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IFS, THOUGH, AND *BECAUSE**

1. INTRODUCTION

Everybody knows that *if* and *because*[1] are related conjunctions. Goodman (1954, p. 14) takes *Because A B* to be equivalent to its "contrapositive", the subjunctive conditional statement *If* $\neg B$ *then* $\neg A$[2], and Ryle (1963, p. 317) sees at least a truth conditional equality between *Because A B* and the subjunctive conditional statement *If* $\neg A$ *then* $\neg B$. The common belief, I think, is already found in Ramsey (1931, p. 248), who mentions *If p then q* and *Because p q* in the same breath stating "*because* is merely a variant on *if* when *p* is known to be true". Beginners in philosophy can already learn much the same from Blau's highly esteemed propaedeutics (1982, 1983, p. 43, my translation): "Closely related to *if*, are the partial truth functional operators *because*, *since*, *hence*, *therefore*, etc. It seems to me they are essentially the conjunction of *A* and *if A then B*." I would like to call the view of Ramsey and Blau the mainstream analysis of the relationship between *because* and *if* (in the following, "*Mainstream Analysis*").

Nobody knows the exact relationship between *if* and *because*. This is strikingly documented by the difference in attention that has been paid to *if* and *because* in modern philosophy. Whereas *if* has gained abundant care by the meanwhile proliferating conditional logics *because* has remained in the shadows.

I think we should do more justice to *because* and shall venture a parallel analysis of both conjunctions. In approaching this I won't prematurely commit myself to one of the views mentioned above. Instead I want to start with the idea that *because* always points to a reason or an explanation. In the next section, the basic ideas of three promising accounts of conditionals, reasons, and explanations are cited. The common feature of these accounts is that they rely on the beliefs of an epistemic subject. In section 3, I shall describe the simple model of beliefs to be used for my analysis. In section 4, the suggested analysis of conditionals (viz., the Ramsey test) is found to be inadequate in the light of the Mainstream Analysis, which points to a modification, viz., to the

Erkenntnis **25** (1986) 345–370.

Strong Ramsey test, as I call it. Then – in section 5 – the mentioned accounts of reasons and explanations are put together, and an alternative analysis of *because* results. My claim in section 6 is that this analysis is at the same time an analysis of *if* by giving rise to the definition of a universal (pro-)conditional not realized in natural language. In a rather straightforward way, a universal contra-conditional and a universal unconditional can be introduced, too. Section 7 lists a handful of general theses on the arrangement of natural language's indicative and subjunctive *if*, *if . . . might*, *even if*, *though*, and *because* within the framework of universal conditionals. In section 8, the relatively complicated acceptability conditions of the natural conjunctions are reduced to handy formulations by working up the accessory conditions concerning the acceptance of "antecedents" and "consequents". In doing so the original theses can be reassessed from the perspective of the final conditions. In the last section, theoretical prospects and practical limitations of my analysis are outlined.

I would like to close this introduction with a word about principles. There are well-founded doubts as to whether it is suitable to assign truth values to conditionals. In accordance with these doubts, my starting point will lead us to epistemic interpretations, and the model I shall employ is a framework for acceptability conditions and not for truth conditions. So far a benevolent reader may accept this line of reasoning. Several points of the following, however, will be subject to fundamental criticism. Some will prefer to consign the relevance condition embodied in the Strong Ramsey test, as well as the accessory conditions for the acceptance of antecedents and consequents to the realm of pragmatics and assertability conditions where Gricean mechanisms are assumed to be at work. I agree with this criticism but I am confident that this slight haziness will not prove pernicious.[3] On the contrary, the integration of some rather strong considerations with a pragmatic flavour into the acceptability conditions is done to bring about a simultaneous treatment of the *if*s, *though*, and *because*. The success of the undertaking may be judged by its results.

2. THE POINT OF DEPARTURE

In the beginning there is the hope that three exemplary accounts of conditionals, explanations, and reasons, all of them well-grounded in the pertinent special discussions, can be combined to a unified analysis of *if* and *because*.

One of the more prominent suggestions how to interpret *conditionals* has Ramsey (1931, p. 247, note 7) as its progenitor and Stalnaker as its initial advocate in conditional logic. Here is the Ramsey test, in Stalnaker's (1968, p. 102) original formulation:

(1) This is how to evaluate a conditional:
First, add the antecedent (hypothetically) to your stock of beliefs; second, make whatever adjustments are required to maintain consistency (without modyfying the hypothetical belief in the antecedent); finally, consider whether or not the consequent is then true.

A main problem of the philosophy of science is that of (scientific) *explanation*. The merits of the following suggestion of Gärdenfors (1980, p. 404) can be found in Gärdenfors' original paper and in Stegmüller (1983, ch. XI); I can only give its idea here:

(2) The central criterion on an explanation is that the explanans in a non-trivial way increases the belief-value of the explanandum, where the belief-value of a sentence is determined from the given knowledge situation.

Finally, Spohn (1983) argues convincingly that a theory of causality is best based on the notion of *reason*. Spohn's (1983, p. 372) explication of "reason" is quite simple:

(3) A is a reason for B for the person X at time s iff X's believing A at s would raise the epistemic rank of B for X at time s.

An account of causation would be due now. I think, however, that it would hardly help us to achieve our object. On the one hand, Spohn has already shown how to parallel the analysis of causes with the analysis of reasons.[4] On the other hand, causation appears to go beyond the limits of the epistemic setting necessary and sufficient to handle (1)–(3). So, if someone insists that *because* is positively about an asymmetric causal relation in our real world, I have to confess that I cannot give a satisfactory interpretation of this "causal" *because*. I shall concentrate on the "informative" *because* specifying just reasons. Yet I conjecture that this informative *because* is the more common and the more general one, and that the causal *because* can eventually be characterized as a special case by a few non-epistemic conditions.

3. THE MODEL

A comparison of (1)–(3) provides encouragement for the present project: it is all a matter of belief. So we must have a model for states of belief. An appropriate model, designed for the analysis of conditionals, is investigated by Gärdenfors (1979, 1981, 1982, 1984a). We do not need his model in its full sophistication, but can be satisfied with a few very plausible conditions.

First of all, we have to give a (idealized) representation of a state of belief in the form of the set of accepted sentences:

(4) A *belief set* K is a set of sentences that contains all logically valid sentences and is closed under modus ponens.

The object language and its logic can be left unspecified for the moment, except, that it should include classical propositional logic (with the symbols $\neg$, $\wedge$, $\vee$, $\supset$, $\equiv$).[5] Note that the set of all sentences is a belief set; it is called the absurd belief set and denoted $K_\perp$.

Now we have to provide for the possible changes of beliefs. Gärdenfors (1979, pp. 391f; 1982, pp. 90–92) motivates the following definition for the case that the new sentence to be accepted does not contradict the old stock of beliefs:

(5) The *expansion* K_A^+ *of* K *by* A is the set of logical consequences of $K \cup \{A\}$, i.e., $K_A^+ = \{B\colon A \supset B \in K\}$.

