case of counterfactuals, the first option has been developed in different ways in in Åqvist 1973 and in Iacona 2015, while the second has been considered in various works, such as Lowe 1990. The idea that contexts vary as a function of the antecedent has been developed in Von Fintel 2001, Gillies 2007, Warmbrod 1981, and Lowe 1995.

F4′

$$\begin{array}{l} \Box(\mathrm{p} \supset q) \\ \Box(r \supset s) \\ \hline \Box(r \supset q) \end{array}$$

F5′

$$\begin{array}{l} \Box(p \supset q) \\ \Box(p \supset \sim q) \\ \hline \sim r \end{array}$$

A3 is adequately formalized as F3′, rather than as F3, because the real antecedent of (10) is 'Brown wins the elections and things are relevantly like in the actual world', so the real antecedent of (11) is not a conjunction that includes the real antecedent of (10) as a conjunct. The real antecedent of (11) is rather 'Smith dies before the election, Brown wins it, and things are relevantly like in the actual world'. Similar considerations hold for A4 and A5. On the assumption that the logical form of (10)-(15) is represented in the way suggested, it turns out that A4 and A5 are adequately formalized as F4′ and F5′ rather than as F4 and F5. Since F3′-F5′ are invalid argument forms, the apparent invalidity of A3-A5 causes no trouble.

Now consider the second option. According to this option, the logical form of $p > q$ as uttered in c is $\Box_c(p \supset q)$, where $\Box_c$ is to be read as 'in every world that is similar to the actual world relative to *c*'. Assuming that different antecedents require different contexts, A3 and A4 are adequately formalized as follows:

F3″

$$\begin{array}{l} \Box_c(p \supset q) \\ \hline \Box_{c'}((p \wedge r) \supset q) \end{array}$$

F4″

$$\begin{array}{l} \Box_c(p \supset q) \\ \Box_{c'}(r \supset p) \\ \hline \Box_{c'}(r \supset q) \end{array}$$

The case of A5 is slightly different. In this case the assumption that different antecedents require different context plays no role, because (10) and (14) have the same antecedent. Nonetheless, it is plausible to postulate a context shift to explain how (10) and (14) can both be true in spite of the fact that they have contradictory consequents. So A5 is adequately formalized as follows:

F5″

$$\begin{array}{l} \Box_c(p \supset q) \\ \Box_{c'}(p \supset \sim q) \\ \hline \sim p \end{array}$$

Since F3″-F5″ involve different operators, they are invalid argument forms. Or at least, this follows from the reasonable assumption that, in a modal language with multiple operators, the valid counterparts of F3-F5 require that the operator is fixed. Again, we get that the apparent invalidity of A3-A5 causes no trouble.

6. Material Conditionals

The second objection concerns material conditionals. As has been explained in section 1, there are cases in which conditionals are *prima facie* tractable as material conditionals, that is, cases in which it is plausible to read $p > q$ as $p \supset q$. Therefore, it might be contended that the strict conditional view is no better than the truth-functional view as far as explanatory power is concerned: each of the two views can account at most for a limited range of cases.

Against this objection it might be argued that the strict conditional view can handle material conditionals. Let us consider an example in which it is plausible to read $p > q$ as $p \supset q$. Suppose that you submit a paper to a journal that announced a special issue on your favourite topic. After six months, you write an email to the editor of the journal to ask about the status of your submission, and you receive the following reply:

(25) Your paper was considered, if submitted before the deadline.

In this case it seems that the assessment of (25) depends on the way things actually are. If one knows whether your paper was actually submitted before the deadline and whether it was actually considered, one is in a position to say whether the assertion made by the editor is true or false.

One way to see the difference between this case and the other cases considered so far is to realize that it would be wrong to explain the truth or falsity of (25) in terms of quantification over a set of worlds that includes non-actual worlds relevantly similar to the actual world. Suppose that the editor of the journal is very unreliable and normally ignores most submissions, but that your submission was considered for purely accidental reasons. On any reasonable understanding of the relevance condition, the set of relevantly similar worlds includes worlds in which the paper was submitted but not considered, so (25) would turn out false. Yet it is plausible to say that (25) is accidentally true.[18]

The strict conditional view leaves room for cases of this kind, because it does not require that the domain of quantification includes worlds other than the actual world. It is consistent with definition 1 to say that there are cases in which the only relevant w' is w itself. In other terms, the cases in which it is plausible to read $p > q$ as $p \supset q$ are cases in which 'Necessarily, if p and things are relevantly like in the actual world, then q' is understood as 'Necessarily, if p and things are exactly like in the actual world, then q'. So the case of (25) can be described as one in which the only relevant world is the actual world. More generally, material conditionals can be treated as a limiting case in which the relevant set of possible worlds contains the actual world as its only member.

Note that conditionals about the future often behave as material conditionals. Consider the following:

(26) If I open this box, I will find chocolates

(27) If tomorrow is sunny, I will go to the beach.

In normal circumstances we take for granted that whether (26) is true or false depends on what is actually inside the box. The existence of a possible world in which the box is empty does not suffice to falsify (26). Similarly, in normal circumstances we take for granted that whether (27) is true or false depends on what will actually happen tomorrow. The existence of a possible world in which tomorrow is sunny but I stay at home does not suffice to falsify (27).

[18] Here it is taken for granted that the truth of the antecedent and the consequent of (25) does not suffice for the truth of (25) if a quantification on possible worlds is involved. But this is not essential to the point, as similar examples may be provided in which the antecedent is false, as it is shown by Kratzer manuscript, section 2.

This is not to say that the account of material conditionals offered by the strict conditional view is better than the account of material conditionals offered by the truth-functional view. At most, the former is as good as the latter. The point here is about explanatory power. While the truth-functional view works for material conditionals but has little to say about nonmaterial conditionals, the strict conditional view applies both to non-material conditionals—at least in some cases—and to material conditionals. Material conditionals can be treated as special cases of strict conditionals, whereas strict conditionals cannot be treated as special cases of material conditionals. In this respect the strict conditional view is definitely better than the truth-functional view.

7. Conclusion

Let us conclude with some general remarks about the logical significance of the strict conditional view. What has been said so far suggests that, at least in a considerably wide class of cases, conditionals are adequately formalized as strict conditionals. Therefore, as long as we restrict consideration to such cases, the logical properties of conditionals can be elucidated by employing the resources of modal propositional logic.

This is not to say that the strict conditional view works for every case. Even if it is granted that some nonmaterial conditionals are adequately formalized as strict conditionals, and that all material conditionals are handled in the way explained, the question remains of whether these two categories of conditionals are jointly exhaustive. What has been said so far is consistent with the possibility that some nonmaterial conditionals are not amenable to the formal treatment suggested.

Nonetheless, the strict conditional view poses an interesting challenge. Most theorists of conditionals tend to think that conditionals do not conform to classical logic: they claim that conditionals are not evaluable as true or false, that the arguments in which they occur are not appropriately assessed in terms of classical validity, that they violate classical rules of inferences, and so on. Insofar as the strict conditional view works, no such revisionary conclusion can be drawn. Even though propositional logic may not be enough in some cases, all we need to do is to go from propositional modal logic to its most familiar extension, modal propositional logic.[19]

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