An Indexical Theory of Conditionals*

Dialogue, Vol XX, No. 4 (December, 1981)

LANGUAGE THEORISTS have recently come to have an increasing appreciation for the fact that context contributes heavily in determining our interpretation of what is said. Indeed, it now seems clear that no complete understanding of a natural language is possible without some account of the way in which context affects our interpretation of discourse. In this paper, I will attempt to explore one facet of the language – context relationship, namely, the relation between conditionals and context. The first part of the paper develops an account of truth for conditionals which allows them to depend on momentary features of the context in which they are uttered. In the second half of the paper, comparisons with other recent theories of the conditional will be considered. Particular attention will be given to the problem of whether the conditional really violates classical inferences such as Hypothetical Syllogism and Contraposition as has often been claimed in recent years.

SEMANTICS

It is helpful to begin with a simple, though formally inadequate, picture of the way in which conditionals depend on context. A speaker who asserts a conditional could be thought of as intending that his conditional be interpreted and judged true or false by reference to a certain set of tacit suppositions. The conditional is true if those auxiliary suppositions are true and if the suppositions plus the antecedent imply the consequent. Under this sort of account, the set of suppositions is a contextual index since it can change from one occasion to another. Truth may be thought of as a relation

* I am grateful to William Cooper for helpful comments on an earlier draft of this paper.

between the conditional sentence and the contextual index which the speaker has in mind.[1] These rough intuitions can be formulated more precisely in terms of a truth condition such as the following.

(T_1) $p \rightarrow q$ is true under Γ iff (1) Γ logically implies $p \supset q$, and (2) every member of Γ is true.

Why should we be interested in developing a semantics for conditionals such as T_1? I will suggest three reasons. First, T_1 provides a way of formulating certain opinions about conditionals that have been common in previous informal literature. For example, T_1 seems to capture F.P. Ramsey's often cited suggestion that an argument about a conditional of the form 'If p, then q' can be settled by adding p hypothetically to one's stock of knowledge and determining whether the result entails q.[2] A speaker's stock of knowledge might be viewed as consisting of a set of sentences Γ which he knows to be true. A conditional $p \rightarrow q$ asserted by that speaker will be true if the antecedent p in conjunction with Γ implies q.[3]

A second reason for being interested in this type of semantics is its relative conservatism. In T_1 we have neither a commitment to possible worlds nor (therefore) to any notion of similarity of possible worlds. These notions are prominent in the recent analyses proposed by Lewis [9], Stalnaker [17] and others. But they are regarded with suspicion by those who object to modal notions. Some philosophers would argue that if possible worlds are an essential element of any descriptively adequate analysis of conditionals, then this simply shows that English conditionals are fundamentally unclear. Thus the parsimony of T_1 makes it potentially attractive provided, of course, that T_1 does not turn out to be deficient in other respects.

A third reason for pursuing a semantics of this sort is that it provides an appealing analysis of certain types of conditionals that otherwise tend to be problematic. For example, it seems silly to debate which of the following is "objectively" true.[4]

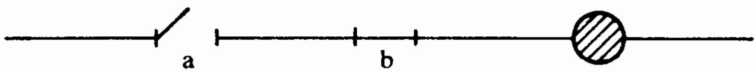
If Apollo had been a man, he would have been mortal.
If Apollo had been a man, not all men would have been mortal.

The sensible answer seems to be that either conditional may properly be deemed true depending on whether, in the context in question, the speaker assumes (and presumably intends to emphasize) certain facts about men or certain facts about Apollo.

The suggestion that the truth of subjunctives is relative to a speaker's assumptions has often been advanced before. What is perhaps less

[redacted]

common is the proposal that indicatives can be treated in this way also. Yet examples such as the following seem to suggest this. Suppose that two speakers S_1 and S_2 (not in conversation with one another) are making indicative conditional assertions about an electric circuit. The circuit consists of two switches and a lamp wired to an appropriate power source.



As in the diagram above, let us suppose that switch a is open, b is closed, and the lamp off. Speakers S_1 and S_2 both know (presumably as a result of inductive evidence) the basic principle governing the circuit, i.e. that the light will be on iff both switches a and b are closed. However, S_1 and S_2 differ in their knowledge of other particulars. S_1 and his audience know that switch b is closed but they do not know or believe anything about the position of switch a or the state of the lamp. Imagine, if you like, that switch a and the lamp have been concealed from S_1's view. It seems reasonable that S_1 could be correct in counting (1) true and (2) false.

(1) If a is closed, then the lamp is on.

(2) If a is closed, then switch b is open.

On the other hand, suppose that speaker S_2 and his listeners know that the lamp is off but this time both switches are concealed. Hence, S_2 does not know or have any belief about the positions of switches a and b. In that case, S_2 and his audience could correctly assert the truth of (2) and deny (1).

There is no paradox in the difference of truth-values which S_1 and S_2 arrive at if we assume that the truth conditions (1) and (2) are correctly given by T_1. That is, (1) is true and (2) is false relative to the facts known by S_1. On the other hand, (2) is true and (1) is false relative to what is known by S_2.

Those who wish to avoid relativizing truth may of course argue that (1) and (2) can be accounted for in other ways. For example, given a distinction between objective truth and reasonable assertability, one might claim that (1) and (2) are both objectively true but not both assertible by each of our speakers.[5] It would of course be fruitless to argue that (1) and (2) cannot be dealt with in any way except that provided by T_1. My main objective here is simply to point out that T_1 affords one plausible way of dealing with them. T_1 has the advantage of accounting for our intuitions in such cases without the need for any further distinction between truth and assertability. Moreover, it is relevant to at least note that there are problems in attempting to account for (1) and (2) without relativizing truth as is done in T_1. First, since S_1 knows that switch b is closed but is uncertain about the position of switch a, it seems entirely reasonable that he should consider (3) true (i.e. he would assent to it even if there were no point in asserting it).