The label "expansion of K by A" is justified by the fact that $K \subseteq K_A^+$ and $A \in K_A^+$. Concerning the more delicate contractions and revisions of states of belief, I shall only have to make use of Gärdenfors' basic postulates for contraction and revision:

(6) A set of sentences K_A^- is a *contraction of* K *with respect to* A only if
(C1) K_A^- is a belief set,
(C2) $\vdash A \equiv B \Rightarrow K_A^- = K_B^-$,
(C3) $K_A^- \subseteq K$,
(C4) $\nvdash A \Rightarrow A \notin K_A^-$,
(C5) $A \notin K \Rightarrow K_A^- = K$, and
(C6) $A \in K \Rightarrow K \subseteq (K_A^-)_A^+$.

(C6) is a principle of economy: make your changes of belief as minimal as possible. The reverse inclusion $A \in K \Rightarrow (K^-_A)^+_A \subseteq K$ follows from (C3) and (5), and given (C1)–(C4), (C6) can be shown to be equivalent to the following condition (cf. Gärdenfors, 1982, pp. 93f):

(7) $K^-_A = K \cap (K^-_A)^+_{\neg A}$.

If a person has to accept (actually or hypothetically) a sentence, the negation of which he accepted before, expansions do not help. Gärdenfors introduces revisions or minimal changes of belief as a generalization of both expansions and such belief-contravening changes. Here is his basic set of postutates:

(8) A set of sentences K_A is a *revision of K needed to accept A* only if
(R1) K_A is a belief set,
(R2) $\vdash A \equiv B \Rightarrow K_A = K_B$,
(R3) $\nvdash \neg A \Rightarrow K_A \neq K_\perp$,
(R4) $A \in K_A$, and
(R5) $\neg A \notin K \Rightarrow K_A = K^+_A$.

Note that the analogue to (C5), viz.,

(9) $A \in K \Rightarrow K_A = K$,

is false for $K = K_\perp$ (unless A is contradictory), but immediately derivable from (R5) and (5) otherwise (resp., from (R4) in the case of a contradictory A). Henceforth, throughout this paper I shall presuppose that we are dealing only with non-absurd belief sets and sentences that are neither tautologies nor contradictions.

Now, intuition suggests that revisions can be accomplished by a combination of contraction and expansion. This has become familiar as *Levi's thesis*:

(10) $K_A = (K^-_{\neg A})^+_A$.

There is also the other way round, from revisions to contractions (cf. (7)):

(11) $K^-_A = K \cap K_{\neg A}$.

To speak of (11) as the reversion of (10) has a good foundation; Gärdenfors (1982) proved the following relationship:

(12) (C1)–(C6) & (10) $\Leftrightarrow$ (R1)–(R5) & (11).

An implication of which we will make regular use is:

(13) $B \in K_A \ \& \ B \in K_{\neg A} \Rightarrow B \in K.$

I'd like to prove this. From (10), we have

$$B \in K_A \cap K_{\neg A} = (K^-_{\neg A})^+_A \cap (K^-_A)^+_{\neg A} \subseteq K^+_A \cap K^+_{\neg A},$$

since $K' \subseteq K''$ implies $K'^+_C \subseteq K''^+_C$ for every sentence C (monotonicity of expansions); therefore, with (5), $A \supset B \in K \ \& \ \neg A \supset B \in K$, and $B \in K$ by definition (4) (and also, by (11), $B \in K^-_A$ and $B \in K^-_{\neg A}$; the reader may also verify the complementary implication $B \notin K_A$ & $B \notin K_{\neg A} \Rightarrow B \notin K$).

Perhaps you noticed that we had to use the indefinite article in the first lines of (6) and (8), for there is no unique K^-_A or K_A singled out by (C1)–(C6) or (R1)–(R5) respectively. However, (1)–(3) seem to presuppose uniqueness in changing states of belief. How this multiplicity can be eliminated is analysed in Gärdenfors (1984a) with the aid of a relation of epistemic importance. In the sequel I shall take it for granted that there is a unique way to contract or revise a belief set with respect to a given sentence, i.e., that there are functions $(K, A) \mapsto K^-_A$, and $(K, A) \mapsto K_A$.

4. THE MAINSTREAM ANALYSIS INDICATES THE RIGHT WAY

The model just sketched out was developed by Gärdenfors to analyse conditionals, and the Ramsey test (1) is easily translated into the language of belief sets. For that purpose we provisionally add the non-truth functional conditional $>$ to our object language:

(14) $A > B \in K \Leftrightarrow B \in K_A.$

This formulation of the Ramsey test, together with (R1)–(R5) and two further postulates for revisions, gives exactly Lewis' (1973a) "official" logic VC for conditionals (cf. Gärdenfors, 1979). Particularly, (9) yields

(15) $A, B \in K \Rightarrow A > B \in K.$

But it is immediately clear now that the Mainstream Analysis must fail in this setting. Symbolizing *because* by ${}^a{>}$,[6] the Mainstream Analysis reads thus, in Ramsey's and Blau's versions respectively:

(16) $A \in K \Rightarrow (A \stackrel{a}{>} B \in K \Leftrightarrow A > B \in K)$,

(17) $A \stackrel{a}{>} B \in K \Leftrightarrow A \in K \;\&\; A > B \in K$.

Using (15), (16) and (17) both validate

(18) $A, B \in K \Rightarrow A \stackrel{a}{>} B \in K$,

which is obviously absurd.

What can one do about this then? At present I don't want to repudiate the Mainstream Analysis; so we have to tackle the problem at (15). Does mere acceptance of A and B really justify the acceptance of *If A B*? Consider the sentence

If Anthony goes to the party Bette will go to the party.

Would you accept this conditional sentence if you knew that both Anthony and Bette go to the party but that Bette's sympathy for Anthony has changed into a strong dislike, so that Anthony's presence was almost reason enough for Bette to stay at home? I am sure you would not. Except for logical puzzles in the weekend issues of pretentious newspapers conditionals in natural language do express some connection between the antecedent and the consequent. (Later on I will argue that this is not the only reason for using *though* instead of *if* in the sentence above to describe the affairs concerning Anthony and Bette.)

Adhering to the model of Section 3, I see only one possibility to undercut (15): we have to change (14) in such a way that the mere belief in A and B does not make the right-hand side true.[7] I believe the right method to attack the problem is to strengthen (14) to the following condition. We will term it the *Strong Ramsey test* and associate a new symbol $\gg$ with it:

(19) $A \gg B \in K \Leftrightarrow B \in K_A \;\&\; B \notin K_{\neg A}$.

Substituting $\gg$ for $>$, the Mainstream Analysis yields a fairly plausible condition in the critical situation $A, B \in K$:

(20) $A \stackrel{a}{>} B \in K \Leftrightarrow B \notin K_{\neg A}$, provided that $A, B \in K$.

Considering the fact that the Ramsey test was contrived for counterfactual conditionals in the first place, it is satisfying that the Strong Ramsey test reduces to the ordinary one in the presumptive context of counterfactuals (this can be seen immediately by applying (13)):

(21) $A \gg B \in K \Leftrightarrow A > B \in K$, provided that $B \notin K$.

Thus (19) is a promising approach to both *if* and *because*.[8] $\gg$ seems to be more adequate for natural language conditionals than $>$, because it explicitly requires the antecedent to be positively relevant for the consequent. Suppose Anthony did not go to the party; then Bette would go there all the sooner; thus the Strong Ramsey test fails, and we do not accept the conditional in question – in agreement with our intuition.

