How Do Inferences Get Invited?

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In this paper I shall try to explicate the problem of invited inferences, although no final conclusive results can be presented at this early stage of the investigation. For clarity and brevity's sake I shall concentrate on only one subclass of invited inferences, namely conditional perfection. Although Geis and Zwicky (1971) presented two more subclasses of invited inferences and Heringer (1971) claimed that Kartunnen's optional implicative verbs (e.g. *remember(to)*, *choose(to)*) are cases where these verbs invite the inference of their complements, conditional perfection is the only clear candidate for the notion of invited inferences and the controversy centered around this phenomenon. Thus we can safely assume that we are justified enough on our policy of investigating only part of the entire phenomenon.

Let me first of all present the rule of conditional perfection as was formulated by Geis and Zwicky (1971).

(1) A sentence of the form $X \supset Y$ invites an inference of the form $\sim X \supset \sim Y$.

(1) was formulated on the bases of sentences like those in (2).

(2) a. If you mow the lawn, I'll give you five dollars.
b. If John leans out of that window any further, he'll fall.
c. If you disturb me tonight, I won't let you go to the movies tomorrow.
d. If you heat iron in a fire, it turns red.
e. If you see a white panther, shout 'Wasserstoff' three times.
f. If Andrew were here, Barbara would be happy.
g. If Chicago is in Indiana, I'm the Queen of Rumania.

For instance (2a) invites the inference, or suggests that if the hearer does not mow the lawn, then the speaker won't give him five dollars. Geis and Zwicky (1971) does not go far in explaining conditional perfection. They merely say that there is 'a tendency of the human mind to perfect conditionals to biconditionals.' Further they reject the possibility of explaining it by means of H. P. Grice(1967)'s Cooperative Principles in conversation, merely noting that one of Grice's maxims, i.e. 'Be relevant' cannnot explain it.

Many counterexamples to conditional perfection have been given, for instance, in Lilje (1972) and Boër and Lycan (1973).

(3) a. If it doesn't say 'Goodyear', it isn't Polyglas. (Lilje)
b. If this cactus grows native to Idaho, then it's not an Astrophytum.(Lilje)

c. If you scratched on the eight-ball, then you lost the game. (Lilje)
d. If the axioms aren't consistent with each other, then every wff in the system is a theorem. (Lilje)
e. If John quits, he will be replaced. (Boër and Lycan)

From (3a), for instance, you cannot infer that if it says 'Goodyear', it is Polyglas, since there are other kinds of tires manufactured by Goodyear.

Further there have been challenges against the validity of examples of conditional perfection cited by Geis and Zwicky (1971). I shall cite two typical arguments of that sort.

> A person to whom (4) (our 2a) is addressed could well ask whether there might be some other way he could earn five dollars, by cleaning up the garage or whatever. That is, if he does want the five dollars, and does not want to mow the lawn, he need not simply conclude that he's out of luck. Nor need the person who utters (4) (our 2a) intend to suggest that (4) (our 2a) could well be the first item on a list of responses to the question, "How can I earn five dollars?" (Lilje, 1972)

Against (2d), which Geis and Zwicky gave the name 'law-like statement', and which they claimed suggests (4) or (5),

(4) Cold iron does not turn red.
(5) Iron not heated in a fire does not turn red.

Boër and Lycan (1973) argue that:

> If (9) (our 2d) is intended as a statement of a (physical) law, we are entitled to infer from it that heating *causes* the iron to turn red, since we know that laws state causal facts. (9) (our 2d) is thus naturally interpreted as a causal claim. But one cannot justifiably infer (10) (our 4) from it, in a physics classroom, without presuming the acceptance (in the context anyway) of a doctrine of unique causation; for (19) (our 4) logically rules out anything happening other than *heating*, which could cause the (cold) iron to turn red. To see this, imagine the lecturer's having added,"...if you bash iron hard enough with a hammer, it turns red: if you subject iron to intense pressure, it turns red; and if you drop iron into certain chemical solutions, it turns red." (Boër and Lycan, 1973)

They claim that the problem of invited inferences is so irregular that it belongs to pragmatics, but not to semantics, thus out of the scope of linguistics proper and note that the entire phenomenon can be explained by one of Grice's maxims, albeit a different one from the cited by Geis and Zwicky (1971), namely, that of quantity: 'Do not make your contribution more informative than is required.' Thus speakers do not generally go to the

length of saying (6).

