If . . . (and Only If):
Conditional Perfection and Completeness

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Contents

1 Introduction **4**
1.1 Invited inferences . . . 4
1.2 Conditional perfection and linguistics . . . 5
1.3 A note on other invited inferences . . . 7
1.4 Prospectus . . . 8

2 Approaches to conditional meaning **10**
2.1 The classical account . . . 10
2.2 Possible worlds . . . 12
2.3 Conditional types . . . 13
2.4 The restrictor analysis . . . 14
2.5 A "working definition" . . . 15
2.6 Mental spaces . . . 16

3 A taxonomy of perfectible conditionals **18**
3.1 Perfectible conditionals . . . 19
3.1.1 Predictions . . . 19
3.1.2 Promises . . . 20
3.1.3 Threats . . . 21
3.1.4 Commands . . . 22
3.1.5 Counterfactuals . . . 23
3.1.6 Warnings . . . 24
3.1.7 Recommendations . . . 24
3.1.8 Non-perfectible conditionals . . . 25
3.2 Characteristics of perfection . . . 27
3.2.1 Desirability and control . . . 27
3.2.2 Relevance and defeasibility . . . 29
3.3 Desiderata and conclusions . . . 30

4 Towards an explanatory account of perfection **31**
4.1 Conditional perfection as pragmatic inference . . . 31
4.1.1 Presupposition . . . 31
4.1.2 Conventional implicature . . . 34

4.1.3 Conversational implicature . . . 35
4.1.4 Generalized conversational implicature . . . 37
4.2 Q and I implicatures . . . 38
4.2.1 Perfection as scalar implicature . . . 38
4.2.2 Perfection from informativeness . . . 42
4.3 Strengthening and exhaustivity . . . 44
4.3.1 Conditional strengthening . . . 44
4.3.2 Exhaustive interpretation . . . 45
4.3.3 Completeness . . . 49
4.3.4 Beyond questions . . . 51
4.4 Default inferences . . . 55

5 A few formalities **58**
5.1 Exhaustivity in dynamic semantics . . . 58
5.2 Relevance and mention-some readings . . . 61
5.3 Conditionality and strengthening . . . 62
5.4 Summary . . . 63

6 Conclusions **65**
6.1 Invited inferences and natural reasoning . . . 65
6.2 Outlook . . . 66

Preface and Acknowledgements

This thesis examines the phenomenon of conditional perfection as originally proposed by Geis & Zwicky (1971). It first develops a linguistic basis for conditional perfection, and an account of conditional semantics on which to base investigation. Subsequently, it examines in detail the types and features of conditional statements which are associated with a perfected interpretation, and from here provides a formal account that makes use of exhaustive interpretation as first developed by Groenendijk & Stokhof (1984). This treatment has ramifications for pragmatic theory in a broader sense; particularly with respect to a project of formal accounting for inference and implicature.

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Chapter 1

Introduction

1.1 Invited inferences

A major area of interest within semantics and pragmatics is the identification and description of the various types of inferences that accompany "what is said" (Grice 1975). It is widely accepted that linguistic utterances come with information that goes above and beyond strictly stated content: this information can be classified in a variety of ways, including as entailment, presupposition, or implicature. One of the tasks of semantics and pragmatics, then, is to identify regular associations between "unsaid" and "said" content, to explain how it comes about, and to determine how such associations fit into the spectrum of communicated content.

In a 1971 squib, Geis & Zwicky (henceforth, G&Z) put forward three instances of such regularly associated content which they class together as "invited inferences." These include conditional perfection, the inclusive interpretation of *or*, and inferred causation between coordinated or otherwise adjacent propositions. What ties these together, for G&Z, is that the inference in each case bears a "quasi-regular association" with the logical form of the sentence (p.562). Invited inferences, then, are inferences that assert certain connections between linguistic form and patterns of reasoning or logic in the human mind. As such, it may be possible to classify them as belonging to one of the inference groups mentioned earlier. G&Z suggest, however, that these quasi-regular associations, in addition to being robustly observed and mutually coherent, are distinctive enough to warrant consideration as a class of inferential patterns independent of entailment, presupposition, and implicature. Insofar as this is a real possibility, invited inferences are in need of study in their own right.