We may test alternative ideas to block (15). One should be aware that the conception of relevance cannot be captured adequately if we try to simplify the right hand side of (19) to $B \in K_A$ & $B \notin K$. This would produce absurd consequences contrary to those of (18): it would be impossible to accept $A \overset{a}{>} B$ if A is accepted, according to the Mainstream Analysis (16), and already if A or B is accepted, according to the Mainstream Analysis (17). Another method to prevent the acceptance of A and B from forcing the acceptance of *If A B* is to contract the original belief set before the Ramsey test (14) is applied. Contraction with respect to A will not do, since $(K_A^-)_A = K_A$ (if $A \in K$, apply (10), (C3), and (C6); if $A \notin K$, apply (C5)). But $B \in (K_B^-)_A$ fares better as a candidate for the acceptability condition of $A > B \in K$: it has no obvious defects, and, though it is scarcely motivated as yet, we will return to its idea from another direction in the next section.

Gärdenfors (1981, pp. 209f) analyses *might* conditionals in the spirit of the Ramsey test, too. Writing $A \diamond B$ for *If A, B might be*, his suggestion is

(22) $A \diamond B \in K \Leftrightarrow \neg B \notin K_A.$

A stronger version analogous to the Strong Ramsey test is

(23) $A \diamond\!> B \in K \Leftrightarrow \neg B \notin K_A \,\&\, \neg B \in K_{\neg A}.$

Some connections may clear up the picture:

(24) $A \diamond B \in K \Leftrightarrow A > \neg B \notin K,$

(25) $A \diamond\!> B \in K \Leftrightarrow \neg A \gg \neg B \in K,$

(26) $A \gg B \in K \Leftrightarrow A > B \in K \,\&\, \neg A \diamond \neg B \in K,$

(27) $A \diamond\!> B \in K \Leftrightarrow A \diamond B \in K \,\&\, \neg A > \neg B \in K.$

It was a merit of the Mainstream Analysis that we have found the Strong Ramsey test (19) for conditionals. Alas, further down (in sections 7 and 8) I reject the Mainstream Analysis. Moreover (in the next two sections), I argue that a careful examination of the meaning of *because* requires a slightly more complicated interpretation of conditionals than the Strong Ramsey test. This interpretation is – in contrast to (19) – also a natural stepping-stone to the acceptance conditions of other kinds of conditionals and *though*.

5. AN ALTERNATIVE ANALYSIS OF *BECAUSE*

My proposition is that *Because* $A\,B$ is synonymous with "A is a reason or an explanation for B." (I want to leave aside causation (see section 2), justification, argumentation, and facilitation of understanding, which involve problems of a different kind.) In following that line we have to discuss (2) and (3), and work out a general acceptability condition for *because* sentences. For fear that further analysis would be blocked I shall rest content with necessary conditions in this section.

Starting with reasons, we may assume that the function of Spohn's personal and temporal indices is taken over by the belief sets in our model, and epistemic ranks are now mirrored by the elementship in the belief sets in question. So, as a first attempt, (3) can be transcribed into

$$(28) \qquad A \,{}^{a}\!\!> B \in K \Rightarrow (B \in K_A \;\&\; B \notin K) \vee (\neg B \notin K_A \;\&\; \neg B \in K).$$

This, however cannot be correct. First, a reason A can already be known and still be a reason; but in (28), $A \in K = K_A$ leads to $A \,{}^{a}\!\!> B \notin K$. We can take account of this shortcoming by employing the Strong Ramsey test (19):

$$(29) \qquad A \,{}^{a}\!\!> B \in K \Rightarrow (B \in K_A \;\&\; B \notin K_{\neg A}) \vee (\neg B \notin K_A \;\&\; \neg B \in K_{\neg A}) \Leftrightarrow A \gg B \in K \vee A \diamond\!\!> B \in K.^{9}$$

Note that in the case of $A, B \in K$ the necessary condition for $A \,{}^{a}\!\!> B \in K$ reduces to $\neg A > B \notin K$, according to (29).

Second, a consequence B can already be known and still be a consequence; but in (28), $B \in K$ leads to $A \,{}^{a}\!\!> B \notin K$. An obvious possibility to avoid this mistake of (28) is

$$(30) \qquad A \,{}^{a}\!\!> B \in K \Rightarrow (B \in (K^{-}_{B})_A \;\&\; B \notin K^{-}_{B}) \vee (\neg B \notin (K^{-}_{B})_A \;\&\; \neg B \in K^{-}_{B}).$$

(30) makes use of the alternative idea to escape (15) which is mentioned above. Note that in the case of $\neg B \notin K$ the necessary condition for $A \,{}^{a}\!\!> B \in K$ reduces to $A > B \in K^{-}_{B}$, according to (30).

It is easily seen that (29), although proposed to deal with the first problem, solves the second as well, and (30), although proposed to deal with the second problem, solves the first. Thus we are at a loss for a criterion whether to favour (29) or (30) as an analysis of *because*. Fortunately a closer examination of explanations shows both ideas to be substantial. Consider (2) and note that in the "given knowledge situation" of an explanation the explanandum is known. So the explication of explanation given by Gärdenfors (1980, cf. also Stegmüller, 1983) must be written

(31) $$A \overset{a}{>} B \in K_B \Rightarrow (B \in K_A \;\&\; B \notin K) \vee (\neg B \notin K_A \;\&\; \neg B \in K).$$

A first familiar argument comes to mind: since we do not want to rule out the possibility $A \in K$, we must replace K by $K_{\neg A}$:

(32) $$\begin{aligned} A \overset{a}{>} B \in K_B \Rightarrow\; & (B \in K_A \;\&\; B \notin K_{\neg A}) \\ & \vee (\neg B \notin K_A \;\&\; \neg B \in K_{\neg A}) \\ \Leftrightarrow\; & A \gg B \in K \vee A \Diamond\!> B \in K. \end{aligned}$$

There is a more important problem. Gärdenfors, and also Stegmüller, apparently want to take K to be the last belief set before the surprising explanandum has come to one's knowledge, i.e., before the actual situation K_B. But this is an unwarranted simplification. Think of the bomber pilot who racks his brain about the question why he pressed the button then, decades ago – he doesn't acknowledge the norms of those days any more. Astronomers may well search for an explanation of a strange phenomenon known since Tycho Brahe's observations – nevertheless, nobody wants to go back to a belief state of the 16th century. Scientific revolutions sometimes produce a demand for explanation of facts that were regarded as self-evident up until then.[10] Summing up, the step from K_B back to K is by no means a trivial one. So much the better that we can already account for that problem by making use of contractions:[11]

(33) $$\begin{aligned} A \overset{a}{>} B \in K \Rightarrow\; & (B \in (K_B^-)_A \;\&\; B \notin (K_B^-)_{\neg A}) \\ & \vee (\neg B \notin (K_B^-)_A \;\&\; \neg B \in (K_B^-)_{\neg A}) \\ \Leftrightarrow\; & A \gg B \in K_B^- \vee A \Diamond\!> B \in K_B^-. \end{aligned}$$

This is my first claim: (33) is a (relatively, see below) conclusive analysis of *because* sentences. Be aware that (33), by combining the provisions of (29) and (30), guarantees that accepting A and/or B does not prejudge acceptance or rejection of *Because* $A\,B$.[12]

6. UNIVERSAL CONDITIONALS

My second claim is more far-reaching than the first: (33) is to be the central idea for a viable analysis of the whole field of natural language marked out by the *ifs*, *though*, and *because*. I shall postulate a basis of universal conditionals that are not realized in natural language. To indicate this conception assumed in the mind but not in the dictionary I'll use the arrow $\rightarrow$ instead of $>$.

