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On the Logical Form of Evidential Conditionals

"Ich freue mich, wenn es regnet,
denn wenn ich mich nicht freue, regnet es auch."
Attributed to Karl Valentin*

Abstract. The dominant analyses of the logical form of natural-language conditionals take them to be "suppositional conditionals". The latter are true or accepted if the consequent is true/accepted on the supposition of the antecedent. But this can happen although the antecedent is completely irrelevant (or even somewhat adverse) to the consequent. In natural-language conditionals, however, the antecedent is typically meant to *support* or *be evidence for* the consequent. The logical form of conditionals will thus be more complex than the suppositional theory would have it. Recently some suggestions as to what this logical form might look like have been made. In this paper, I critically discuss Vincenzo Crupi and Andrea Iacona's account of "evidential conditionals", including its recent amendments.

Keywords: conditionals; logical form; evidential conditionals; support conditionals; concessive conditionals

1. Introduction

The logical form of a sentence of natural language is, or is expressed by, a formula of some regimented language that can be assigned to the former in a systematic way, with the goal of making transparent the truth conditions or inferential properties of this sentence. The regimented language is supposed to have a clear syntax and semantics, and usually we presuppose that a good formal system for this language is available.

* Cf. Valentin (2021). In English: *I am happy if it rains; for if I am not happy, it rains anyway.*

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How do we know what the logical form of a natural-language sentence is, or whether the form assigned to it is the right one? A number of theorists recommend the method of reflective equilibrium: Generate general hypotheses — a theory — about truth conditions or inferential roles, then look at particular cases in examples. Then adapt the hypotheses in order to better come to terms with the examples. Or reconsider the particular cases and see if your prior intuitions can be corrected and the examples reinterpreted. Do all of this repeatedly until some kind of convergence of theory and data is achieved. See to it that your theory retains as much simplicity and generality as possible, avoid ad hoc hypotheses and the introduction of epicycles. Part of the philosophical work involved in the pursuit of a reflective equilibrium consists in articulating our direct intuitions about what we mean by a natural-language sentence. Another part is the inquiry into which inferences using the sentences under considerations are intuitively valid and which are intuitively invalid. These two parts may well overlap, but is makes sense to ask which part should take priority. Another question is what we should do if the intended reading of a natural-language expression does not fit together with the lists of desirable and undesirable inferences that we have established (perhaps because its meaning is more complex than that of its designated formal counterpart).[1]

This paper is a case study in logical form. It takes a look at the case of conditionals, i.e., sentences using the connective *if (... then)*, as uttered in real-life conversations. It has been hypothesised that the logical form of such conditionals can be captured by material conditionals, strict conditionals and suppositional conditionals. But none of these conditionals capture the idea that antecedents of conditionals support their consequents.

Crupi and Iacona have recently put forward an analysis of "the logical form of concessive conditionals" (2202b). They base this analysis on a series of other papers on what they call *the evidential conditional* (EC). The style of this work is similar to their work on concessives, so one may well say — even if they themselves do not use the locution in their other paper — that they have been (and are) investigating the *logical form* of evidential conditionals. In the present paper, I will discuss the modal account of evidential conditionals introduced in (Crupi and Iacona, 2022a).

[1] Much more thorough considerations on logical form that might be applied to the examples below can be found in (Brun, 2023) and (Peregrin and Svoboda, 2023).

According to (Crupi and Iacona, 2202b), the defining characteristic of ECs is absent from concessive conditionals. I emphatically agree with the suggestion that antecedents in non-concessive conditionals increase the firmness of the belief in the consequents. A central point of Crupi and Iacona's account, however, is that evidential conditionals can be characterised as conditionals that satisfy the formal scheme of contraposition. I briefly recount this idea in section 2. In section 3, I show that, contrary to what most examples given in the literature suggest, a violation of contraposition does not enforce a concessive reading of the conditionals involved. I present examples in section 4 showing that the acceptance of the contrapositive is neither necessary nor sufficient for the acceptance of a *support conditional*, i.e., a conditional in which the antecedent provides evidential support for the consequent. Very recently, Crupi and Iacona (2023a,b) and (Iacona, 2023) made a number of amendments to their modal account of evidential conditionals. They are reviewed and discussed in Section 5. In section 6, I conclude that the satisfaction of contraposition has little to do with the idea of evidential support. The logical form of support conditionals in natural language is not characterised by the inference scheme of contraposition.