(3) If a is closed, then b is closed.

But this is the contrary of (2). Generally speaking, if we consider a conditional true and its antecedent is not absurd, then we automatically count the contrary conditional false. A theory that (1) and (2) are both objectively true must either sacrifice this principle or else give some reason why we should say that S_1 is wrong in counting (3) true.

Second, if we claim that (1) and (2) are both objectively true but not both assertible by S_1 and S_2, we cannot claim that the unassertability is due to lack of enough information. If we imagine a third speaker S_3 who knows the positions of both switches and the lamp state, we are not more inclined to rely on his intuitions about (1) and (2). Since S_3 knows that a is closed, both conditionals are unassertible for him. It is otiose to make an indicative claim about what is the case if a is closed once one has ascertained that a is open. Moreover, it is difficult to imagine *any* speaker who might be in a position to assert both (1) and (2).

Even if it is granted that T_1 provides a plausible account of the truth conditions of *some* subjunctives and indicatives, one may still doubt whether such a truth condition is reasonable for conditionals that have an air of objectivity, e.g.,

If I release this pencil in midair, it will fall.

I think that such cases can be accounted for in terms of T_1 also, but a full explanation would require a more in-depth discussion of pragmatics than is possible in the present paper. Basically, what is needed is a pragmatic theory of supposition choice. Speakers seldom state their auxiliary suppositions explicitly. Yet it seems that listeners usually manage to guess what is being supposed. The only reasonable explanation for this, it would seem, is that both speakers and hearers are normally guided by mutually accepted pragmatic rules (perhaps just rules of thumb) in their choice of suppositions. In certain cases such as that of the conditional above, the rules governing supposition choice invariably lead speakers and hearers to adopt the same (or equivalent) suppositions. Hence, the conditional seems "objectively" true since alternative supposition sets that would make it come out false are just prohibited by our pragmatic rules. The situation may be viewed as analogous to that which arises in the interpretation of quantified sentences in terms of a domain of discourse. In the course of a lecture (and speaking in a sufficiently loud voice), I might assert

Everyone can hear what I am saying.

My remark is invariably viewed as expressing an "objective" truth in spite of the fact that it is a simple matter to specify a domain of discourse which would make the sentence false. The explanation for the appearance of objectivity is simply that the pragmatic rules that govern our selection of a domain require us to pick a set that excludes people outside the lecture hall. A really complete theory about conditionals (or quantified sentences) in a natural language would of course need to include such pragmatic rules. However, the problem of developing such a pragmatic theory about the choice of auxiliary suppositions and domains is obviously separate from the present semantic problem of explaining exactly how truth and falsity depend on such suppositions.

From a formal point of view, a theory similar to T_1 has been suggested recently by Charles Daniels and James Freeman.[6] They propose to represent the conditional as a ternary operator r p > q where the third sentential term r amounts to a tacit auxiliary supposition. On their view r p > q is equivalent to r & $\Box$ ((r & p) $\supset$ q) where '$\Box$' is the necessity of the Feys-von Wright modal theory T. The differences between T_1 and the Daniels-Freeman proposal are superficial but still worth noting. Under T_1 the syntax of the conditional more nearly resembles that of the English conditional since both are binary. Hence, T_1 can lay claim to a slightly greater descriptive accuracy. Second, T_1 easily allows cases in which a speaker's supposition set is infinitely large. Within the framework of the Daniels-Freeman proposal, the only way to allow for this would be to permit the third term r to be an infinite conjunction. Still, I doubt that either of these points is sufficient to make T_1 clearly preferable to the Daniels-Freeman proposal. As formulated here, both theories share a serious flaw which will be considered in detail below. The main advantage of T_1 is that it readily admits of reformation to eliminate the flaw.

To provide a formal framework in which to assess T_1, let us imagine that we are working with a language L containing in one form or another, the usual truth-functional operators '$\sim$', '&', '$\supset$' etc. and a non-truth-functional conditional. I shall represent such conditionals with an '$\rightarrow$' regardless of their mood or tense. When it is necessary to indicate mood or tense explicitly, this will be done in context. We also assume that L contains a denumerable supply of atomic sentences.

The first problem we will deal with in connection with T_1 arises from the requirement that a conditional is to be counted as false unless all the auxiliary suppositions are true. In most cases this seems reasonable. In the circuit example, let us use 'A' for 'a is closed', 'B' for 'b is closed' and 'L' for 'The lamp is on'. Suppose that speaker S_1 subsequently discovered that he had been wrong in believing switch b to be closed. He would surely retract his assertion '$A \rightarrow L$'. But it does not seem that the discovery that one's auxiliary suppositions are false would always lead to retraction of a conditional. For example, suppose that the conditional asserted is '$A \rightarrow A$'. If switch b turns out to be open, then under T_1 speaker S_1 would be wrong even in making this assertion. That is, '$A \rightarrow A$' is false relative to S_1's supposition set if 'B' is false.

One could avoid this problem by simply eliminating the requirement in T_1 that every member of the supposition set Γ be true (i.e. clause (2) of T_1). Daniels and Freeman suggest something quite like this. They suggest that their ternary conditional $r\,p > q$ might alternatively be treated as equivalent to $\Box((r \,\&\, p) \supset q)$ (rather than $r \,\&\, \Box((r \,\&\, p) \supset q)$). But this type of solution seems too drastic. It would not explain our inclination to say that S_1's original assertion '$A \rightarrow L$' should be considered false once his assumption 'B' proves untrue.

To get a more complete picture of the nature of the problem, imagine that S_1 holds the same beliefs as before and that he asserts indicative versions of (4)–(6). Let us consider the truth-values that might be ascribed to his claims if the state of the circuit is different from that above.