Of the three examples, conditional perfection seems to provide the most scope for investigation. G&Z observe that, "in a wide variety of circumstances, sentences having the form of $[p \rightarrow q]$ are interpreted [...] as if they imply the truth of $[\neg p \rightarrow \neg q]$" (p.562). For instance, a sentence such as (1.1)a is taken to imply (1.1)b and thus to give rise to the proposition in (1.1)c, when the explicit content and the inference are taken together.

(1.1) a. If you mow the lawn, I'll give you five dollars.

b. If you don't mow the lawn, I won't give you five dollars.

c. If and only if you mow the lawn, will I give you five dollars.

The general principle of conditional perfection can be stated as follows:

(1.2) **Conditional Perfection:** A sentence of the form $X \to Y$ invites an inference of the form $\neg X \to \neg Y$.

Formally, (1.1)b is the logical converse of (1.1)a. Taken together, they give rise to the biconditional (1.1)c: thus, conditional perfection can be associated with a "tendency in the human mind to 'perfect conditionals to biconditionals.'"[1] Moreover, this tendency is represented in the logical fallacies of *denying the antecedent*, and, to a lesser extent, *affirming the consequent*.[2] These fallacies are frequently observed in naïve reasoning and are well-documented, having been described as early as Aristotle.

Conditional perfection, then, provides a good basis for examining invited inferences as a potential class of inferential phenomena that are associated with patterns in human reasoning. Insofar as both denying the antecedent and affirming the consequent are, formally, logical fallacies, it is easy to see that a phenomenon based upon them is necessarily weaker than entailment. However, just as entailments correspond to the logically valid inferential rules of *modus ponens* and *modus tollens*, invited inferences may turn out to represent a pattern of linguistic behavior that corresponds to certain deductive reasoning rules available in the human mind. A proper classification along these lines can only be achieved by examining the phenomenon in detail; in this thesis, I propose to examine the inferential status of conditional perfection, and in so doing, aim to provide a case study for the classification of invited inferences.

1.2 Conditional perfection and linguistics

I take as an important premise for the investigation of conditional perfection (henceforth, CP) that it has some connection to the cognitive reality of human reasoning. Given this, it seems important to provide some justification for the claim that they represent a *linguistic* effect. This is particularly important in light of oft-cited arguments against regarding CP as a genuine linguistic phenomenon. These can be countered, and I position my case for CP against them.

Boer & Lycan (1973) take issue with the notion of a statement which "invites" a listener to assume that the speaker is committing herself to an unsaid proposition. They argue that the relation intended by G&Z's phrase "invites the inference of" necessarily means something along the lines of (1.3):

(1.3) S_1 invites the inference of S_2 just in case that, given certain background beliefs and attitudes, we would have some warrant for assuming that if someone J says S_1, he will act as if he is willing to be regarded as having committed himself to the truth of S_2.[3]

[1] Terminology attributed by G&Z to Lauri Karttunen.

[2] Given $p \to q$, denying the antecedent is the fallacy of concluding $\neg q$ from $\neg p$; affirming the consequent is concluding p from q.

[3] Paraphrased from Boer & Lycan (1973; pp.484-486)

They claim that linguistics ought not to be concerned with commitments of this type, pointing out that (1.4)a warrants the assumption that the speaker is willing to be regarded as committed to (1.4)b.

(1.4) a. Those goddamn hairy demonstrators should go back to Hanoi, where they take their orders from.

b. The Vietnam War is morally obligatory.

The warrant here is based on the fact that someone uttering (1.4)a is likely to have (1.4)b as part of his background beliefs. The association between the two, according to Boer & Lycan, falls outside the purview of linguistics on the grounds that intuitions about the belief systems of discourse participants are not linguistic objects.