2. A simple logical form: Crupi and Iacona's Chrysippus Test and suppositional conditionals

Crupi and Iacona started out their explication of evidential conditionals referring to an incompatibility between the antecedent and the negated consequent of such conditionals. They took the term "incompatibility" from Chrysippus, but caution the reader that "the word 'incompatible' may be construed in different ways, and nobody knows what Chrysippus exactly had in mind." (Crupi and Iacona, 2022a, p. 2901) They then offered their own interpretation:

> The core idea of the evidential account is that a conditional $A \rhd C$ is true if and only if A and $\neg C$ are incompatible in the following sense: if A is true, then C cannot easily be false, and if C is false, then A cannot easily be true.
>
> (Crupi and Iacona, 2022a, p. 2900, notation adapted)

Crupi and Iacona then went on and analysed the first part of the quoted passage by the Ramsey Test for the suppositional conditional $A > C$, and the second part by the Ramsey test for $\neg C > \neg A$. This conjunction they called *Chrysippus Test* (2022a, p. 2901). Crupi and Iacona did not literally formulate their characterisation of evidential conditionals in terms of suppositional conditionals (but see their Fact 22). However, the following representation of the evidential conditional is a good rendering of the essence of Crupi and Iacona's original idea.

(CT) $A \rhd C$ is true$^{\mathrm{A}}$ iff both $A > C$ and $\neg C > \neg A$ are true$^{\mathrm{A}}$.

Davis's (1983, p. 62) initial proposal of an analysis of 'strong conditionals' is virtually identical with (CT).

Let us suspend judgment on the question whether conditionals have truth values or only acceptability or assertibility values. When I say that a conditional is true$^{\mathrm{A}}$, this may be taken literally as "true", but it may also be interpreted as "accepted by the agent". The Chrysippus Test (CT) presents a very simple and straightforward idea. It says that an evidential conditional is true$^{\mathrm{A}}$ if the corresponding suppositional conditional *and* its contrapositive are true$^{\mathrm{A}}$. Crupi and Iacona contend that this test "seems required in order to preserve the intuition that A must support C" and that it "characterizes the evidential interpretation" according to which "a conditional is true just in case its antecedent provides evidence for its consequent" (2022a, pp. 2888 and 2901). As mentioned above, Crupi and Iacona have very recently made a few amendments to (CT) which one may view as later stages in an attempt to find the logical form of evidential conditionals using the method of reflective equilibrium. We will discuss these new amendments in Section 5 below.

But first we need to say more about *suppositional conditionals*. The conditional $A > C$ should be read as *If A, then C*. It is intended to be an ordinary suppositional conditional of the kind that has been studied in conditional logic since the pioneering works of Stalnaker (1968) and Lewis (1973). $A > C$ means, roughly, that AC-worlds are more possible (closer to the actual world or more plausible) than $A\overline{C}$-worlds, in symbols $AC \prec A\overline{C}$.[2] Lewis's (1973) "comparative possibility" can be

[2] $\preceq$ is presumed to be a weak order on the set of possible worlds, with $\prec$ as its asymmetric and $\sim$ its symmetric part (indicating a tie). In line with the tradition, "$x \prec y$" means "x is closer to the evaluation world than y" or "x is more(!) plausible than y." The expression "$AC \prec A\overline{C}$" can be read in two ways. *Either* we think of it as a relation between partial possible worlds (only very few facts are represented) that are identified with valuations on a select set of elementary propositions. *Or* it is a relation between propositions (sets of full possible worlds consisting of very many

regarded as a cover term for both metaphysical "closeness to the evaluation world" and epistemic "plausibility". Suppositional conditionals form the background of Crupi and Iacona's theory of ECs. Crupi and Iacona presume that the meaning of suppositional conditionals can be analysed in terms of Lewis's semantics based on systems of spheres of possible worlds. For this semantics, Lewis's "official" conditional logic **VC** is sound and complete. Suppositional conditionals satisfy the principles of Reflexivity, Left Logical Equivalence, Right Weakening, Conjunction in the Consequent, Disjunction in the Antecedent, Cautious Cut, Cautious Monotonicity and Rational Monotonicity.[3] In the language of suppositional conditionals, one can define two kinds of modal operators in the language of suppositional conditionals: $\Box B$ abbreviates $\neg B > \bot$ and expresses the outer necessity (metaphysical or doxastic necessity) of B; $\boxdot B$ abbreviates $\top > B$ and expresses the inner necessity (the truth or belief) of B (cf. Lewis, 1973, pp. 22, 30).

The suppositional conditional is an interesting and sophisticated candidate for capturing the logical form of conditionals as uttered in natural language. Why is it not satisfactory? Suppositional conditionals allow truth or acceptance "by inertia". If the antecedent does not interfere with the truth$^{\mathrm{A}}$ of the consequent, this is enough for the conditional to be true$^{\mathrm{A}}$. If the consequent is (believed to be) true "anyway", regardless of whether the antecedent is (believed to be) true or not, a suppositional conditional is accepted. In contrast, many — I am not claiming all — conditionals as uttered in natural language are support conditionals, i.e., give expression to the idea that the antecedent supports, is positively relevant for, or makes a difference to the consequent.