(33) is already perfect for the analysis of what you can call a "conditional connection". For the purpose of the introduction of the *universal (pro-)conditional* $\rightarrow$ the implication of (33) can be strengthened to an equivalence:

$$(34) \qquad A \rightarrow B \in K \Leftrightarrow A \gg B \in K_{\bar{B}}^{-} \veebar A \Diamond\!> B \in K_{\bar{B}}^{-}.$$ [13]

In following discussions we will call the first disjunct of the right-hand side the $\Box$-*version* of $\rightarrow$, and the second disjunct the $\Diamond$-*version* of $\rightarrow$.

To deal with connectives like *though*, we will need some picture of "the contrary" $\multimap\!\!<$ of a conditional connection, that is to say, an interpretation for conjunctions indicating a somehow counteractive connection. There are two immediate possibilities, and I cannot think of a criterion to decide which of the two is the better:

$$(35) \qquad A \prec B \in K \Leftrightarrow \neg A \gg B \in K_{\bar{B}}^{-} \veebar \neg A \Diamond\!> B \in K_{\bar{B}}^{-}.$$

$$(36) \qquad A \prec B \in K \Leftrightarrow A \gg \neg B \in K_{\bar{B}}^{-} \veebar A \Diamond\!> \neg B \in K_{\bar{B}}^{-}.$$

Fortunately, as is easily verified through application of (19) and (23), (35) and (36) are equivalent, with the respective $\Box$-versions and $\Diamond$-versions changing rôles. As a convention, I take (35) as the standard formulation for reference when speaking of $\Box$-versions and $\Diamond$-versions,[14] and call $\prec$ the *universal contra-conditional*. As is desirable, $A \rightarrow B \in K$ and $A \prec B \in K$ cannot hold at the same time – it is impossible for A to be simultaneously positively and negatively relevant for B. Of course, there is a third possibility: A need neither promote nor handicap B – they can be disconnected. This state of affairs brings into the mind the *universal unconditional* $\dashv$, which can be put:

(37) $A \dashv B \in K \Leftrightarrow A \rightarrow B \notin K \;\&\; A \prec B \notin K.$

This completes the disjoint and exhaustive set of universal conditionals that underlie the variety of actually realized natural language conditionals.

7. NATURAL LANGUAGE CONDITIONALS – THESES

In speaking of natural language conditionals I would like to include *if*, *if . . . . might*, and *even if*, all of them with the indicative mood as well as with the subjunctive mood (these are "the *if*s"), *though*, and *because* (both only with the indicative mood, naturally).[15] I refer to the subordinate clause as the "antecedent" and to the main clause as the "consequent" in the relevant complex sentences.

These, now, are my theses on natural language conditionals:

(38) Natural language conditionals are about acceptance in belief states.

(39) Natural language conditionals are about acceptance of universal conditionals ("principal conditions") and about acceptance of the corresponding antecedents and consequents ("accessory conditions").

(40) *If* and *because* are realizations of the universal pro-conditional; *though* is a realization of the universal contra-conditional; *even if* is a realization of the universal unconditional.[16]

(41) Realizations of the universal pro-conditional are accepted only if the acceptance status of the antecedent and the consequent are equal; realizations of the universal contra-conditional and unconditional are accepted only if the consequent is accepted.

(42) *Because* and *though* are accepted only if the antecedent is accepted; the *if*s are accepted only if the antecedent is not accepted, and it is the grammatical mood that indicates the exact acceptance status of the antecedent.[17]

8. NATURAL LANGUAGE CONDITIONALS – DETAILED EXPOSITION

For the sake of simplicity and conciseness, (38)–(42) were not presented as an explicit analysis of the natural language conditionals. They require some justification. Let me try to supply some support by giving the acceptability conditions separately and checking their consequences.

Starting with the conditional in the narrowest sense, viz., *if*, I have to defend three rather controversial hypotheses. First, as to (42), why shouldn't we accept both *A* and *If A B*? I hope you concede that we would also accept *B* in that situation. My answer then is that we either assume a "conditional connection" between *A* and *B*, then we have to accept *Because A B* (since we actually accept *A* and *B*), or we assume no conditional connection, in which case we have to accept either *Though A B* (if *A* is adverse to *B*) or cannot accept more than the inexpressive conjunction *A and B* (if *A* is irrelevant to *B*). But we do not accept *If A B*, for this would imply ignorance of *A* and a positive connection between *A* and *B*. Let me emphasize that the difference in the acceptance status of the antecedent as laid down in (42) is exactly the argument the Mainstream Analysis falls victim to.

Second, as to (42), isn't it shown conclusively by Adams' famous Kennedy example that a joint analysis of indicative and subjunctive conditionals is impossible? For, as Adams and many others claim, we all accept

(43) If Oswald did not kill Kennedy, then someone else did.

and, simultaneously,

(44) If Oswald had not killed Kennedy, then Kennedy could still be alive.

But precisely this I bluntly deny. If you accept (43), then you do not believe to know Kennedy's murderer; but if you accept (44), then you do: it was Oswald, in your opinion. And, of course, both epistemic commitments are mutually exclusive. Only our uncertainty whether we should know that Oswald killed Kennedy gives the example its persuasive power: (43) induces a context where we – like the police inspector setting about his investigations – are ignorant of the assailant, while (44) at once arranges the scene so that we – well-informed by the media – are aware of the facts.[18]

Third, as to (41), aren't there counter-examples to the claim that the antecedent and the consequent of a realization of the universal pro-conditional must be of equal acceptance status? Remember Bette who doesn't like Anthony any more. The critical case is the following. Suppose you know that Anthony comes to the party but you don't have any idea whether Bette plans to show up. It seems you can accept

> If Anthony stayed at home, Bette would go to the party.

However, I think it may well be that someone would protest: "Now, it ain't a settled affair at all that Bette isn't going to the party." Thereupon you have to be more precise about what you really meant:

> If Anthony stayed at home, Bette certainly would go to the party.

And you have a consequent whose negation you accept.

As a result of (40)–42), *if* (with either mood) is the only natural language conditional where the consequent is not accepted. This brings about that *if* is the only natural language conditional with a $\Diamond$-version to be analysed separately. In all other cases it would be pointless to apply a *might*-operator to the consequent – you already accept it. If a *might* is really found in the consequent, it can be conceived as an integral part of that consequent.