This seems reasonable at first; at any rate, the objection applies to the relationship between (1.4)a and (1.4)b. Where Boer & Lycan go wrong, however, is in assuming that the link between (1.1)a and (1.1)b is of the same type. While the fact that (1.1)b is frequently communicated by the utterance of (1.1)a does suggest that the speaker believes (1.1)b, it crucially suggests something stronger. In particular, it reflects the fact that the speaker understands (1.1)b to be part of the meaning communicated by using (1.1)a, and thus *intends to communicate* (1.1)b in using (1.1)a. Thus, (1.1)a "invites" (1.1)b through intuitions about communicative intent, not simply underlying beliefs. It thus belongs with the bulk of Gricean pragmatics — both are part of the broad notion of $meaning_{NN}$ (Grice 1957), which holds that the basis of much linguistic communication is the role that language plays as a signifier of communicative intent.[4] Boer & Lycan's objection represents a mischaracterization of the relationship between a conditional and the inference it invites; the true relationship is, fundamentally, linguistic.

Another objection is raised by Lilje (1972), who argues that to understand a conditional as a biconditional is to misunderstand it. This is a peculiar criticism: if a conditional statement is understood to have precisely the meaning "$\rightarrow$" (no more and no less), then Lilje's claim is obviously true. However, if this were the case, then there would be no question of a biconditional interpretation: the entire meaning of the conditional statement would be encapsulated by material implication. The fact that biconditionality occurs at all indicates that, at least in some cases, English conditionals have this interpretation as part of their meaning in usage. In examining the full range of meaning communicated by conditionals, it would be jumping ahead to presume that this comprises precisely the one-way conditional. Moreover, while principle (1.2) does correspond to a logical fallacy in the formal sense, it is premature to say that this a) either makes it of no interest as a linguistic phenomenon or b) necessarily corresponds to "fallacious" reasoning in an informal (natural) context. Indeed, robust observation of the biconditional interpretation suggests that the inference pattern described by CP at least has validity in linguistic contexts. It is precisely this that I propose to investigate.

[4]Roughly, a speaker can be said to have $meant_{NN}\ y$ by saying x if she intends her audience to believe y, and to recognize that she intended this belief to come about as a result of using x.

Lilje also claims that the instances where CP applies cannot be isolated by appealing to the logical form of the utterance. This is true in the sense that not *all* conditional statements invite perfection. However, it does seem to be the case that accurate predictions about the presence or absence of perfection can be made when we consider the use to which a conditional utterance is put. G&Z themselves observe this: they claim that CP arises in predictions, promises, threats, and commands, among others. Characterization by use corresponds well with illocutionary force, in the sense of Austin (1956), and this will provide at least as linguistically valid a taxonomy as appeal to logical form.

I have argued that CP represents a pattern of linguistic reasoning, and relates directly to the fundamental pragmatic concept of $meaning_{NN}$ (as well as possibly to illocutionary force). These points are sufficient warrant for a linguistic examination of CP. Before proceeding, however, I add some observations about the behavior of CP as a nonexplicit aspect of communicated meaning.

First, CP is weaker than entailment. If John says (1.1)a to Bill, who subsequently mows the lawn, Bill will have grounds to accuse John of lying if he does not then produce five dollars. On the other hand, if Bill does not mow the lawn, and John nevertheless gives him five dollars, it will be seen as unwarranted for Bill to accuse him of lying. Thus, the speaker is not as strongly committed to the invited inference as he is to the entailed content of the conditional, and CP can be seen to be weaker than entailment.

In addition, invited inferences can be explicitly or implicitly cancelled. For example, while (1.5)a uttered alone is subject to perfection, if it is amended as in (1.5)b, the inference is defeated.

(1.5) a. If you get me some coffee, I'll give you a cookie.

b. If you get me some coffee, I'll give you a cookie. Or if you make some tea.

Similarly, if (1.5)a is uttered in a context in which perfection contradicts what is already known — for instance, if I have already unconditionally offered you a cookie — the inference is defeated.

Both defeasibility and the relative weakness of the commitment argue for a pragmatic classification of CP, as does the observation that perfection can be linked to $meaning_{NN}$. A detailed examination of this will be left for later.