The most distinctive property of Crupi and Iacona's connective $\rhd$ is that it satisfies contraposition, essentially by definition. Two other very important properties are that it satisfies *neither* Strengthening of the Antecedent (aka Monotonicity) *nor* Weakening the Consequent (aka Right Weakening):

(Mon) If $A \rhd C$ and $B \vdash A$, then $B \rhd C$. Strengthening the Antecedent
(RW) If $A \rhd C$ and $C \vdash B$, then $A \rhd B$. Weakening the Consequent

facts) stating that for every world satisfying $A \wedge \neg C$ there is a closer/more plausible world satisfying $A \wedge C$.

[3] Cf. (Rott, 2022b), where the principles are formulated in the metalanguage, without embeddings of conditionals, in order to make consistent place for the view that conditionals do not have truth values.

Along with transitivity and contraposition, (Mon) has been regarded as one of the paradigmatic invalidities of indicative and subjunctive conditionals at least since the seminal works of Adams (1965), Stalnaker (1968) and Lewis (1973). (RW) was more recently suggested to be a paradigmatic invalidity ("the hallmark") of conditionals in which the antecedent is positively relevant for the consequent (Rott 2022a, pp. 137 and 153).

The regimented language in which the logical form of evidential conditionals is formulated is the language of suppositional conditionals. The fact that a special symbol $\rhd$ is used here for the evidential conditional should not be taken to indicate that the logical form of such conditionals is just $A \rhd C$. Obviously, this would trivialise the point of this paper.[4]

3. Not only concessive conditionals fail to contrapose

Most counterexamples to contraposition that can be found in the literature are such that the premise conditional admits a concessive interpretation. Indeed, the classical works of contemporary conditional logic feature examples of this kind (see Adams, 1965, p. 191; Stalnaker, 1968, p. 107; Lewis, 1973, p. 35). These examples start from conditionals *If A, then* C, in which A does not quite effect $\neg C$, but A at any rate goes some way towards bringing $\neg C$ about. Moreover, it is often plausible to assume that A is necessary for $\neg C$. Such conditionals may aptly be called *conditionals of insufficient reason*.[5] A typical pattern of comparative possibility in such examples is $\overline{A}C \preceq AC \prec A\overline{C} \prec \overline{A}\overline{C}$, with a "large distance" between $\overline{A}C$ and $\overline{A}\overline{C}$ (and $\overline{A}\overline{C}$ sometimes being completely impossible or inconceivable). This is indeed a situation in which *Even if A, C* may appropriately be asserted.[6]

Like several authors before them, Crupi and Iacona suggest that violations of contraposition always involve concessive conditionals (2022a,

[4] I am grateful to an anonymous referee for alerting me to this point.

[5] This term, which I first found in (Gomes, 2019, p. 55), has been used in German linguistics for concessives since Erben (1958, p. 131, "Bindewörter des 'unzureichenden Grundes'"). The classical examples of Adams, Stalnaker and Lewis are recapped in (Rott, 2022b).

[6] In this paper, I take it that concessive conditionals are equivalent to, and can be rephrased as, conditionals featuring *even if* in the antecedent or *still* in the consequent. In order to avoid ambiguities, I will always formulate concessives as *even if* conditionals.

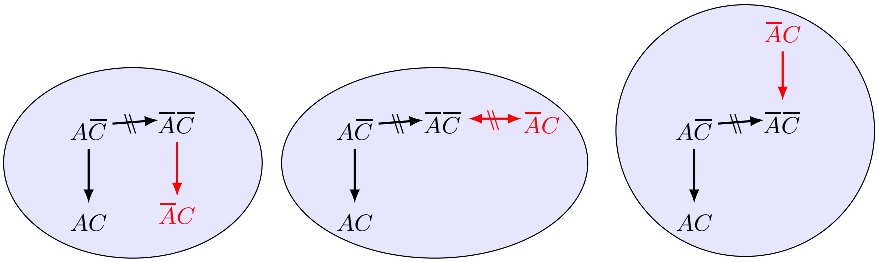
pp. 2908–2909). And the counterexamples and statements in the more recent literature all seem to confirm this claim.[7] However, the apparent plausibility of the claim results from a strangely one-sided selection of examples in the literature.