(6) If you mow the lawn I'll give you five dollars, but if you don't mow the lawn, I won't give you five dollars.

(6) is too lengthy and (7), which is logically equivalent as shown by the Law of Material Implication in symbolic logic, sounds pedantic, presumably because it says everything explicitly as in mathematics.

(7) I'll give you five dollars if and only if you mow the lawn.

What happens is presumably people do not say what can be easily inferred from the context or common sense. In this particular instance, it is taken to be common sense that people do not give away money for free. As to the counterexamples in (5), the speaker did not omit anything and that common sense or the facts of the world around us prevent us from inferring invited inferences.

Several explanations for invited inferences have been offered, Boër and Lycan (1973) being one of them, as I have given a brief summary thereof above. Wirth (1975) claims that conditionals in natural language are ambiguous between pure logical conditionals and biconditional in the same way as disjunction in natural language is between exclusive and inclusive disjunction, but provides no evidence for her claim and no explication as to when conditionals can be ambiguous and when not. We may regard her claims as essentially empty.

A rather interesting explanation was offered by Heringer (1971). He reformulates the rule of conditional perfection as in (8).

(8) A sentence of the form $X \supset Y$ invites an inference of the form $X \equiv Y$.

There is a logical tautology (9).

(9) a. $(X \equiv Y) \supset (X \supset Y)$
b. $(X \equiv Y) \supset (\sim X \supset \sim Y)$

Heringer claims that logical tautologies provide the basis for invited inferences. Tautologies with logical formulas on both sides of an implication sign (a horse shoe) functions as basis for invited inferences in that the logical formula on the right hand side of the horse shoe invites the inference of the logical fornula on the left side. We might formulate the formula of conditional perfection as in (10) (representing the relation of invited inference by $\supseteq$).

(10) a. $(X \supset Y) \supseteq (X \equiv Y)$
b. $(\sim X \supset \sim Y) \supseteq (X \equiv Y)$

(11) $(X \bar{v} Y) \supset (X v Y)$

Although Heringer himself does not note it, conditional perfection furnishes the foundations for all invited inferences. If we substitute the left hand side formula of (11) ($\bar{v}$

representing exclusive disjunction) for X in (10a) and the one on the left hand side for Y in (10a), we get (12).

(12) $[(X \bar{\vee} Y) \supset (X \vee Y)] \supset [(X \bar{\vee} Y) \equiv (X \vee Y)]$

(12) represents inclusive disjunction inviting the inference of exclusive disjunction. Note that we can also obtain this result by assuming Geis and Zwicky's formulation of conditional perfection.

(13) $(X \supset Y) \supseteq (\sim X \supset \sim Y)$

By means of the Law of Transposition in symbolic logic, we get (14).

(14) $(X \supset Y) \supseteq (Y \supset X)$

By substitution of (11) for (14), we get (15),

(15) $[(X \bar{\vee} Y) \supset (X \vee Y)] \supseteq [(X \vee Y) \supset (X \bar{\vee} Y)]$

It is not clear whether his claim that invited inferences are based on tautologies can encompass all tautologies in propositional logic. For instance, Zwicky (as reported in Heringer (1971) through personal communication) pointed out that the logical tautology (16) does not give any basis for the presumed invited inference (17), since (17) cannot be one of invited inferences.

(16) $A \supset (A \vee B)$
(17) $(A \vee B) \supseteq A$

But I wonder if this is really a counterexample. (16) itself seems to play no role in everyday inference. It is well known that in symbolic logic disjunction does not account for indeterminateness or non-equalness of disjuncts. Hence if someone said that *if A, then A or B*, he would be considered some kind of a nut. If no such inference as (16) exists in natural logic, there is no reason to expect the invited inference (17).

Relying heavily on tautologies, however, does not explain anything. We have to look for the reason behind the apparent reversal of the direction of the inference. Also Heringer has to have the help of Grice's maxims, since his theory cannot explain when the invited inferences can occur and when not.

Another interesting attempt at explaining conditional perfection was made by Johnson (1976). She offered a plausible explanation of conditional promises and requests by means of speech acts felicity conditions. If promises or requests are made conditionally, it is meant that on condition that the condition specified in the conditional clause is fulfilled, the speaker in the case of promises, or the hearer in the case of requests, have to shoulder the obligation to perform the act specified in the main clause. If, on the other hand, conditions are not fulfilled, then the obligation automatically disappears. Thus felicity conditions pertaining to obligations in promises and requests are conditional in these

conditional promises and requests, rather than something really binding as is the case in ordinary promises and requests. This explanation cannot, however, be extended to other cases like (2b, d, f), and also the the problem of why they mean biconditionals is never explained. This problem remains mysterious as ever. It seems to point out simply the fact that invited inferences are almost obligatory in conditional promises and requests, but never explain why. Eventually this explanation has to be subsumed under a more comprehensive viable explanation.