At last we are able to explicitly specify the acceptability conditions of indicative and subjunctive conditionals. In the sequel I use variants of $\rightarrow$ instead of $>$ to mark the distinction between this analysis based on universal conditionals and that of sections 4 and 5. I am sorry to say that due to the explicit $\Diamond$-versions needed there is another intermediate stage not realized in natural language:

(45) $A\ {}^{o}\!\!\rightarrow B \in K \Leftrightarrow A \rightarrow B \in K \ \&\ A, \neg A, B, \neg B \notin K.$

(46) $A\ {}^{r}\!\!\rightarrow B \in K \Leftrightarrow A \rightarrow B \in K \ \&\ \neg A, \neg B \in K.$

One arrives at the natural language *if* by taking the $\Box$-version of $\rightarrow$ and at the natural language *if ... might* by taking the $\Diamond$-version of $\rightarrow$; of course, ${}^{o}\!\!\rightarrow$ is the indicative[19] and ${}^{r}\!\!\rightarrow$ is the subjunctive case:

(47) $$A\ {}^{o}\Box\!\!\rightarrow B \in K \Leftrightarrow A \gg B \in K_{\bar{B}} \ \&\ A, \neg A, B, \neg B \notin K$$
$$\Leftrightarrow A \supset B \in K \ \&\ A, \neg A, B, \neg B \notin K.$$

(48) $$A\ {}^{o}\Diamond\!\!\rightarrow B \in K \Leftrightarrow A \Diamond\!> B \in K_{\bar{B}} \ \&\ A, \neg A, B, \neg B \notin K$$
$$\Leftrightarrow \neg A \supset \neg B \in K \ \&\ A, \neg A, B, \neg B \notin K.$$

(49) $$A\ {}^{r}\Box\!\!\rightarrow B \in K \Leftrightarrow A \gg B \in K_{\bar{B}} \ \&\ \neg A, \neg B \in K$$
$$\Leftrightarrow B \in K_{A} \ \&\ \neg A, \neg B \in K.$$

(50) $$A\ {}^{r}\Diamond\!\!\rightarrow B \in K \Leftrightarrow A \Diamond\!> B \in K_{\bar{B}} \ \&\ \neg A, \neg B \in K$$
$$\Leftrightarrow \neg B \notin K_{A} \ \&\ \neg A, \neg B \in K.$$

One can easily show that the upper lines of (47–(50) reduce to the final lower lines (using particularly (C5), (R5), (9), and the fact that belief sets are closed under tautological implication). I don't want to discuss these results here; in any case, a good deal of justification for (47), (49) and (50) is given in Gärdenfors (1981).[20]

The last pro-conditional to be looked at is *because*. Following the above-mentioned argument, we don't have to keep apart the $\Box$-version and $\Diamond$-version and can proceed to the natural language $^{a}\!\!\rightarrow$ in one step:

(51) $$A \,{}^{a}\!\!\rightarrow B \in K \Leftrightarrow A \rightarrow B \in K \;\&\; A, B \in K$$
$$\Leftrightarrow (B \in (K_{\bar{B}})_A \vee\!\!/ \neg B \in (K_{\bar{B}})_{\neg A}) \;\&\; A, B \in K.$$

The simplification is done by (13) and (C3). It is illuminating to consider cases with regard to the retention of A in $K_{\bar{B}}$. In the case of $A \in K_{\bar{B}}$, one immediately sees that the $\Box$-version is impossible (because of (9) and (C4)), and there remains the condition of the $\Diamond$-version to be considered. In the case of $A \notin K_{\bar{B}}$, on the contrary, the $\Diamond$-version is obviously satisfied (R5) and $\neg A \supset \neg B \in K_{\bar{B}} = K \cup K_{\neg B}$, since $A \in K$ and $\neg B \in K_{\neg B}$); therefore, $A \notin K_{\bar{B}}$ can only come to pass in a nontrivial way if the $\Box$-version is intended, the acceptability condition of which can be transformed to $A \supset B \in K_{\bar{B}}$ (by (C3) and (R5)), or equivalently $\neg A \in K_{\neg B}$ (by contraposition of the material implication, (5) and (10)).

We pause for a moment to see if our analysis can give some correct predictions. Recall Anthony and Bette, again, and take for granted that both will go to the party and that Carl will be present, too (Bette has got an eye on Carl now). We accept

> It is not because Anthony goes to the party that Bette goes to the party.

It appears correct to symbolize this by $\neg(A \,{}^{a}\!\!\rightarrow B) \in K$, which implies $A \,{}^{a}\!\!\rightarrow B \notin K$, that is

(52) $$(B \notin (K_{\bar{B}})_A \vee\!\!/ B \in (K_{\bar{B}})_{\neg A})$$
$$\& \; (\neg B \notin (K_{\bar{B}})_{\neg A} \vee\!\!/ \neg B \in (K_{\bar{B}})_A).$$

Let's check the intuitive adequacy of this theoretical prediction. Suppose we didn't know of Bette's decision to attend the festivity. Would we consequently drop our conviction that Anthony goes to the party? Certainly we would not, since Anthony's presence is at best irrelevant, probably even adverse to Bette's presence, i.e., it increases the credibility of our very supposition. Thus $A \in K_B^-$, $(K_B^-)_A = K_B^-$, and the first term of (52) holds by (C4), while the last term contradicts $\neg B \notin K$ (by (C3)). We have to maintain $\neg B \notin (K_B^-)_{\neg A}$. But, given ignorance as to Bette's plans, the assumption that Anthony stayed away will by no means establish Bette's absence, and we are done.

Compare this with the real motive of Bette's presence:

Because Carl goes to the party, Bette goes to the party.

This, being the antithesis of the foregoing sentence of our party chatter, is usually taken to mean that the antecedent necessitates the consequent. Doubts about Bette's presence would also entail doubts about Carl's presence, and in contrast to Anthony's case we intuitively have $C \notin K_B^-$. And this is exactly what the present analysis has foretold for the $\Box$-version of ${}^a\!\!\rightarrow$.

We now switch over to contra-conditionals. Keep the example and suppose that Bette used to be anxious not to cross a disappointed admirer's path. We accept

Though Anthony goes to the party, Bette goes to the party.

Here we definitely expect $A \in K_B^-$ – why exclude a belief from a contraction if that very belief makes the contraction more plausible? It is pleasing that our analysis predicts this as well. Taking ${}^a\!\!\prec$ as a symbol for *though*, the analysis according to (40)–(42) runs as follows:

$$(53) \qquad A \,{}^a\!\!\prec B \in K \Leftrightarrow A \prec B \in K \;\&\; A, B \in K$$
$$\Leftrightarrow (B \in (K_B^-)_{\neg A} \vee\!\!\!/ \; \neg B \in (K_B^-)_A) \;\&\; A, B \in K.$$

The simplification is again done by (13) and (C3). Assume for the sake of argument that $A \notin K_B^-$. Then the $\Box$-version amounts to $\neg A \supset B \in K_B^- \subseteq K_{\neg B}$; since $\neg B \in K_{\neg B}$ it follows that $A \in K_{\neg B}$ and also $A \in K_B^- = K \cap K_{\neg B}$, in contradiction to the assumption. The $\Diamond$-version implies that $\neg B \notin (K_B^-)_{\neg A}$ (otherwise, by (13), $\neg B \in K_B^- \subseteq K$ which is incompatible with $B \in K \neq K_\perp$). According to our assumption this amounts to $\neg B \notin (K_B^-)^+_{\neg A}$, i,e., $\neg A \supset \neg B \notin K_B^-$. But $A \in K$ and $\neg B \in K_{\neg B}$, so $A \vee \neg B \in K \cap K_{\neg B} = K_B^-$ by (11), and we have a contradiction. Hence we have gained the intuitively desired result $A \in K_B^-$. But now we see at once that the $\Diamond$-version of ${}^a\!\!\prec$ is self-defeating: it comes out at $\neg B \in K_B^-$ which is forbidden by (C3) and the accessory condition $B \in K$. Thus the sole principal condition for *though* is $B \in (K_B^-)_{\neg A}$.