(4) $$A \rightarrow L$$

(5) $$(A \,\&\, B) \rightarrow L$$

(6) $$A \rightarrow A$$

The various states of the circuit can be satisfactorily represented by assignments of truth-values to the sentences 'A', 'B', and 'L'. Three states V_1, V_2, and V_3 are of particular interest. The truth-values for S_1's assertions that seem reasonable in each state are as follows.

	A B L	$A \rightarrow L$	$(A \,\&\, B) \rightarrow L$	$A \rightarrow A$
V_1	F T F	T	T	T
V_2	T F F	F	T	T
V_3	T T F	F	F	T

V_1 was originally assumed to be the actual state of the circuit, and in this case all three assertions are plausibly counted true where S_1 is the speaker. If V_1 turns out not to have been actual, some (but not all) of S_1's assertions will be falsified. For example, if the actual circuit state is V_2, S_1 surely asserted a falsehood in claiming 'A $\rightarrow$ L' since the antecedent is true and the consequent is false. However, under V_2, S_1 would still have been correct in making the more guarded assertions '(A & B) $\rightarrow$ L' and 'A $\rightarrow$ A'. Unfortunately, T_1 has the effect of falsifying all three assertions under both states V_2 and V_3. The suggested revision of T_1 is no help. If we simply drop the requirement that auxiliary suppositions must be true, then (4)–(6) come out true under all three circuit states. Neither option allows for the fact that, if V_1 turns out not to be actual, the subset of S_1's assertions that are falsified will vary depending on which alternative to V_1 is actual (i.e. depending on what the facts are).

One way to make sense of these intuitions is to notice that under V_2 and V_3 some, but not all of S_1's background beliefs are falsified. For example, under V_2 his belief 'B' is falsified but '(A & B) $\equiv$ L' remains true. If we "credit" S_1 with a subset of his background beliefs that are still true, it is easy to see why his assertions '(A & B) $\rightarrow$ L' and 'A $\rightarrow$ A' are still counted true. The corresponding material conditionals are still implied by a subset of his true beliefs.

We can express this idea more precisely by assuming that S_1 is to be credited with different sets of auxiliary suppositions for different circuit states. Formally speaking, this can be represented by assigning a set of suppositions Q_V to each valuation V. We thus use valuations to represent alternative circuit states that might obtain. Generalizing, let us call Q a "supposition assignment" if Q assigns a set of auxiliary suppositions Q_V to each valuation V of L. Q is a contextual index just as Γ was under T_1. Hence, we can expect different supposition assignments to be used in interpreting conditionals on different occasions since the background knowledge, etc. of speakers is variable. In the examples we have been concerned with, Q_V has been a subset of the beliefs held by the speaker. But this might not always be the case. For example, there might be some cases (especially in interpreting subjunctive conditionals) where the set would include subtle facts or laws unknown to the speaker. The job of determining the precise characteristics of supposition assignments falls primarily to pragmatics. Within semantics we should limit ourselves to those features of supposition assignments that can pretty safely be considered to be universal. For example, it seems reasonable to require that every supposition assignment Q satisfy the following constraint. For every valuation V, every member of Q_V should be true under V. This requirement, of course, does not mean that speakers are forbidden to believe or assume what is false. It simply guarantees that a speaker's conditional p $\rightarrow$ q will not be counted true in cases where the antecedent is true and the consequent is false (e.g., '$A \rightarrow L$' where V_2 is actual). In addition, to allow that "logical implication" in our truth condition can mean "tautological implication", we stipulate that Q_V must always consist entirely of truth-functional sentences.

We are now in a position to reformulate our truth condition T_1 to deal with the problem of false suppositions. For convenience, we will say that a valuation V is *actual* iff, for each atomic sentence p, V assigns 'true' to p just in case p is true.[7] Thus suppose that V^* is actual. Then T_1 can be replaced by the following.

(T_2) $p \rightarrow q$ is true under Q iff $Q_V{}^*$ logically implies $p \supset q$.

T_2 simply replaces the single set of auxiliary suppositions Γ with the assignment Q as a contextual index. The troublesome requirement that every auxiliary supposition must be true is now packed into our stipulation that all members of $Q_V{}^*$ must be true under V^*. However, it no longer causes problems. Let us consider how the assertions attributed to S_1 fare under T_2. For each V, Q_V is a subset of S_1's background beliefs that are true under V. Thus if V_2 is actual, then (5) and (6) but not (4) come out true since '$(A \& B) \equiv L$' but not 'B' belongs to Q_{V_2}. Moreover, it is easily seen that no matter which circuit state is actual, the truth-values of (4)–(6) will be exactly as indicated in the chart earlier.

One objection to T_2 might be that, in effect, possible worlds have now been reintroduced in the form of valuations. Hence, one might argue that the parsimony for which we admired T_1 has disappeared. However, this criticism assumes too much about the present use of valuations. It is true that valuations, when used in this way, do *resemble* possible worlds. Indeed, we might reasonably call them "worlds". But there is still an important difference: valuations need not be viewed as *possible* worlds. The fact that a sentence is true under some one valuation need not imply any expectation that it is intuitively possible. Similarly, we do not expect or intend that everything that seems intuitively necessary will hold true under every valuation. Valuations are poor substitutes for possible worlds if our aim is to analyze modal notions. But that is not our purpose. On the contrary, our subject is conditionals, and we need not assume that a proper account of conditionals must employ any standard modal notions. In effect, our analysis of conditionals needs worlds. But we are not required to make any commitment to the effect that some worlds (valuations) but not others are *possible*. Hence, the vagueness often ascribed to the latter modal notion still need not be viewed as infecting our conditional semantics.[8]

The truth condition T_2 is still plagued by a problem of a more formal nature. Under T_2, no truth-values can be ascribed to nested conditionals. This problem is easily rectified by noting first that T_2 can be viewed as a special case of the following.