In fact, a violation of contraposition does not necessarily involve a premise conditional that can be interpreted as a concessive conditional. A counterexample to contraposition (for suppositional conditionals) consists in a pairing of $A > C$ and $\neg C \not> \neg A$. This means that $AC \prec A\overline{C}$ and $\overline{A}\overline{C} \not\prec A\overline{C}$. Call this the *violation-of-contraposition situation*. Does it *follow* from the violation of contraposition that the premise $A > C$ is a concessive conditional? In answering this question, I use two of Crupi and Iacona's own theses concerning concessive conditionals: (i) *Even if A, C* entails C, and (ii) *Even if A, C* entails the suppositional conditional *If* $\neg A$*, then* C ($\neg A > C$). Entailment (ii) is part of Crupi and Iacona's analysis of *even if*, according to which the logical form of a concessive *Even if A, C* is a conjunction $(A > C) \wedge (\neg A > C) \wedge (\neg C > A)$. Entailment (i) is a consequence of this analysis (see Crupi and Iacona, 2202b, pp. 644–647). Should a situation in which contraposition fails be compatible with the falsity$^{\mathrm{A}}$ of either C or *If* $\neg A$*, then* C, then clearly the premise $A > C$ is not a covert *even if* conditional.

Now, the violation-of-contraposition situation implies that the consequent C is true$^{\mathrm{A}}$, provided that Rational Monotonicity is available (Rott, 2022b, p. 6). However, it does not imply that $\neg A > C$ is true$^{\mathrm{A}}$. This conditional means that $\overline{A}C \prec \overline{A}\overline{C}$. And this relation is not entailed by the relations that characterise a violation of contraposition, as we can see in Fig. 1. The position of the $\overline{A}C$-worlds is entirely unconstrained by the failure of $A > C$ to contrapose. Only case (a) is compatible with an *even if* interpretation of $A > C$, cases (b) and (c) clearly are not.

The upshot of this section is that there is ample theoretical room for the possibility that not only concessive conditionals, but also support conditionals fail to contrapose. In the next section we substantiate this point by a concrete example making clear that contraposition is indeed not necessary for the relation of support between antecedent and consequent. Another example will show that contraposition is not sufficient either.

[7] See (Pollock, 1976, p. 40), (Jackson, 1979, pp. 581–582), (Jackson, 1991, p. 3), (Kratzer, 1979, pp. 140–141), (Stalnaker, 1984, p. 124); (Lycan, 2001, pp. 31–34), (Priest, 2001, p. 75), (Bennett, 2003, pp. 32, 143–144), (Douven, 2016, pp. 13–14), (Gomes, 2019, pp. 54–56).



case (a) case (b) case (c)

Figure 1. Violation-of-contraposition situations with $A > C$ and $\neg C \not> \neg A$. Arrows point downwards to more plausible worlds. Read the edge $A\overline{C} \longrightarrow AC$ as $AC \prec A\overline{C}$. The negated edge $A\overline{C} \not\longrightarrow \overline{A}\overline{C}$ should be understood as expressing $\overline{A}\overline{C} \not\prec A\overline{C}$. It may be thought of as pointing either upwards or sideways. In red: potential positions of $\overline{A}C$ in relation to $\overline{A}\overline{C}$.

4. Contraposition does not capture the idea of evidential support

In this section we move on from the logical form of concessives to that of evidential conditionals.

4.1. Contraposition is not necessary for support

The counterexamples against contraposition one can find in the literature showcase just *one* type of situation in which contraposition fails. There are others. A case in point is provided by the witty slogan attributed to the great Bavarian comedian Karl Valentin (1882–1948) that I used as a motto at the beginning of this paper. His conditional "I am happy if it rains" is probably a concessive, and it duly fails to contrapose.[8] Had he instead said "I am sad if it rains", that would probably have been an evidential conditional, but it would have failed to contrapose in just the same way (apart from the joke).[9] We will have a more systematic look at the situation now. Importantly, the conditionals (1) to (7) below are meant to be interpreted as *suppositional* conditionals that are accepted

[8] In times of global warming, the concessive reading of Valentin's conditional may no longer be prevalent.

[9] This variation of the Valentin example is rather close to examples given by Routley et al. (1982, p. 43). It is different in kind from the examples I will discuss.

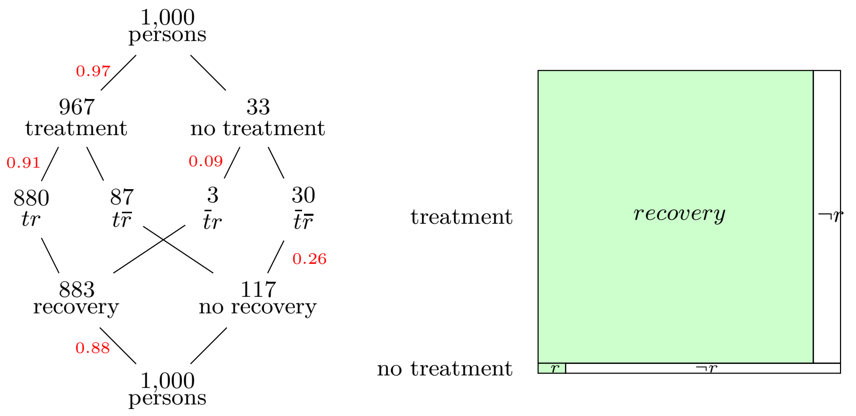


Figure 2. Contraposition is not necessary for support: The baleful disease

if the conditional probability of the consequent given the antecedent is "sufficiently high".[10]