One would suppose that *even if* is the contra-conditional in the case of an antecedent that is not accepted. Let me show why this is illusory. On the basis of the foregoing theses and simplifications you will have no difficulty in checking the following conditions. I use ${}^{o}{-}\!\!<$ and respectively ${}^{r}{-}\!\!<$ for the supposed indicative and subjunctive *even if*:

$$\text{(54)}\qquad \begin{aligned} A\,{}^{o}{-}\!\!< B \in K &\Leftrightarrow A \,{-}\!\!< B \in K \;\&\; A, \neg A \notin K \;\&\; B \in K \\ &\Leftrightarrow \neg A \supset B \in K^{-}_{B} \;\&\; A, \neg A \notin K \;\&\; B \in K \\ &\Leftrightarrow A \in K_{\neg B} \;\&\; A, \neg A \notin K \;\&\; B \in K. \end{aligned}$$

$$\text{(55)}\qquad \begin{aligned} A\,{}^{r}{-}\!\!< B \in K &\Leftrightarrow A \,{-}\!\!< B \in K \;\&\; \neg A, B \in K \\ &\Leftrightarrow (B \in (K^{-}_{B})_{\neg A} \mathbin{\vee\!\!/} \neg B \in (K^{-}_{B})_{A}) \\ &\qquad \& \; \neg A, B \in K. \end{aligned}$$

Some comments are in order. As to ${}^{o}{-}\!\!<$, the $\Diamond$-version leads to a contradiction, so that the principal condition of the $\Box$-version remains; while the second line of (54) looks rather plausible, the third line, which is in fact equivalent to the second, is intuitively too strong. For instance, imagine yourself being ignorant of Anthony's but sure about Bette's going to the party and accept

> Even if Anthony goes to the party, Bette will go to the party.

However, on the hypothetical condition that Bette didn't come, you would not exchange your ignorance about Anthony for the belief that he would attend the party. For, from the premises of this example, his presence could not prevent Bette from going to the party.

As to ${}^{r}{-}\!\!<$, there is perfect symmetry with the situation about *because*. In the case of $\neg A \in K^{-}_{B}$, we immediately recognize that the $\Box$-version is impossible, and there remains the condition for the $\Diamond$-version. In the case of $\neg A \notin K^{-}_{B}$, the $\Diamond$-version is obviously satisfied, and the $\Box$-version reduces to $\neg A \supset B \in K^{-}_{B}$, or equivalently $A \in K_{\neg B}$. In fact, comparing (55) with (51), one realizes that $A\,{}^{r}{-}\!\!< B \in K$ is equivalent to $\neg A \,{}^{a}\!\!\rightarrow B \in K$. This definitely shows that, without further refinements, ${}^{r}{-}\!\!<$ cannot even be a partial explication of the subjunctive *even if*:

> Even if Anthony went to the party, Bette would go to the party.

and

> Because Anthony doesn't go to the party, Bette goes to the party.

are by no means synonymous but, on the contrary, appear to have mutually exclusive acceptability conditions.

What, then, can we learn from this situation? It seems that contra-conditionals are not the only device for communicating a counteractive connection. The *even if* of natural language, though frequently indicating such a counteractive connection, is not a contra-conditional, for the adverse circumstances mentioned in the antecedent are not effective enough to overcome the belief in the consequent. The consequent is accepted unconditionally, and *even if* is an unconditional. To prepare the analysis of unconditionals, we shall give the basic idea (37) a more convenient shape:

$$
\begin{aligned}
(56)\qquad A \dashv B \in K &\Leftrightarrow A \to B \notin K \mathbin{\&} A \prec B \notin K\\
&\Leftrightarrow (B \in (K^-_B)_A \Leftrightarrow B \in (K^-_B)_{\neg A}) \mathbin{\&}\\
&\qquad (\neg B \in (K^-_B)_A \Leftrightarrow \neg B \in (K^-_B)_{\neg A})\\
&\Leftrightarrow B \notin (K^-_B)_A \mathbin{\&} B \notin (K^-_B)_{\neg A} \mathbin{\&}\\
&\qquad (\neg B \in (K^-_B)_A \Leftrightarrow B \in (K^-_B)_{\neg A}).
\end{aligned}
$$

The theses (40)–(42) finally yield the following acceptability conditions for the indicative and subjunctive *even if*, which are symbolized by ${}^{o}\!\dashv$ and ${}'\!\dashv$ respectively:

$$
\begin{aligned}
(57)\qquad A\,{}^{o}\!\dashv B \in K &\Leftrightarrow A \dashv B \in K \mathbin{\&} A, \neg A \notin K \mathbin{\&} B \in K\\
&\Leftrightarrow A \supset B, \neg A \supset B \notin K^-_B \mathbin{\&} A, \neg A \notin K \mathbin{\&} B \in K\\
&\Leftrightarrow A, \neg A \notin K_{\neg B} \mathbin{\&} A, \neg A \notin K \mathbin{\&} B \in K.
\end{aligned}
$$

$$
\begin{aligned}
(58)\qquad A\,{}'\!\dashv B \in K &\Leftrightarrow A \dashv B \in K \mathbin{\&} \neg A, B \in K\\
&\Leftrightarrow B, \neg B \notin (K^-_B)_A \mathbin{\&} \neg A, B \in K.
\end{aligned}
$$

Observe that due to the common accessory condition $B \in K$, in (57) and (58) $A \dashv B \in K$ reduces to $B, \neg B \notin (K^-_B)_A, (K^-_B)_{\neg A}$. As to (57), the simplification is done by (R5), (5), contraposition of the material implication, (C6), and (10). As to (58), verify that $\neg A \notin K^-_B$ leads to a contradiction. The implication of $\neg A \in K^-_B$, though not completely implausible, is certainly a very strong stipulation. I suppose that we have to penitently resume the examination of (55) for the analysis of *even if*, trying to avoid the absurd equivalence to a *because* clause with negated antecedent, perhaps by distinguishing normal and exceptional cases with regard to the acceptance status of A in K^-_B. But this is too sophisticated and questionable a matter to be treated here.

I don't know of a natural language realization of the unconditional in which the antecedent and the consequent are accepted. For the sake of completeness, however, we list the acceptability condition:

$$(59) \qquad A\ {}^{a}\!\!\dashv B \in K \Leftrightarrow A \dashv B \in K \;\&\; A, B \in K$$
$$\Leftrightarrow B, \neg B \notin (K_{\bar{B}})_{\neg A} \;\&\; A, B \in K.$$

It is obvious that $A\ {}^{a}\!\!\dashv B \in K$ is equivalent to $\neg A\ {}^{r}\!\!\dashv B \in K$. This gives rise to speculation as to why ${}^{a}\!\!\dashv$ is not realized: it is because of the economy of natural language. Ignoring the above-mentioned suspicion, exactly the same reason applies to ${}^{r}\!\!\prec$ (remember, $A\ {}^{r}\!\!\prec B \in K \Leftrightarrow \neg A\ {}^{a}\!\!\rightarrow B \in K$). On the other hand, I am not so sure about the non-existence of ${}^{o}\!\!\prec$ in natural language (remember, (54) just yielded an acceptability condition which is too strong). There is some evidence that the indicative *even if* is best caught by a disjunctive combination of ${}^{o}\!\!\dashv$ and ${}^{o}\!\!\prec$, which leads to the acceptability condition $A \supset B \notin K_{\bar{B}}$, or equivalently $\neg A \notin K_{\neg B}$.[21]

The formal results of my theses are summarized synoptically in table I.