$p \rightarrow q$ is true under $\langle V, Q\rangle$ iff, for every V', if every member of Q_V is true under V', then $p \supset q$ is true under V'.

To allow for nesting, we need only revise the right side of the truth condition to allow Q to be carried along so that it is available to determine truth values for p and q:

(T_3) $p \rightarrow q$ is true under $\langle V, Q\rangle$ iff, for every V', if every member of Q_V is true under V' then $p \supset q$ is true under $\langle V', Q\rangle$.

It is simple to establish that T_2 and T_3 differ only in cases of nesting. In other cases and where V^* is actual, $p \rightarrow q$ will be true under Q (according to T_2) iff $p \rightarrow q$ is true $\langle V^*, Q\rangle$ (according to T_3).

The new truth condition T_3 could easily serve as a basis for a more fully developed semantics for conditional logic. However, one further minor revision seems appropriate. Let us say that two sets of auxiliary suppositions Γ and Γ' are *equivalent* if the set of valuations that verify every member of Γ is identical with the set of valuations that verify every member of Γ'. It is clear that if two distinct supposition assignments Q and Q' always assign equivalent sets to the same valuations, then any conditional sentence true under $\langle V, Q\rangle$ will be true under $\langle V, Q'\rangle$ and vice versa. Though such assignments are distinct, the differences between them have no effect as far as the theory of truth is concerned. Hence, it would be simpler to develop the semantics in a way that suppresses these inconsequential differences.

This theoretical point is mirrored to some extent in our intuitions about meaning. If two speakers assert a single conditional $p \rightarrow q$, we can allow that they meant different things in asserting $p \rightarrow q$ if the set of auxiliary suppositions Γ which one speaker has in mind is not equivalent to the supposition set Γ' which the other speaker has in mind. But it seems less reasonable to say that their meanings were really different if their auxiliary suppositions are logically equivalent.

There is a simple way of eliminating the superfluous differences between equivalent sets of auxiliary suppositions. We can replace the supposition assignment Q with an "accessibility" relation R defined on the valuations of L. Given an assignment Q, we obtain an accessibility relation R as follows.

$$VRV' \text{ iff every member of } Q_V \text{ is true under } V'.$$

Instead of thinking of a speaker as associating a set of suppositions Q_V with each factual circumstance, we think of him as associating a set of such circumstances (i.e. the accessible valuations) with each circumstance.

Once the assignment Q is thus replaced by its corresponding accessibility relation R, we are finally in a position to state a more full blown semantic account of the language L. The new definition T_4 of 'p is true under $\langle V, R\rangle$' is given by cases. Case IV replaces the truth condition T_3.

(T_4) I. Where p is atomic, p is true under $\langle V, R\rangle$ if V assigns "true" to p. Otherwise p is false under $\langle V, R\rangle$.

II. Where p is $\sim q$, p is true under $\langle V, R\rangle$ if q is false under $\langle V, R\rangle$. Otherwise p is false under $\langle V, R\rangle$.

III. Where p is $q \supset r$, p is true under $\langle V, R\rangle$ if either q is false under $\langle V, R\rangle$ or r is true under $\langle V, R\rangle$. Otherwise p is false under $\langle V, R\rangle$.

IV. Where p is $q \rightarrow r$, p is true under $\langle V, R\rangle$ if, for every V' such that VRV', $q \supset r$ is true under $\langle V^1, R\rangle$. Otherwise, p is false under $\langle V, R\rangle$.

Clauses for '&', '≡', etc. are generated in the standard manner. A reasonably straightforward inductive argument can be used to show that where R is defined in terms of a given supposition assignment Q as indicated earlier, any sentence will be true under $\langle V, R\rangle$ iff it is true under $\langle V, Q\rangle$ in virtue of the truth condition T_3.

Given an account of truth, it is customary to generate definitions of validity, consistency and implication, and this is easily done. Let us refer to any pair $\langle V, R\rangle$ as a "model" for language L if V is a valuation of L (i.e. V assigns a truth-value to each atomic sentence of L) and R is a binary, reflexive relation defined over all valuations of L. The reason for requiring reflexivity will be discussed below. We can now define "p is valid" by "p is true under every model". To say that a set of sentences Γ is *consistent* is to say that there is some model M such that every member of Γ is true under M. Definitions of implication and validity for arguments are straightforward.

Some readers will perhaps have guessed already that the set of valid sentences thus characterized can be identfied axiomatically as an existing modal theory. If we introduce '$\Box$' by viewing $\Box p$ as an abbreviation for $\sim p \rightarrow p$, and, correspondingly, add '$\rightarrow$' to a modal language by taking $p \rightarrow q$ as short for $\Box(p \supset q)$, then the valid sentences turn out to be just those that are provable in the Feys-von Wright modal theory T (or M). The proof of this does not figure prominently in the discussion which follows. Hence it has been omitted. It should be noted that the axiomatic characterization of '$\rightarrow$'

in terms of theory T betrays no covert acceptance of modalities. The '$\Box$' is obviously open to non-modal interpretations.

Before turning to a consideration of the pragmatics of conditionals, it is of some interest to pause briefly to reflect on the formal restriction of reflexivity imposed on the relation R. It is easily seen that this restriction is a consequence of our earlier requirement that an assignment of auxiliary suppositions Q must be such that, for each V, every member of Q_V is true under V. If R is obtained from Q so that VRV′ holds iff every member of Q_V is true under V′, it is clear that R will be reflexive. Reflexivity guarantees that if $p \rightarrow q$ is true under a model $\langle V, R \rangle$, then $p \supset q$ is true under $\langle V, R \rangle$ also. An account of the conditional that did not require this would be obviously implausible.

