If AND *Only If*
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References by logicians to the expression *only if* generally consist merely of a statement that it is the converse of *if*, e.g. "whereas 'if' is thus ordinarily a sign of the antecedent, the attachment of 'only' reverses it; 'only if' is a sign of the consequent. Thus '*p* only if *q*' means, not '*p* if *q*', but 'if *p* then *q*'" (Quine 1962, 41).[1] Logicians systematically ignore the morphemic composition of *only if* and treat it as if it were simply an idiom.

It is understandable that logicians would fail to treat *only if* as *only* plus *if*. In standard analyses, *only* corresponds to an expression involving a quantifier, whereas *if* is a propositional connective and does not provide any variable for that quantifier to bind. Thus, a decomposition of *only if* into *only* and *if* must involve a different analysis of them than logicians provide. Since it is beyond question that *only if* is no idiom (i.e. that any speaker of English who understands the words *only* and *if* is able to understand *only if* without learning anything new), a linguistically adequate analysis of *only if* must deviate from standard logical analyses of *only* or *if* (or both).

To my knowledge, the first work in which an analysis is proposed in which *only if* is treated as a combination of garden-variety *only* and garden-variety *if* is Geis (1973). Geis's treatment involves a reanalysis of *if*: rather than taking it to be a simple propositional connective, Geis analyzes it as something on the order of 'in cases in which'. I say "on the order of" since Geis is equivocal as to what quantifier should go with *cases*; on page 235 he uses paraphrases containing "in some circumstances", but elsewhere he seems to have "in all cases" in mind, especially on page 244, where he notes that (1) is contradictory:

(1) I'll leave if Bill doesn't phone soon, and I won't leave if Bill doesn't phone soon.

If *if* were merely "in some cases in which", (1) would not be contradictory, since there is nothing to prevent there from being both cases in which Bill doesn't phone soon and I leave and cases in which Bill doesn't phone soon and I don't leave. In any event, "in all cases" is the only one of those two alternatives which seems to fit the truth conditions of *if*. However, that analysis appears to yield the wrong truth conditions for *only if*; (2a) does not allow the paraphrase (2b):

[1] The supposed paraphrase relationship between *if* constructions and *only if* constructions is in fact quite dubious. It fails for many of the standard examples of *if* that appear in logic texts, e.g.

If butter is heated, it melts.
??Butter is heated, only if it melts.

(2) a. Tom will leave only if John comes back by midnight.
b. Tom will leave only in all cases in which John comes back by midnight.

(2b) implies that Tom will leave in all cases in which John comes back by midnight and thus implies that Tom will leave *if and only if* John comes back by midnight.

A possible way to salvage Geis's approach to *only if* emerges from an examination of further examples involving *only*. Consider the sentences (3a–c):

(3) a. Only Muriel voted for Hubert.
b. Only Muriel, Lyndon, and Ed voted for Hubert.
c. Only Southerners voted for Hubert.

Horn (1969) had argued that (3a) does not assert but only presupposes that Muriel voted for Hubert; its assertion is that no one else voted for Hubert. Horn's analysis of (3a) can easily be generalized to cover (3b):

(4) a. Presupposition: Muriel voted for Hubert.
Assertion[2]: (All x such that not (x = Muriel)) not (x voted for H)
b. Presupposition: (All x such that $x \in \{M, L, E\}$) x voted for H [i.e. M, L, and E all voted for H]
Assertion: (All x such that not ($x \in \{M, L, E\}$) not (x voted for H)

More generally, *Only* $x_1, x_2, \ldots$ *and* x_n *voted for Hubert* would be analyzed as in (5):

(5) Presupposition: (All x such that $x \in \{x_1, x_2, \ldots, x_n\}$) x voted for H
Assertion: (All x such that not ($x \in \{x_1, x_2, \ldots, x_n\}$)) not ($x$ voted for H)

The direct analogue of these analyses in the case of (3c) is (6):

(6) Presupposition: (All x such that x is a Southerner) x voted for H
Assertion: (All x such that not (x is a Southerner)) not (x voted for H)

The assertion in (6) fits the truth conditions of (3c), but the

[2] Horn has a formula involving unrestricted quantification:

(All x) (not (x = Muriel) $\supset$ not (x voted for Hubert))

I have substituted a formula with restricted quantification, since Horn's version of (4a) involves $\supset$ (= *if . . . then*), whose status is at issue here.

presupposition does not; saying (3c) does not commit one to believing that *all* Southerners voted for Hubert.

The reason for this apparent lack of uniformity in the behavior of *only* is probably to be found in the realm of conversational implicature. A speaker is taken as having the relevant facts about the people and things that he mentions unless he makes clear that he does not. Thus, if one includes Lyndon in an enumeration such as that of (3b), he is taken as knowing how Lyndon voted and thus as having excluded Lyndon from the set of people he says did not vote for Hubert by virtue of knowing that Lyndon did vote for Hubert. On the other hand, (3c) does not involve an enumeration of all Southerners and thus does not give the impression that the speaker knows how each Southerner voted. If this proposal is correct, then only the "assertion" part of Horn's analyses is part of the semantic structure of the examples. His presuppositions are "pragmatic" rather than "semantic" presuppositions; they are merely things that a speaker would generally commit himself to by virtue of adherence to the rules of sportsmanlike behavior in speaking.

I would like to suggest that the role of "cases in which John comes back by midnight" in (2a) is exactly the same as that of "Southerners" in (3c): that (2a) asserts that for all cases which are not cases in which John comes back by midnight, Tom won't leave (just as (3c) asserts that for all x such that x is not a Southerner, x did not vote for Hubert), and it no more commits the speaker to the belief that he will leave in all such cases than (3c) commits him to the belief that all Southerners voted for Hubert.

But what then is the analysis of simple occurrences of *if* such as in (7)?

(7) Dick will resign if he is convicted of accepting bribes.

I have already argued that neither "in some cases . . . " nor "in all cases . . . " gives a satisfactory analysis of *if*. However, (7) in fact implies that Dick will resign in all cases in which he is convicted of accepting bribes. One possible way out of this dilemma is to treat (7) as not involving a quantifier at all but rather a "free" variable and thus to treat the proposition that Dick will resign in all cases in which he is convicted of accepting bribes as only inferrable from (7) (via the inference rule of universal generalization) rather than as being part of its meaning. Under this proposal, *if* always carries a variable with it but does not itself bind that variable; it may occur in composition with something that binds the variable (such as *only* or *even*), but it does not have to. However, in making that move, the linguist–toreador has only jumped off of the dilemma's horns and under its hooves, since absurdities would then result whenever a conditional sentence was embedded in any context other than one which binds its quantifier; for example, (8a) would then have a logical form such as (8b), from which (8c) would be inferrable:

(8) a. No one knows whether Dick will resign if he's convicted.
b. Not (Exist x: x is a person) (x knows whether (in case y in which Dick is convicted, Dick will resign))
c. (All y) Not (Exist x: x is a person) (x knows whether (in case y in which Dick is convicted, Dick will resign))

But (8c) implies that for each possible circumstance in which Dick is convicted no one knows whether he will resign under that circumstance, which is not what (8a) implies. One can consistently maintain (8a) while also maintaining that Jack Anderson knows that Dick would resign if he were convicted on the basis of testimony by Billy Graham and promised clemency if he agreed to devote the rest of his life to missionary work in Venezuela.

The only remaining alternatives appear to be analyses involving strange ad hoc rules, e.g. an analysis in which *if* is treated as "in all cases in which", with the qualification that the *all* is to be ignored when another quantifier lays claim to its variable. Have I missed an alternative?

References

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