9. PROSPECTS

I believe work has to proceed in two directions. The first is with respect to the theoretical modelling of states of belief. There are two important ways to give a more informative picture of belief states: probability functions (the old Bayesian way), and the so-called ordinal conditional functions (the new method of Spohn, 1986). Both ways admit plausible definitions of expansions, contractions, and revisions in such a way that Levi's thesis can be proven. As to the probabilistic approach, acceptance can be identified with probability assignment of 1, but then we have to provide for conditionalization on zero antecedents. Another possibility would be to postulate that the probabilities of all contingent sentences lie strictly between 0 and 1, and to take sufficiently high probability as acceptance, getting on with generalized conditionalization in Jeffrey's manner, again with weighting parameters strictly between 0 and 1. However, we must put up with the loss of logical closure of the set of accepted sentences, as the lottery paradox shows. This flaw is avoided by Spohn's ordinal conditional functions, the dynamics of which make use of a safety-parameter, too. A problem revealed by both probability functions and conditional functions is that

TABLE I

Acceptability conditions of natural language conditionals.

Accessory conditions	Without explicit *MIGHT*			With explicit *MIGHT*	
	$B \in K$			$B, \neg B \notin K$	$\neg B \in K$
	THOUGH $A \overset{a}{\multimap} B \in K$	* $A \overset{a}{\dashv} B \in K$	*BECAUSE* $A \overset{a}{\rightarrow} B \in K$		
$A \in K$	$\square$-vers. $B \in (K_{\bar{B}})_{\neg A}$ only if $A \in K_{\bar{B}}$ $\Diamond$-vers. contradictory	$B, \neg B \notin (K_{\bar{B}})_{\neg A}$ only if $A \in K_{\bar{B}}$	$\square$-vers. $A \supset B \in K_{\bar{B}}$ or eq. $\neg A \in K_{\neg B}$ only if $A \notin K_{\bar{B}}$ $\Diamond$-vers. $\neg B \in (K_{\bar{B}})_{\neg A}$ trivial if $A \notin K_{\bar{B}}$		

IFS	contra-conditionals	unconditionals	(pro-)conditionals	
$A, \neg A \notin K$	* (ind. *EVEN IF*?) $A\,{}^{o}\!\!-\!\!\!< B \in K$ ——— $\Box$-vers. $\neg A \supset B \in K_{\bar{B}}$ or eq. $A \in K_{\neg B}$ $\Diamond$-vers. contradictory	indicative *EVEN IF* $A\,{}^{o}\!\!-\!\!\!\mid B \in K$ ——— $A \supset B, \neg A \supset B \notin K_{\bar{B}}$ or eq. $A, \neg A \notin K_{\neg B}$	indicative *IF* $A\,{}^{o}\Box\!\!\rightarrow B \in K$ ——— $A \supset B \in K$ or eq. $\neg A \in K_{\neg B}$ ——— ind. *IF . . . MIGHT* $A\,{}^{o}\Diamond\!\!\rightarrow B \in K$ ——— $\neg A \supset \neg B \in K$	
$\neg A \in K$	* (subj. *EVEN IF*??) $A\,{}^{r}\!\!-\!\!\!< B \in K$ ——— $\Box$-vers. $\neg A \supset B \in K_{\bar{B}}$ or eq. $A \in K_{\neg B}$ only if $\neg A \notin K_{\bar{B}}$ $\Diamond$-vers. $\neg B \in (K_{\bar{B}})_A$ trivial if $\neg A \notin K_{\bar{B}}$	subjunctive *EVEN IF* $A\,{}^{r}\!\!-\!\!\!\mid B \in K$ ——— $B, \neg B \notin (K_{\bar{B}})_A$ only if $\neg A \in K_{\bar{B}}$		subjunctive *IF* $A\,{}^{r}\Box\!\!\rightarrow B \in K$ ——— $B \in K_A$ or eq. $B \in (K_{\bar{B}})_A$ ——— *subj. IF . . . MIGHT* $A\,{}^{r}\Diamond\!\!\rightarrow B \in K$ ——— $\neg B \notin K_A$

because cannot be captured completely by the disjunction of *if* and *if . . . might* as suggested in (33); it seems that we will need a conditional of the form *if . . . rather*, or something similar.

The second direction investigation should follow is a more practical one. To be sure, my procedure is a top-down approach, based on ideas of philosophy (especially, philosophy of science). For a genuine analysis of natural language, which must properly be bottom-up, one has to test whether the results presented in section 8 are adequate to the current use of the *if*s, *though*, and *because*. In particular, the logic of my natural language conditionals has to be subjected to a thorough examination. I have become suspicious that misfits and fallacies may eventually make clear the need to consider a pragmatic relevance relation, which plays a rôle in natural language conditionals, over and above the epistemic relevance relation I've been riding around upon since the introduction of the Strong Ramsey test (19).[22]

Be that as it may, I contend that any conditional logic should be able to comfortably come to terms with *even if*, *though*, and *because*. At any rate, my analysis has given an answer to the question of the exact relationship between *if* and *because*. The Mainstream Analysis was rejected on account of (42). And my theses have delivered the result that the $\Box$-version of *Because* $A\,B$ (probably the version normally intended) is equivalent to the subjunctive or "counterfactual" conditional sentence *If* $\neg B \neg A$. Thus, despite similarities in the titles, I would like to reject Ryle's suggestion and prefer that of Goodman.[23]

NOTES

* I am grateful to Peter Gärdenfors and Wolfgang Spohn for helpful comments on an earlier version of this paper and to William Finnoff for correcting my English.

1 I treat *since* as a synonym of *because*.

2 Accordingly, Goodman calls *because* (in fact, he chooses *since*) the "factual conditional".

3 The only instance where it seems undeniable that I give assertability conditions instead of acceptability conditions is the indicative *might* conditional (cf. note 20). It might be instructive to treat my accessory conditions as presuppositions (not as conjuncts of the acceptability conditions as I treat them) and try to carry through reductions analogous to section 8.

4 Roughly, his final suggestion (Spohn 1983, p. 388) says: a proposition A is a *direct cause* of a proposition B (in the actual world w_0) iff A and B are true (in w_0), A is temporally prior to B, and, given the obtaining circumstances (in w_0), A is a reason for B. The obtaining circumstances are taken to be the whole history of the real world up to B,

except the "factor" which A belongs to. A major problem to be solved is how to get from direct causes to causes.

[5] By contrast, the corresponding symbolic abbreviations of the metalanguage are $\neg\!\!\!\neg$, &, $\vee\!\!\!\vee$, $\Rightarrow$, and $\Leftrightarrow$.