1.3 A note on other invited inferences

G&Z also describe two other phenomena as instances of invited inference. The first of these, inclusive *or*, is encapsulated as follows:

(1.6) **Inclusive *Or*:** A sentence of the form $(X \vee Y) \rightarrow Z$ invites the inference $(X \wedge Y) \rightarrow Z$.

According to G&Z, the inclusive interpretation is worthy of note in this context because English *or* is "in many contexts, unspecified as to its inclusive or exclusive sense" (p.563).

However, as current thinking treats *or* as having an inclusive semantics, the claim that this should represent nonexplicit content is suspect. With respect to the "quasi-logical" nature of invited inference, however, suffice it to say that inclusive *or* does not represent a robust inferential phenomenon in the way that CP does. I shall set the question of whether they class together aside here. It may be the case that the preferred exclusive reading that arises in examples such as (1.7) warrants investigation alongside CP, but I shall set this question aside as well.

(1.7) Martin will dance a jig or play a blues number.

Inferred causation, the last of G&Z's invited inferences, refers to the tendency to assume a causal link between coordinated or adjacent propositions which are temporally ordered.

(1.8) After a large meal, we slept soundly.

The inference here is that the consumption of a large meal (the first situation) is the reason for sleeping soundly (the second situation). In some ways, this has a better claim than inclusive *or* to belong to the same class as CP: it corresponds to the logical fallacy *post hoc ergo propter hoc*. However, it cannot be stated in logical terms with the same efficacy as CP, and the class of linguistic constructions to which it applies cannot be isolated and encapsulated in as neat a fashion as those which CP affects, so there are grounds for questioning a joint classification. I leave both inferred causation and this last point for future investigation.

1.4 Prospectus

In this thesis, I investigate and describe CP as a pragmatic inference, and provide an account of the circumstances and process by which it is derived. In so doing, I address the following issues.

In order to understand what precisely perfection adds to a conditional, we must first have an account of the explicit semantic content. The meaning of a conditional may be related to material implication, but this cannot be concluded without investigation. Chapter 2 provides a discussion of various approaches to conditional meaning, with an eye to clarifying this. The semantics of conditionals will also be relevant in considering the form that the perfecting inference takes. G&Z propose that a conditional invites its converse; however, there is no *a priori* reason to prefer this description over one which says that a conditional invites a biconditional interpretation, or one which says that, under certain circumstances, a conditional is directly understood as a biconditional.

Chapter 3 considers the use to which conditionals can be put, and provides a taxonomy of perfectible conditionals. On this basis, I isolate and describe a set of characteristics prevalent among perfectible conditionals. This provides a preliminary list of desiderata for an account of CP.

Chapter 4 addresses the question of where CP fits along the spectrum of communicated pragmatic content, and compares it to the received classes of pragmatic inference. I also examine a number of accounts that have been proposed to handle CP, and use an understanding of where they go wrong to build an account of perfection which relates it to exhaustive interpretation (cf. Groenendijk & Stokhof 1984). This account resolves the question of the inference form, while simultaneously providing a description of the "calculation" that gives rise to CP.

Finally, Chapter 5 provides a more careful look at the formal machinery involved in accounting for CP via exhaustive interpretation. I also discuss the ramifications of this for approaches to conditional meaning.

An overarching question treated by this thesis is whether or not CP constitutes a logical fallacy that has come into use as a linguistic convention. I argue that CP — and perhaps the linguistic use of a variety of logical fallacies — may instead be said to reflect a broader truth about the connection between the logic of natural language (as distinct from formal logic), and the practical processes and patterns of human reasoning. This question is perhaps not strictly linguistic, but is well worth investigating insofar as the study of linguistics fits into the broader study of cognitive phenomena, and into an investigation of how logic and reasoning work in the human mind.

Chapter 2

Approaches to conditional meaning

Consider again the principle of CP:

(2.1) **Conditional Perfection:** A sentence of the form $X \to Y$ invites an inference of the form $\neg X \to \neg Y$.

As offered, (2.1) makes an implicit and nontrivial claim about statements of the form "if p, q" — namely, that they can be represented by the logical formula $p \to q$. This assumes that material implication provides a sufficient semantics for English conditional statements. As this is currently an unjustified claim, I revise (2.1) to the following:

(2.2) **Conditional Perfection (revised):** A sentence of the form "If X, Y" invites an inference of the form "If not X, not Y."