Thus far we have been discussing what has been achieved in explaining invited inferences and, as is clear from that, everybody seems to have given disparate accounts. Perhaps there is a way to integrate them all and give a coherent account. The following is my first shot at such an integration.

As a way of looking into and exploring how to begin explaining, let me present two test frames. The first test is making the consequent clause of the presumed invited inference probabilistic by means of such words as *might.* The second test is the insertion of the expression *other things being equal* at the consequent clause of presumed invited inferences. Applying these two tests on the sentences in (2) and (3), we get:

(18) a. If you don't mow the lawn, I might not give you five dollars.
b. If you don't mow the lawn, other things being equal I won't give you five dollars.

(19) a. If John doesn't lean out of that window any further, he might not fall.
b. If John doesn't lean out of that window any further, other things being equal he won't fall.

(20) a. If you don't disturb me tonight I might let you go to the movies tonight.
b. If you don't disturb me tonight, other things being equal I will let you go to the movies tonight.

(21) a. If you do not heat iron in a fire, it might not turn red.
b. If you do not heat iron in a fire, other things being equal it does not turn red.

(22) a. If you don't see a white panther, you might not have to shout 'Wasserstoff' three times.
b. If you don't see a white panther, other things being equal don't shout 'Wasserstoff' three times.

(23) a. Andrew is not here and so Barbara might not be happy.
b. Andrew is not here and so, other things being equal Barbara must be unhappy.

(24) a. If it says 'Goodyear', it might be Polyglas.
b. *If it says 'Goodyear', other things being equal it is Polyglas.

(25) a. If this cactus does not grow native to Idaho, then it might be an Astro-

phytum.

b. *If this cactus does not grow native to Idaho, then other things being equal it is an Astrophytum.

(26) a. If you did not scratch on the eight-ball, then you might not have lost the game.

b. If you did not scratch on the eight-ball, then other things being equal you have not lost the game.

(27) a. If the axioms are not consistent with each other, then every wff in the system might not be a theorem.

b. *If the axioms are not consistent with each other, then other things being equal every wff in the system is not a theorem.

(28) a. If John does not quit, he might not be replaced.

b. If John does not quit, other things being equal, he will not be replaced.

In some cases (a) sentences do not sound quite so good, in that case it might be better to replace *might* by *there is a possibility that*. In any case the point is that both kinds of sentenes, those that allow invited inference and those that do not, are equally acceptable on the possibility test, but that some of those that do not allow invited inferences, namely (24b), (25b)and (27b), fail the *other things being equal* test. When we look for the reason for this difference, we immediately notice (3a, b, d) are not cause-effect sentences, they are sentences where the speaker bases his judgement in the main clause on what is hypothetically supposed in the conditional clause. They expresss inclusion relations between objects and categories. Of course there can be one-member sets and in such cases, invited inferences are easily applicable, as in (29).

(29) a. If that white house has the number 734, it's Bill's.

b. If that white house does not have the number 734, it's not Bill's.
(Of course excluding the cases where Bill has two houses)

In most cases, however, sets have more than one member. Another factor is that you cannot act as if there were no other members in set-membership relations, while you can in cause-effect relations. Now this brings us to the problem of why *other things being equal* is applicable to cause-effect relations but not to set-membership relations. *Other things being equal* is essentially a device that enables us to ignore other factors that might effect the same consequence. If we were to set up a hierarchy of the tolerance of invited inferences, multimember set-membership relations would come at the bottom. The facts of the things around our world is such that usually only one cause sufficiently effects the consequence and other potential causes do not come into play. We might say that in the case of set-membership relations, other members not mentioned in the sentence are actually present and that in the case of cause-effect relations, other causes not mentioned in the sentence are imminently present and presumed absent.

The possibility test, on the other hand, is different. You acknowledge the existence of other potential causes and hence all the sentences pass this test.

Now the problem arises as to how to handle sentences generally assumed not to invite inferences that pass the *other things being equal* test, namely (3c, e) and in addition (30a), which does not invite the inference of (30b).