[6] The reader should not be deterred from reading further by the following symbol menagerie. The taxonomy is simple. Arrows $>$ mark preliminary analyses of natural language conditionals, arrows $\rightarrow$ (resp., $\multimap$, $-\!|$), introduced in section 6, mark (specializations of) universal conditionals. A superscript placed before an arrow is to indicate the acceptance status of the antecedent: "^{a}" stands for "accepted", "^{r}" for "rejected", and "^{o}" for "open". Lastly, sometimes subspecies are classified with the help of the box $\Box$ and the diamond $\Diamond$.

[7] Further and perhaps more striking reason to abandon (14) is adduced by a recent theorem of Gärdenfors (1984b) implying that (14) together with (R5) leads to triviality.

[8] Of course, due to the strength of (19), the logic of $\gg$ is rather poor. For reasons given in later sections, I think that the logics of ${}^r\Box\!\!\rightarrow$, ${}^o\Box\!\!\rightarrow$, ${}^a\!\!\rightarrow$, etc., are far more important and interesting than that of the connective interpreted by the Strong Ramsey test alone. It is surprising that the double pragmatization (relevance plus accessory conditions) reduces to principal conditions often identical with the established semantic analyses. The triviality result of Gärdenfors (1984b) is prevented by the accessory conditions.

[9] At this juncture, it is interesting to compare the alternative analysis with what could be called the contribution of David Lewis to the analysis of *because*. He might say that *Because A B* is synonymous to *B is causally dependent on A* which for its part is explained thus (cf. Lewis, 1973b, p. 563, and his interpretation of counterfactuals in 1973a):

$$\begin{aligned} A \,{}^a\!\!> B \in K &\Rightarrow A > B \in K \;\&\; \neg A > \neg B \in K \\ &\Leftrightarrow B \in K_A \;\&\; \neg B \in K_{\neg A} \\ &\Leftrightarrow A \gg B \in K \;\&\; A \Diamond\!\!> B \in K. \end{aligned}$$

If (3) is intuitively adequate – and there is good evidence that it is – Lewis' explication is too strong for an analysis of *because* sentences.

[10] Cf. for instance Kuhn: "Through his [viz., Hauksbee's] researches ... repulsion suddenly became *the* fundamental manifestation of electrification, and it was then attraction that needed to be explained." (1962, pp. 116f), "Lavoisier's reform ... ended by depriving chemistry of some actual and much potential explanatory power." (1962, p. 106), and, more generally, "Changes in the standards governing permissible problems, concepts, and e x p l a n a t i o n s can transform a science." (1962, p. 105, my interspacing)

[11] Gärdenfors indicates the use of contractions in explanatory contexts in (1980, p. 412; 1981, p. 205; 1982, note 4, and 1984a, p. 139).

[12] If this argument from explanations couldn't convince you of the necessity to take (33) instead of the simpler methods (29) or (30), you may be satisfied with the information that the latter don't yield a general analysis along the lines of sections 6 and 7. For example, (29) wouldn't admit of the acceptance of *Though A B* (the contra-conditional with $A, B \in K$), while (30) would separate (35) from (36) and rule out indicative *might* conditionals.

[13] You could try to drive the universalization still further by taking the symmetric $(K_{\bar{B}}^-)_{\neg B}^-$ instead of $K_{\bar{B}}^-$. Given my assumptions about natural language conditionals (see section 7), a difference would follow only for counterfactual conditionals. However, it is

(34) that will prove to be in a satisfactory accordance with the established interpretation of counterfactuals.

[14] The distinction between $\Box$-versions and $\Diamond$-versions of contra-conditionals will eventually turn out superfluous in section 8. This rather justifies the uncertainty whether to take (35) or (36).

[15] Maybe we could include conjunctions like *but* and *therefore*, the former being to *though* as the latter to *because*.

[16] I cannot think of a conjunction functioning as an unconditional when possible antecedents and consequents are accepted. Regarding the question whether *even if* might be a contra-conditional, see section 8.

[17] This general statement neglects the fact that (*even*) *if* sometimes means (*even*) *though* and vice versa (consult the dictionaries); I may overemphasize the functional discriminations to some degree especially between contra-conditionals and unconditionals. Since *even if* can be synonymously replaced by *if* . . . *still* (*still* in the main clause), it may be problematic to treat *even if* as a lexical unit at all. Furthermore I suppress the well-known observation that the grammatical mood may be misleading if the conditional is about future events; cf. Thomson and Martinet (1980, p. 188): "Sometimes, rather confusingly, type 2 [viz., subjunctive conditionals] can be used as an alternative to type 1 [viz., indicative conditionals] for perfectly possible plans and suggestions."

[18] Similar examples can already be found in Ramsey (1931, p. 249) and Mackie (1962, p. 71). I regard the process induced by these pairs to be a paradigm example of what Lewis (1979b) calls "conversational scorekeeping". Though I think that the answer given in the text is sufficient to meet the objections, discussions with Wolfgang Spohn have convinced me that there *is* a further difference between indicative and subjunctive conditionals. In my opinion, both obey the same form of the (Strong) Ramsey test, but the methods of revision differ. As regards the indicative case, one has to imagine that one *really* gets the antecedent as a *new incontestable piece of information*, and the revision is based on a relation of epistemic importance reflecting degrees of confirmation. In the subjunctive case, one has to assume the antecedent *for hypothesis*, with the epistemic importance involving considerations of the kind discussed by Lewis (1979a).

[19] Of course, ${}^{o}\Diamond\!\!\rightarrow$ can be read as *if* . . . *may* as well.

[20] I grant that (48) is certainly much more an assertability condition than an acceptance condition, since for instance $A\,{}^{o}\Diamond\!\!\rightarrow B \in K$ and $A\,{}^{o}\Diamond\!\!\rightarrow \neg B \in K$ cannot hold at the same time. (I am indebted to Peter Gärdenfors for this observation.)

[21] Cf. Goodman's (1954, note 2) hesitation whether to interpret *even if* as the contradictory or the contrary of *if*. His observation that (the subjunctive) *Even if A B* is normally meant as the negation of the counterfactual *If A B* (Goodman, 1954, pp. 15f; note that this is exactly Lewis' (1973a, p. 2) stipulation for *might* counterfactuals) is not sufficient for an account of *even if*, if the following idea is right: I suggest that the negation of a natural language conditional is accepted iff its accessory conditions are accepted, but its principal condition is not; this means, for the case in question, that $\neg(A\,{}'\Box\!\!\rightarrow \neg B) \in K \Leftrightarrow \neg B \notin K_A \;\&\; \neg A, B \in K$ (cf. (49)). But the characteristic condition $\neg B \notin K_A$ is certainly too weak for *Even if A B* (instead, the present suggestion confirms Lewis). Anyway, as (40)–(42) make the acceptance of *Even if A B* imply $A \notin K \;\&\; B \in K$, Goodman's proposal to call *even if* the "semifactual conditional" fits in nicely with my theses. Gärdenfors' (1981, p. 209) acceptability condition $B \in (K^{-}_{A})^{-}_{\neg A}$ for *Even if A B* is

also too weak: it is always satisfied if $A, \neg A \notin K$ and $B \in K$, a situation which is necessary but not at all sufficient for the indicative *even if*.

[22] I think of something like Van Fraassen's (1980, ch. 5) relation of explanatory relevance.

[23] However, if I had followed the lines indicated in note 13, I would have confirmed the Rylean idea.

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Manuscript received 16 August 1985

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