Example 1 (baleful disease). An infectious disease breaks out with millions of cases, and a treatment has been developed to combat the disease. More than 95% of the infected persons are administered the treatment, and more than 90% of the patients treated recover. However, more than 90% of the persons without treatment do not recover. With t for treatment and r for recovery, let us assume for concreteness that the probabilities are $Pr(tr) = 88\%$, $Pr(t\bar{r}) = 8.7\%$, $Pr(\bar{t}\bar{r}) = 3\%$ and $Pr(\bar{t}r) = 0.3\%$ (see Fig. 2[11]). A corresponding ordering of comparative possibility is this: $tr \prec t\bar{r} \sim \bar{t}\bar{r} \prec \bar{t}r$.

Now suppose we know that Ann contracted the disease, but we do not know whether she has received the treatment. We have good reasons to say:

(1) *If Ann has received the treatment, she recovers.*

[10] Examples 1–3 (the first two of which are taken from Rott 2022b) will be described in probabilistic terms. An alternative, purely qualitative presentation would be possible, but I think it helps to derive the qualitative picture from the probabilistic one. In the transformations I will adopt the rough and simple rule that a (partial) possible world v is more plausible than another (partial) possible world w if and only if the probability of v is *a lot higher* (*orders of magnitude higher* as it were) than the probability of w.

[11] This and the following two figures use representations by means of double trees and unit squares (Büchter et al., 2022).

The fact that Ann received the treatment would clearly support, or be evidence for, the fact that she recovers.[12] It would also make recovery very likely. Now, is it appropriate to assert

(2) *If Ann does not recover, she has not received the treatment.*

in this scenario? No, because almost three quarters of the people who do not recover did in fact get the treatment. So contraposition fails. Yet the antecedent of the premise conditional (1) clearly supports its consequent. It is not a concessive conditional.

Contraposition fails in situations that are commonly referred to when the *base-rate fallacy* is discussed. For its failure, the only thing that matters is the pattern of probabilities or comparative similarities. The patterns we need to make our point are ubiquitous. Example 1 may be subsumed under case (c) of Fig. 1, $AC \prec A\overline{C} \sim \overline{A}\overline{C} \prec \overline{A}C$. The example illustrates that not all conditionals in which the antecedent supports the consequent contrapose. Contraposition is not necessary for support.

4.2. Contraposition is not sufficient for support

Now I want to show that contraposition is not sufficient for conditionals that are meant to encode the idea of evidential support.

Example 2 (benign disease). The scenario begins like Example 1, only some of the figures are different: more than 93% of the infected persons are administered the treatment, and more than 94% of the patients treated recover. The big difference is that this time the disease is rather benign, so that almost 91% of the persons who have not been treated recover, too. For concreteness, let us assume that the probabilities are $Pr(tr) = 88\%$, $Pr(t\bar{r}) = 5.4\%$, $Pr(\bar{t}r) = 6\%$ and $Pr(\bar{t}\bar{r}) = 0.6\%$ (see Fig. 3). A corresponding ordering of comparative possibility is this: $tr \prec \bar{t}r \sim t\bar{r} \prec \bar{t}\bar{r}$.

[12] One might feel tempted to object that the degree of support or evidence that the antecedent of (1) lends to its consequent is negligible, because $\Pr(r\,|\,t) = 0.91$ which exceeds $\Pr(r) = 0.88$ just a little bit. But this is the wrong contrast for judging how much the treatment supports recovery. If we look at the numbers of persons indicated in Fig. 2, this is a comparison of a subgroup of 967 persons with the full group of 1,000 persons. This means comparing a large group of people with essentially themselves! No wonder that we do not get an impressive contrast here. The right contrast is with the subgroup of *untreated* persons. Here we get $\Pr(r\,|\,\bar{t}) = 0.09$ which makes for a huge contrast with $\Pr(r\,|\,t)$.