The observation that R should be reflexive raises interesting questions about whether R should also be expected to have other properties such as symmetry and transitivity. Assuming that R is derived from Q in the standard manner, these properties translate into constraints on Q. Thus R would be symmetrical if Q satisfied the following condition.

If every member of Q_V is true under V′, then every member of $Q_{V'}$ is true under V.

Transitivity for R results when Q is restricted by this condition.

If every member of Q_V is true under V′ and every member of $Q_{V'}$ is true under V″, then every member of Q_V is true under V″.

It seems likely that interpretation of conditionals may often result in supposition assignments that satisfy these conditions. However, there seems to be no reason for thinking that either of these conditions should be imposed universally. In fact, if our theory is to be applicable to subjunctives as well as indicatives, there are reasons for resisting any further restrictions in the formal semantics. Returning to our initial circuit state V_1 (where a is open, b is closed and the light is off), consider the truth-values that might be assigned to subjunctive conditionals (e.g. 'If a were closed, the light would be on') by a speaker fully informed about both switch positions and the lamp state. Given the state V_1, such a speaker might plausibly assign truth-values as follows.

$A \rightarrow L$	True
$\sim B \rightarrow (A \rightarrow L)$	False
$B \,\&\, \sim L$	*True*
$A \rightarrow (B \rightarrow L)$	*True*
$A \rightarrow \sim L$	*False*

If R is restricted only by reflexivity, a model that assigns these truth-values is easily constructed. Hence, there is at least a possibility that our speaker is right about all five sentences. However, if transitivity is also imposed, there is no model which assigns the above values to the first two sentences. Under symmetry, our speaker is automatically wrong about one of the last three sentences.[9] Since there seems to be no reason for not allowing that the above truth-values *might* be correct, we should avoid further restrictions on R.

The formal properties of R are a comparatively minor matter, however. When R is viewed as a contextual index as suggested here, there is a reasonable prospect that once our semantics has been supplemented with an adequate pragmatic theory, we will be able to identify not only the formal properties of R but the specific relation R itself. That is, if we assume that R is normally to be recovered from a supposition assignment Q, then the problem of pinning down a specific accessibility relation reduces to that of identifying a speaker's auxiliary suppositions.

Although the use of an accessibility relation R as a contextual index has a small theoretical advantage over the earlier supposition assignment Q, the talk of auxiliary suppositions still has a heuristic utility especially in informal discussions of specific examples. Hence, the discussion in the next section will be developed in terms of the semantics of auxiliary suppositions (i.e. T_3). Such talk can always be translated into the jargon of the official semantics, when this is desired, by means of the formula given earlier for recovering an accessibility relation R from a given assignment Q of auxiliary suppositions.

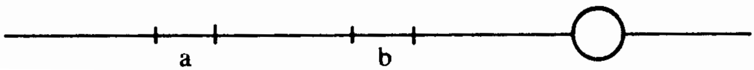
OTHER THEORIES

The present account of conditionals differs from others that have been proposed in recent years in the treatment of various controversial inferences. For example, both of the following are invalid in T.

(7) $$p \rightarrow (q \vee r) \;/\therefore\; (p \rightarrow q) \vee (p \rightarrow r).$$

(8) $$p \,\&\, q \;/\therefore\; p \rightarrow q.$$

Schema (7) is a direct consequence of Stalnakers' [17] axiom "a5" in his system C2. Yet there are plausible counterexamples to (7). Returning to the first circuit, suppose that both switches are closed and the lamp is on.



Given '$(A \& B) \equiv L$' as an auxiliary supposition, we could reasonably assert '$\sim L \rightarrow \sim A \vee \sim B$' and still deny both '$\sim L \rightarrow \sim A$' and '$\sim L \rightarrow \sim B$'. The counter example seems to work for both indicative and subjunctive phrasing. For the indicative, simply assume that the speaker knows '$(A \& B) \equiv L$' but is uninformed about the actual switch positions and the lamp state. Plausible counter examples to (8) have been suggested elsewhere and need not be repeated here.[10]

Certain other inference forms considered valid under theory T have been rejected in several recent discussions of conditionals. For example, where T provides our formal account of the conditional, Hypothetical Syllogism (HS) and Contraposition (CT) are counted valid. But plausible counterexamples have been suggested to these inferences and, consequently, recent theorists such as Lewis [9], Stalnaker [17] and Thomason [18] have held that these inferences must be rejected for subjunctives. Ernest Adams [1] has devised persuasive counterexamples to the same inferences using indicative conditionals.

If T is to be defended as a theory of the conditional, it must be shown that the problematic counterexamples can be explained away. I will argue that, in all cases, the counterexamples in question commit a type of equivocation. In this respect, my treatment of the counterexamples will be similar to that of Daniels and Freeman.[6] It is most important to insure, however, that explanations for counterexamples not be purely ad hoc. If this were permitted, one could justify virtually any formal account of the conditional. If we are to explain away counterexamples, we should attempt to formulate our explanations systematically and provide some theoretical basis for them. In what follows, I will try to show that an adequate pragmatic theory would provide the theoretical framework needed for such explanations. Hence, when our semantic account of the conditional is supplemented with a suitable pragmatic theory (which is needed anyway to account for supposition choice) the whole apparatus provides a plausible account of the problematic counterexamples.

What would a theory of supposition choice look like? The following rough picture seems a reasonable first approximation. In the normal case, a speaker and his audience make a determination at or near the beginning of a conversation of what supposition assignment is to be used in interpreting the conditionals of that conversation. A good pragmatic theory would provide a set of rules to explain how this is done. Once arrived at, that same supposition assignment would then be used in determining truth-values for all conditionals occurring throughout that conversation.