(30) a. I'll flunk you if you do not take the test.
b. I won't flunk you if you take the test.
c. ?If you don't take the test, other things being equal I won't flunk you.

They seem to involve various factors in a continuous time span. Taking the test is prerequisite to passing the course, but in addition you have to get points above the passing mark. Thus you cannot simply ignore this second factor that causes your passing. We might say that these conditioning factors are like hurdles arranged sequentially and in order to come out unscathed you have to go over them. The same things apply to (3c), there being many factors that can cause your losing in the time span of one game. You simply cannot ignore other factors, since they have a strong possibility of causing your loss. In symbolic terms we might represent what's happening as in (31).

(31) $\sim A \supset (\sim B \supset (\sim C \supset (\sim D \ldots (\sim N\text{-}1 \supset \sim N))))$

Fulfilling the condition A does not give the result N, you have to fulfill all the other intervening conditions also. On the other hand, sentences in (2) which inferences enable us to ignore the other potential causes that appear as intervening antecedent elements in (31), and this assumed deletion of intervening factors is expressed by ***other things being equal.***

Now let us turn our eyes to conditional promises and requests. According to Searle (1969), (32) is one of the preparatory conditons for requests and promises.

(32) It is not obvious to both *S* (the speaker) and *H* (the hearer) that *H* will do *A* (the act) in the normal course of events of his own accord.

Thus sentences like (33) are strange.

(33) a. I promise to give you five dollars, which I was going to anyway.
b. Will you give me five dollars if you were going to (do so) anyway?

Consequently we can say that (32) removes the obligation from the shoulder of the speaker in the case of conditional promises and from that of the hearer in the case of conditional requests, when the conditon is not fulfilled. On the other hand, the speaker may make another request or promise different with respect to the condition but the same with respect to the consequent, though it does not happen so often. Therefore usually conditonal promises and requests are assumed to invite inferences, and on the other hand invited inferences may be suspended by another request or promise. I do not know whether there

is a case of obligatory invited inferences, parallel to the case of obligatory non-application of invited inferences involving multimember set-membership relations. Presumably this would be a case of one-to-one cause-effect relations. If such unique causal relations exist in this world, then it would come to the top of the inference inviting hierarchy. Even if no such relations exist, there surely are one member sets. Another way of obtaining obligatory invited inferences is specifying all the potential causes in the conditional clause. In the case of set-membership sentences, we can string in the main clause all the characteristics that are necessary to focus onto only one entity.

(34) a. If A, B, C,...or N-1, then N.
b. If neither A, B, C,...nor N-1, then not N.
(all the potential causes specified in the antecedent)

(35) a. If this cactus does not grow native to Idaho and its color is so-and-so and its shape so-and-so, ..., then it's an Astrophytum.

(35) might be represented schematically as (36b).

(36) a. If A, B, C, and N-1, then N. (invited inference)
b. If not (A, B, C...and N-1), then not N. (original conditional)

From (36b), we get (37).

(37) 1. $\sim(A \cdot B \cdot C \ldots N\text{-}1) \supset \sim N \;/\therefore \sim A \supset \sim N$

2.	$\sim A$	
3.	$(\sim A \vee \sim B \vee \sim C \ldots \sim N\text{-}1) \supset \sim N$	1, De Morgan
4.	$\sim A \vee \sim B \vee \sim C \ldots \sim N\text{-}1$	2, Addition
5.	$\sim N$	3, 4, Modus Ponens
6.	$\sim A \supset \sim N$	2-5, Conditional Proof

Thus negation of only one subpart of the antecedent is sufficient.

On the bottom of the hierarchy would be multi-member sets and inbetween there would be cause-effect relations which do not list all the potential causes that effect the same consequence. Presumably there are various degrees of difficulty in ignoring other potential alternative causes, those in (2) being easier ones and (3e) being one of the harder ones. Of course this state of affairs is not absolute. Conditional promises or requests might not invite inferences if other alternative causes are specifically mentioned or hinted at. We may say that Grice's axiom 'Do not make your contribution more informative than is required' is responsible for not mentioning the ignoring of other alternative causes.

In conclusion let me point out that all we have seen seems to point the problem of invited inferences in the direction of pragmatics, since the case or difficulty of invited inferences depends so much on the facts of the world surrounding us. However, this does not preclude the study of invited inferences from the proper domain of linguistics. To

date nobody has ever shown clearly that there is a clear-cut boundary between semantics and pragmatics. Whatever may turn out to be the case, it is clear that if we try hard enough, we can capture generalizations.

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