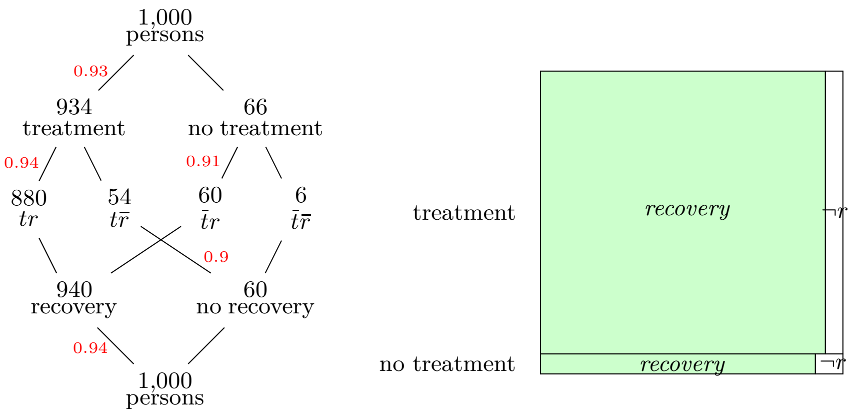


Figure 3. Contraposition is not sufficient for support: The benign disease

Suppose again we know that Ann contracted the disease, but we do not know whether she has received the treatment. Are we are ready to assert the conditional

(3) *If Ann has not received the treatment, she recovers.*

in this scenario? It is very likely that Ann recovers, but not receiving the treatment would not support her recovery. Considering the figures, not getting the treatment would in fact be slightly unfavourable to her recovery. In as far as we feel justified in asserting (3), it is not an evidential conditional, but rather more like an *even if* conditional. Still, contraposition works here:

(4) *If Ann does not recover, she has (still) received the treatment.*

The explanation for this lies in the particular figures of the case: the contraposed conditional (4) is acceptable because it is extremely unlikely that Ann is an untreated patient who does not recover. But (4), too, has an *even if* flavour, since we can equally well say

(5) *If Ann recovers, she has received the treatment.*

Crupi and Iacona's modal analysis predicts that *If* $\neg t$*,* r is an evidential and *If* t*,* r is a concessive conditional. Both claims are counterintuitive here.

For the presence or absence of evidential support, the only thing that matters is the pattern of probabilities or comparative similarities.

It is easy to come by a pattern that is suitable to make our point. In Example 2, the pattern is $\overline{A}C \prec AC \sim \overline{A}\,\overline{C} \prec A\overline{C}$, where A is the antecedent and C the consequent of the contraposing conditional. The example illustrates that not all contraposing conditionals are such that the antecedent supports the consequent. Contraposition is not sufficient for support.

The examples in this section show, I submit, that whether or not the contrapositive of a true$^{\mathrm{A}}$ suppositional conditional is true$^{\mathrm{A}}$, too, does not depend on whether or not this suppositional conditional expresses a relation of evidential support between its antecedent and its consequent.

5. Towards more complex logical forms: Crupi and Iacona's recent amendments

Let us first recast the original version of the Chrysippus Test (Crupi and Iacona, 2022a, pp. 1900–1901) in two ways: by giving semantic truth conditions and by giving a definition in terms of suppositional conditionals:

(CT1) $A \rhd C$ is true iff

(a) for every world in which A is true and C is false, some strictly closer world is such that both A and C are true and

(b) for every world in which A is true and C is false, some strictly closer world is such that both A and C are false.

More compactly, $A \rhd C$ can be defined as $A > C$ and $\neg C > \neg A$.

Crupi and Iacona recently entered a process that can be described as theory modification through aiming at a reflective equilibrium. Considering a number of critical examples, Crupi and Iacona came to realise that there are serious challenges to their formalisation of evidential conditionals. So they have given up on the idea of relying exclusively on the principle of contraposition and now use a more complex truth condition for evidential conditionals (cf. Crupi and Iacona, 2023a, p. 132; and Iacona, 2023, pp. 12–13):

(CT2) $A \rhd C$ is true iff

(i) there are no worlds in which A is true and C is false, or

(ii) (a) and (b) as in (CT1) and

(iii) A and C have the same truth value in at least one of the closest worlds.

More compactly, $A \rhd C$ can be defined as $\Box(A \supset C)$ or $(A > C$ and $\neg C > \neg A$ and not $\boxdot(A \equiv \neg C))$.

The amendments are carefully crafted so that contraposition remains a valid inference scheme. Notice also that (CT2)'s truth condition is a strengthening of (CT1)'s truth condition, because (CT2)(i) implies the latter. I will neglect the new clause (CT2)(i) in the following and focus on the new clause (CT2)(ii-c).

Crupi and Iacona (2023a, p. 32) and Iacona (2023, pp. 12–13) do not provide much motivation for (CT2), but refer the reader to (Crupi and Iacona, 2023b) for explanations. They call (CT2)(ii-c) "a minimal condition" for the incompatibility of A and $\neg C$ (2023a, p. 132), but it remains unclear why it should be forbidden that two incompatible sentences are both (believed to be) false. They also say that (CT2)(ii-a)–(ii-c) express that $A \wedge \neg C$ is a "remote possibility" (Crupi and Iacona, 2023b, pp. 18–19). But this does not seem to be a very felicitous expression either, unless "remote" is supposed to mean "not closest". Nothing in (CT2) excludes $A \wedge \neg C$-worlds residing in the sphere of second closest worlds.