The only difficulty with this general picture is that it assumes that speakers and hearers have adequate criteria for determining when an old conversation had ended and a new one has begun (since a new conversation requires a new supposition assignment). The truth is that we do not have very good criteria for individuating bodies of discourse. Of course, there are obvious clues such as a long period of silence or an abrupt change of topic. But these are obviously neither necessary nor sufficient conditions for concluding that a new body of discourse has begun and that the old assumptions have been adandoned.

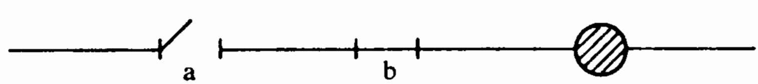
Obviously, it would be desirable to identify some more definite indicators of when we are to assume that a new supposition assignment is in effect. It does appear that there is at least one such indicator. Suppose that, in the course of a conversation, a speaker advances a conditional $p \rightarrow q$ where the antecedent p is inconsistent with suppositions that have previously been operative. If we keep the same supposition assignment, the speaker's conditional comes out trivially true: any conditional with that antecedent will be true. We generally avoid such trivial interpretations of what is said except when there is no other alternative. Hence, under such circumstances, it seems reasonable to assume that our normal interpretive practice is to modify our previous interpretation and find a new supposition assignment that does not have the effect of trivializing what is said.

We can express this idea more precisely by assuming that the following is one of our pragmatic interpretive rules.

(P) If the antecedent p of a conditional is itself consistent, then $Q_V \cup \{p\}$ is consistent.

It seems quite plausible that rule P should figure as part of an explanation of supposition choice. Moreover, it happens that rule P is also the main assumption we need to account for apparent counterexamples to HS and CT.

Consider first a counterexample to HS. Suppose that our electric circuit is in the state V* illustrated below.

(V*) 

Using abbreviations adopted earlier, it seems plausible to consider (9) and (10) true and (11) false.

(9) $$A \rightarrow L$$

(10) $$A \,\&\, {\sim}B \rightarrow A$$

(11) $$A \,\&\, {\sim}B \rightarrow L$$

Subjunctive wording is intended. However, this example as well as all others discussed in this section can easily be reconstructed in both the indicative and subjunctive moods. For the indicative, simply assume that the speaker believes both '(A & B) ≡ L' and 'B' but that he is somewhat less confident about the latter belief. Notice also that (9) and (11) alone provide a counterexample to another classical inference – Antecedent Strengthening:

$$p \rightarrow r \,/ \therefore (p \,\&\, q) \rightarrow r.$$

The auxiliary suppositions that are naturally ascribed to a speaker asserting '$A \rightarrow L$' under the circumstances in question are

$$Q_V{}^* = \{B, (A \,\&\, B) \equiv L\}.$$

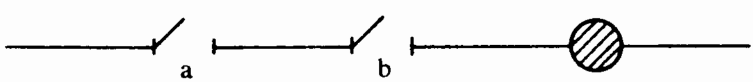
That is, the speaker presumably asserts '$A \rightarrow L$' because he believes switch b to be closed and because he thinks that the circuit operates under the principle '(A & B) ≡ L'. But notice that while (10) and (11) remain true under $\langle V^*, Q\rangle$, the same suppositions in these cases seem odd. Rule P is violated because the antecedent '$A \,\&\, {\sim}B$' is inconsistent with the supposition 'B'. To assert (10) and (11) with these suppostions in mind would be to assert a triviality. Hence, to avoid trivialization, we tend naturally to revise the supposition set when we encounter the second premise and thus eliminate the inconsistency. The natural revision results in a new set of auxiliary suppositions, viz.

$$Q'_{V^*} = \{(A \,\&\, B) \equiv L\}.$$

Interpreted in terms of the new suppositions, (10) remains true but (11) comes out false. Hence, HS (and AS) seem to fail. In reality, the failure is merely apparent. What has actually occurred is a subtle shift in our interpretation of the conditionals in mid argument. The shift has the virtue of preventing trivialization. Yet it amounts to a type of equivocation.

Apparent counterexamples to CT can also be explained by appealing to rule P. Suppose this time that the actual circuit state is V^+.

(V^+)



It seems reasonable to consider (12) true and (13) false.

(12) $$A \rightarrow {\sim}L$$

(13) $$L \rightarrow {\sim}A$$

Again, the example works nicely with both indicative and subjunctive wording. The supposition assignment that leads to assertion of (12) seems to be

$$Q_{V^+} = \{\sim B, (A \& B) \equiv L\}.$$

Yet this supposition set is inconsistent with the antecedent of (13). Following rule P, we revise the supposition set to avoid trivialization of the conclusion:

$$Q'_{V^+} = \{(A \& B) \equiv L\}.$$

But now (13) comes out false under the new model $\langle V^+, Q' \rangle$. Hence, again, a classical inference form seems (incorrectly) to have turned out invalid. As before, what actually happens is that we shift contextual indices in mid argument in order to avoid a trivial interpretation.

Let us consider one final inference form which is valid in my semantics but which has been a subject of controversy. Donald Nute [14] has argued that the inference "Simplification of Disjunctive Antecedents" (SDA) should be considered valid:

$$(p \vee q) \rightarrow r \;/ \therefore p \rightarrow r.$$

Though SDA is valid in my semantics, it is not valid in the conditional logics proposed by Lewis [9] and Stalnaker [17]. Moreover, a counterexample to SDA has been suggested by Michael Dunn.[11]

If Jones were to run for the House or Senate, then he would run for the Senate.
Therefore, if Jones were to run for the House, then he would run for the Senate.

The example can easily be rephrased in the indicative. A background situation in which the counterexample seems especially plausible would be that in which Jones has decided against running for the House, but he has not made up his mind yet about whether to become a candidate for the Senate. Hence, we assert the premise on the basis of the supposition '∼Jones will run for the House'. But since this supposition is inconsistent with the antecedent of the conclusion, rule P requires that it be eliminated when interpreting the conclusion. As a result, the conclusion is interpreted in a way that makes it false, and SDA seems to fail.

Thus apparent counterexamples to these classical inferences can be reconciled to my semantics by supposing that we sometimes shift our interpretation of conditionals in mid argument to avoid trivialization. Of course, one might object that this appeal to pragmatics is only one of two available ways of dealing with these cases. The other option is to take the counterexamples to be genuine and revise the semantics as Stalnaker, Lewis and others have proposed. Why should we prefer either approach over the other? In preserving classical inferences such as HS and CT, the present approach allows us to retain a larger portion of traditional sentential logic. But it may well be objected that this type of support amounts to nothing more than the prejudice of centuries of logical dogmatism. However, there are two other considerations that also weigh in favor of the view advanced here.

First, for many of the alleged counterexamples to classical inferences, their plausibility depends heavily on the order in which the premises are presented. For example, consider the following counterexample to HS advanced by Ernest Adams [1] a number of years ago.

If Brown wins the election, Smith will retire to private life. If Smith dies before the election, Brown will win it. Therefore, if Smith dies before the election, then he will retire to private life.

The argument looks convincing as a counterexample to HS. But now imagine the same premises presented in reverse order. We are much less inclined to view both premises as true. If such counterexamples really show that HS is invalid (i.e. that the premises are true and the conclusion is false) they should be persuasive regardless of premise order. By contrast, the conditional theory developed here easily accounts for these variations in plausibility. We interpret the first premise by assuming (among other things) that Smith will survive the election and that he will either win or retire. Hence, the first premise comes out true. To avoid a paradoxical reading of the second premise and conclusion, however, we revise our supposition set to eliminate these assumptions. As a result, the second premise remains true, but the conclusion is counted false. By contrast, if the premise order is reversed, we start with the more modest set of assumptions to avoid paradox from thē outset. This time we have no need to change our assumptions when we come to the later premise and conclusion since there is no danger of paradox. But the effect of starting with the more modest supposition set is that the new second premise comes out false, and hence the alleged counterexample seems less plausible.[12]

Another point which supports this way of dealing with counterexamples is the fact that very similar pragmatic principles can be used to obtain plausible explanations for apparent counterexamples in quantificational logic. Imagine the curator of a museum for rare gems excitedly reporting a theft to a police lieutenant:

(14) Everything has been stolen from the museum.

It would be quite absurd to draw an inference such as

(15) Every citizen of Canada has been stolen from the museum.

Yet, when these sentences are represented in the most straightforward way in standard first order notation, the inference is considered valid.

$$(x)\, Sx$$
$$/\therefore (x)\, (Cx \supset Sx).$$

Similarly, we would think it unreasonable to conclude from (14) that

(16) Pierre Trudeau has been stolen from the museum.

Yet the obvious symbolization in this case yields an apparent counterexample to Universal Instantiation.

These quantificational examples are intriguing because of the fact that one can appeal to pragmatics to reconcile them to the standard semantics, and the pragmatic explanations one can use are strikingly similar to those used above to explain sentential counterexamples. In quantification theory, the truth of a quantified sentence is relative to what amounts to a contextual index, i.e. a domain of discourse. Like auxiliary suppositions, domains are normally tacitly understood. A listener must guess what domain a speaker has in mind. To keep the listener from getting too far off track, both speaker and hearer can normally expect that the guesswork will be guided by certain rules of thumb. Two such rules seem to be operative in the case of the inference from (14) to (15). First, a principle of judicious benevolence seems to be involved. If a speaker's quantified sentences are asserted in earnest (i.e. he does not seem to be joking or exaggerating), if there is no reason to suspect lying, and if the speaker is apparently well informed, then it is a safe bet to interpret his assertions by reference to a domain that will make them come out true. In the case in question, we have no reason to doubt the curator's motives, and surely he is in a position to know whether a theft has occurred. Hence, benevolence suggests a domain consisting of just those artifacts normally kept on display in the museum. Benevolence excludes citizens of Canada since (14) will come out false if the domain includes human beings. In the interpretation of (15), however, a second principle comes into play: choose a domain that provides nonempty extensions for the predicates. Violation of the second principle can result in a kind of trivialization not unlike that which resulted from violating rule P. For example, when (14) is interpreted in terms of a domain consisting of museum artifacts only, the sentence comes out vacuously true. Each Canadian citizen in that domain (i.e. none) has been stolen from the museum. To avoid trivialization, we tend to shift to a different domain for an interpretation of (15). Once Canadians are added to the domain, (15) comes out false. So the inference looks invalid. In fact, what has occurred is exactly analogous to what happened in the case of apparent failures of HS, etc. We simply shifted contextual indices to avoid trivialization.

The situation is similar in the case of the apparent failure of Universal Instantiation. If (14) is interpreted by reference to a domain including the man normally denoted by "Pierre Trudeau", it comes out false. Hence, benevolent interpretation of (14) requires that Pierre Trudeau be excluded from the domain. On the other hand, if Trudeau is excluded, we have no interpretation for (16) at all save one that can only be considered non-standard (i.e. where we use that name to refer to some museum artifact).

Of course, these arguments cannot be said to show that the Stalnaker-Lewis analysis of conditionals is untenable. What they show, I think, is that the present approach is a serious competitor. When fully developed as a semantic and pragmatic analysis, this approach offers a theoretically motivated account of the apparent counterexamples to HS and CT plus certain other phenomena that are difficult to account for within the Stalnaker-Lewis framework. Moreover, the fact that HS and CT are *classical* inferences, while not by itself decisive, should still not be dismissed. It is historically accurate to point out that, until perhaps 15 years ago, these inferences were regarded as acceptable by logicians and common men alike. Hence if apparent counterexamples can be plausibly and systemically explained within a theory that preserves these inferences, this option seems preferable to that of simply abandoning the inferences in favor of a weaker theory of the conditional.