Let us now see what difference the inclusion of (CT2)(ii-c) makes. We proceed by considering cases. Case 1: Suppose that there is a closest world at which A is true (not $\boxdot\neg A$, the "open case"). Then this world must be a C-world, by (CT2)(ii-a). So (CT2)(ii-c) is satisfied automatically and does not make any difference in this case. Case 2: Suppose that there is no closest world at which A is true ($\boxdot\neg A$, the "counterfactual case"). Then (CT2)(ii-c) says that there must be a closest world at which C is false (not $\boxdot C$). In sum, this is what (CT2)(ii-c) comes down to: if $\boxdot\neg A$, then not $\boxdot C$. This can be equivalently transformed into: if $\boxdot\neg A$, then not $\neg A > C$. (CT2)(ii) can thus be rephrased as: $A > C$ and $\neg C > \neg A$ and if $\boxdot\neg A$, then not $\neg A > C$. It may be pointed out here as a side remark that the rejection of the suppositional conditional $\neg A > C$ is precisely the characteristic extra condition for difference-making conditionals in the sense of Rott (2022a). So one may perhaps say that Crupi and Iacona's amendment in effect amounts to endorsing Rott's suggestion for the counterfactual case.

The next question is whether the above objections against Crupi and Iacona's original Chrysippus test still apply to their amended version. First we note that since the truth condition of (CT2) is a strengthening of the truth condition of (CT1), Rott's (2022b) objection that the truth

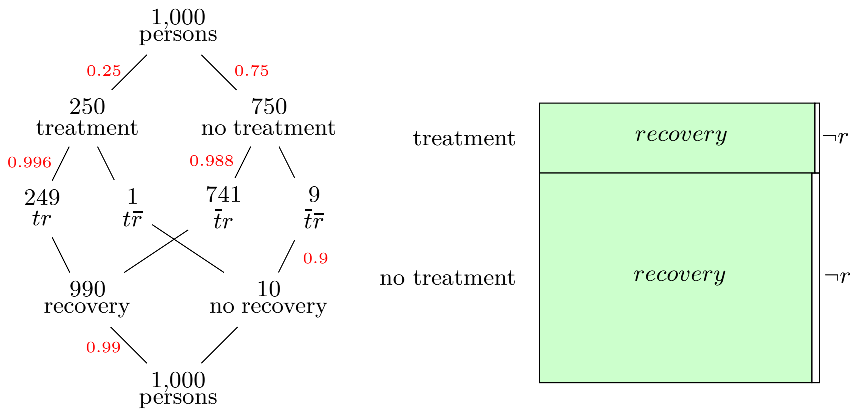


Figure 4. Contraposition is not sufficient for support, also on the amended proposal

condition of (CT1) is not necessary for the encoding of a support relation remains standing. Example 1 still works as a counterexample.

The new question thus is whether the amended truth condition is sufficient for expressing evidential support. Example 2 cannot be used any more since the antecedent and the consequent of (3), i.e., $\neg t$ and r have different truth values in the single most plausible ("closest") world tr. So (3) will not pass as an evidential conditional any more according to Crupi and Iacona's amended truth definition. But here are two other examples indicating that the suggested cure does not solve the principal problem.

Example 3 (variant of benign disease). The scenario is similar to Example 2, but again some of the figures are different: this time 25% of the infected persons are administered the treatment, and more than 99% of the patients treated recover. On the other hand, also close to 99% of the persons who have not been treated recover. For concreteness, let us assume that the probabilities are $Pr(tr) = 24,9\%$, $Pr(t\bar{r}) = 0.1\%$, $Pr(\bar{t}r) = 74,1\%$ and $Pr(\bar{t}\bar{r}) = 0.9\%$ (see Fig. 4). A corresponding ordering of comparative possibility is this: $\bar{t}r \sim tr \prec \bar{t}\bar{r} \prec t\bar{r}$. Here the agent accepts $t > r$ and $\neg r > \neg t$. We may also suppose, using a probability threshold of 0.85, say, that she accepts r, but neither t nor $\neg t$. So the conditional "If t then r" passes Crupi and Iacona's new criteria in (CT2)(ii). t is actually positively relevant to r (99,6% is more than

98,8%), but arguably the difference is not big enough to warrant calling "If t then r" a support conditional.

In the next example, which is not presented in a probabilistic setting, the antecedent seems completely irrelevant to the consequent.