KEN WARMBRŌD
University of Manitoba

NOTES

1 Conditionals are indexical in the sense that their truth-values are relative to features of context (indices) that can vary from one occasion to another. In this respect, the

general notion of "indexical" here assumed is approximately that of Scott [16], Montague [13], and Lewis [10]. Beyond this general feature of the notion of "indexical", nothing else of these analyses will be assumed.

2 F.P. Ramsey, "General Propositions and Causality" [15].

3 T_1 may also be viewed as providing a way of formulating Chisholm's [5] theory that "a man in asserting a counterfactual is telling us something about what can be deduced from some "system of statements" when the indicative version of the antecedent is added to this system as a *supposition*. We are referring to the statements of this system (other than the indicative version of the antecedent) as the *presuppositions* of his assertion. And we are suggesting that, normally, at least part of the point of asserting a counterfactual is to *call attention to*, *emphasize*, or *convey*, one or more of these presuppositions."

4 Example from Chisholm [4].

5 David Lewis [9] and [11] and H.P. Grice [8], for example, have both advocated this sort of view. According to them, the indicative conditional is really material. Apparent differences between indicative and material conditionals are explained by appealing to assertability conditions. See Ellis [7] for interesting criticisms of the Lewis-Grice theory.

6 "An Analysis of the Subjunctive Conditional", read at a meeting of the Pacific Division of the American Philosophical Association in March, 1977.

7 No circularity occurs here. The standard truth-functional semantics leaves "p is true" undefined for atomic p. The model-theoretic notion "p is true under V" is defined independently.

8 Of course, it may yet be that the standard problems with possible worlds and modalities will eventually be resolved to everyone's satisfaction. Indeed, logicians who are untroubled by these problems may prefer to go ahead and substitute possible worlds for valuations. However, I prefer to operate within a framework that would allow conditional logic to survive possible world theory.

9 For modal logicians, the simplest way to see this point is to notice that while T_4 provides a semantics for the modal system T, the additional requirement of transitivity results in a semantics for S4 and symmetry yields the Brouwerian system. But S4 and the Brouwerian system contain, respectively, the following theorems.

(I) $$\Box(A \supset L) \supset \Box(\sim B \supset \Box(A \supset L)).$$

(II) $$(B \mathbin{\&} \sim L \mathbin{\&} \Box(A \supset \Box(B \supset L))) \supset \Box(A \supset \sim L).$$

Eliminating the arrows from the sentences in the text, it is clear that, given I, the truth-values of the first two sentences are impossible. Given II, the same holds for the last three. It follows, of course, that S5 would also require unacceptable restrictions on the accessibility relation.

10 See, for example, Jonathan Bennett [2] and John Bigelow [3].

11 Cited in Daniels and Freeman [6]. For a similar example, see McKay and Van Inwagen [12].

12 The plausibility of a counterexample can also be affected by background prompting. Suppose that, in presenting Adams' example, I begin as follows. "Smith may die before the election. But if Brown wins the election, Smith will retire to private life ..." The prefatory observation that Smith's death is possible has the effect of eliminating an assumption (i.e. that Smith will survive the election) that we would otherwise make in interpreting the first conditional premise. Without that assumption, the premise cannot plausibly be considered true, and the counterexample no longer works.

BIBLIOGRAPHY

[1] Adams, Ernest W., "The Logic of Conditionals", *Inquiry* 8 (1965), 166–197.

[2] Bennett, Jonathan, "Counterfactuals and Possible Worlds", *Canadian Journal of Philosophy* 4 (1974), 381–402.

[3] Bigelow, John C., "If-Then Meets the Possible Worlds", *Philosophia* 6 (1976), 215–236.

[4] Chisholm, R.M., "The Contrary-to-Fact Conditional", *Mind* 55 (1946), 289–307.

[5] Chisholm, R.M., "Law Statements and Counterfactual Inference", *Analysis* 15 (1955), 97–105.

[6] Daniels, Charles B. and James B. Freeman, "An Analysis of the Subjunctive Conditional", read at the Pacific Division meeting of the American Philosophical Association, March, 1977.

[7] Ellis, Brian, "A Unified Theory of Conditionals", *Journal of Philosophical Logic* 7 (1978), 107–124.

[8] Grice, H. Paul, "Logic and Conversation", The William James Lectures, mimeographed.

[9] Lewis, David K., *Counterfactuals*, Harvard University Press, Cambridge, 1973.

[10] Lewis, David K., "General Semantics", in *Semantics of Natural Language* (ed. by D. Davidson and G. Harman), D. Reidel, Dordrecht, 1972.

[11] Lewis, David K., "Probabilities of Conditionals and Conditional Probabilities", *Philosophical Review* 85 (1976), 297–315.

[12] McKay, Thomas and Peter Van Inwagen, "Counterfactuals with Disjunctive Antecedents", *Philosophical Studies* 31 (1977), 353–356.

[13] Montague, Richard, "Pragmatics", in *Formal Philosophy* (ed. by R. Thomason), Yale University Press, New Haven, 1974.

[14] Nute, Donald, "Counterfactuals and Similarity of Worlds," *The Journal of Philosophy* 72 (1975), 773–778.

[15] Ramsey, F.P., *The Foundations of Mathematics*, Routledge & Kegan Paul, London, 1931.

[16] Scott, Dana, "Advice on Modal Logic", in *Philosophical Problems in Logic* (ed. by K. Lambert), D. Reidel, Dordrecht, 1970.

[17] Stalnaker, Robert C., "A Theory of Conditionals", *American Philosophical Quarterly*, monograph series 2 (1968), 98–112.

[18] Thomason, Richmond, "A Fitch-Style Formulation of Conditional Logic", *Logique et Analyse* 13 (1970), 397–412.