Example 4 (energy density). Modern physics has established the claim that the energy density in the very early universe was extremely close to the critical density ρ_c, which is approximately 10^{-26} kg/m^3. Should we thus accept the suppositional conditional

(6) *If at least one author is late with her submission, the energy density of the very early universe was extremely close to the critical density ρ_c.*

The answer is "Yes". On the supposition that some author is late with her submission, the early universe's energy density would certainly remain the same, so (6), taken as a suppositional conditional, is acceptable. As it turns out, its contraposition is acceptable, too, to scientifically enlightened minds:

(7) *If the energy density in the very early universe hadn't been extremely close to the critical density ρ_c, then no author would be late with her submission.*

The reason is this: If the energy density in the very early universe had deviated from ρ_c just a little bit, stars could not have formed and life could not have come into existence. So there would not be any authors around to submit their papers too late. The last part we need to check is (CT2)(ii-c), i.e., whether there are any closest worlds in which the antecedent and the consequent of (6) have the same truth value. This is indeed plausible, since the closest worlds have all the same energy density as ours and in some of them there will be authors submitting their papers too late. So conditional (6) passes Crupi and Iacona's new criteria in (CT2)(ii). If A and C are the antecedent and the consequent of the contraposing conditional, respectively, we have the structure $\overline{A}C \sim AC \prec \overline{A}\overline{C} \prec A\overline{C}$ here (as in Example 3 before).[13]

Yet conditional (6) seems rather odd and would in normal circumstances be rejected. When evaluating the possible consequences of the supposition that some author is late with her submission, we need not

[13] Notice the similarity to Example 2.

consider remote possibilities with different energy densities and starless universes. The density of the universe certainly does not depend on the tardiness of some authors. If no author is late with her submission, the energy density of the early universe was close to ρ_c all the same. If these intuitions are correct, then Crupi and Iacona's amended truth conditions (CT2) are still insufficient to establish a relation of evidential support between antecedent or consequent.[14]

The authors's most recent suggestion includes yet another amendment which consists in a further strengthening of the truth condition of (CT2). According to (Crupi and Iacona, 2023b),

(CT3) $A \rhd C$ is true iff
- (i) (a) there are no worlds in which A is true and C is false and
  - (b) there is a world in which A is true and
  - (c) there is a world in which C is false, or
- (ii) (a)–(c) as in (CT2) and
  - (d) there is a world in which A is true and C is false.

More compactly, $A \rhd C$ can be defined as $(\Box(A \supset C)$ and $\neg\Box\neg A$ and $\neg\Box C)$ or $(A > C$ and $\neg C > \neg A$ and $\neg \boxdot (A \equiv \neg C)$ and $\neg\Box(A \supset C))$.

This last proposal further adds (CT3)(i-b)–(i-c) and (CT3)(ii-d) as new clauses. These changes are irrelevant to the above arguments against (CT2).

We have seen that there has been a significant increase in the complexity of the logical form that Crupi and Iacona assign to evidential conditionals.[15] Do their amendments represent progress on the way to find a reflective equilibrium that will ultimately lead to the right logical form of evidential conditionals? Or are the amendments rather epicycles — ad hoc patches to their original theory in order to come to terms with critical examples?

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[14] It is natural to say that the authors' tardiness is *irrelevant* to the universe's energy density at any time. However, I admit that there is a rivalling intuition saying that the existence of authors *is evidence* for the life-enabling energy density at the beginning of our universe.

[15] It is interesting that Davis (1983) also modified and complicated (CT1) as his analysis of strong conditionals proceeded. In contrast to Crupi and Iacona, Davis successively *weakenend* the truth condition of (CT1) in three steps.

6. Conclusion

I have argued that the satisfaction of contraposition is not an essential feature of the logical form of conditionals expressing a relation of evidential support between the antecedent and the consequent. First I showed that a violation of contraposition does not imply that its premise is a concessive conditional. Then I presented two examples showing that the fact that a conditional is true or accepted along with its contrapositive is neither necessary nor sufficient for its antecedent supporting the consequence. One of the examples (for the not-necessary claim) still applies to the recently amended versions of the theory of Crupi and Iacona, the other example (for the not-sufficient claim) has to be replaced by a different one. These examples exhibit patterns of probability and plausibility that are instantiated in countless real-life situations.

We have long become used to the fact that conditionals as uttered in natural-language conversations appear to be non-monotonic, i.e., that they do not satisfy Strengthening the Antecedent. Why should they satisfy contraposition? It seems to me that salvaging some cherished inference scheme (or more such schemes) should not be a top priority on our way to reaching a reflective equilibrium concerning the logical form of evidential conditionals. It is rather more important to focus intently on the intuitive ideas of evidence and support and their formal representation.

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