Although (2.2) is a better way of phrasing CP, it is less specific than (2.1). In particular, where (2.1) offers a clear (albeit problematic) characterization of what is conveyed by a conditional, and therefore what is added in perfecting a conditional, (2.2) requires us to address these questions separately. In order to understand CP, then, we must first understand what it is that is being perfected — that is, what the semantic meaning of a conditional statement is.

The question of conditional meaning has received much in both the linguistic and philosophical literature, and I do not claim to provide a definitive treatment here. This chapter considers some of the major proposals, with the aim of sketching the basics of a satisfactory account. This provides a framework against which to assess what is added by the perfecting inference described in (2.2).

2.1 The classical account

Philosophers of language have traditionally sought to identify formal logical operators with their natural language counterparts. This is one of the aims of Gricean pragmatics: Grice (1975) attempts to explain the non-formal aspects of connectives such as "and" by way of

context-dependent implicature, leaving only the logical backbone for the semantics. For "if," this gives us G&Z's implicit claim: conditional statements are represented by material implication. On this view, the extension of "if p, q" is given by the truth table for $p \to q$: true just in case q is true or p is false.

This is satisfactory only up to a point. Consider the following:

(2.3) If the plane is on time, Mary will be home for dinner.

Someone stating (2.3) could only be said to have lied if the plane arrives on time but Mary does not come home: that is, if p is true but q is false. If both antecedent and consequent hold, (2.3) is clearly true. But what if the plane is late? Whether or not Mary comes home, the speaker has not lied, and we might regard (2.3) as true. Intuition, however, suggests that situations where the plane arrives late render (2.3) irrelevant, rather than false. (2.4) makes the issue clearer:

(2.4) If the moon is made of plastic, the sun will not rise tomorrow.

Since we can be reasonably certain that the moon is not plastic, material implication gives (2.4) as true. This is intuitively wrong. Should the moon turn out to be plastic, it remains unlikely that the sun will fail to rise; (2.4) seems false because it suggests a false connection between the moon's composition and the rising of the sun.

From this point of view, the problem with material implication is that it allows the truth of p and q as independent propositions to determine the truth value of "if p, q." Intuition suggests that the truth of a natural language conditional ought to be determined instead on the basis of a connection between the propositions.[1] Insofar as a semantic account ought to capture the behavior of language users, this is a serious mark against material implication.

Higginbotham (1986) raises a more formal issue: material implication behaves noncompositionally when embedded under quantifiers.

(2.5) a. Everyone will succeed if he works hard.

b. No one will succeed if he goofs off.

Material implication renders these as:

(2.6) a. $\forall x[(x \text{ works hard}) \to (x \text{ succeeds})]$

b. $\neg\exists x[(x \text{ goofs off}) \to (x \text{ succeeds})]$
$\iff \forall x[(x \text{ goofs off}) \wedge \neg(x \text{ succeeds})]$

(2.6)a is a reasonable translation of (2.5)a, but (2.6)b requires that everyone both goofs off and does not succeed, which is evidently much stronger than (2.5)b.

For these reasons, material implication is unsustainable. It has largely been supplanted by approaches based on possible world semantics.

[1] This observation is the basis for relevance logic, which attempts to codify the desire for a connection between p and q in terms of a shared variable between the propositions. See Anderson & Belnap (1975).

2.2 Possible worlds

In a possible-worlds framework, "if p, q" is true just in case q holds in all worlds where p holds. This allows us to incorporate the idea that a false antecedent renders the conditional irrelevant: we restrict the worlds under consideration to those where p holds. "If p" signals the hearer to restrict himself to p-worlds: the truth value of the conditional then depends only on the status of q in those worlds.

This is called *strict conditionality*, and is an improvement on material implication. However, Stalnaker (1968) observes that it predicts the validity of certain inference patterns which are challenged by natural language evidence.

(2.7) a. If Kennedy is alive then Oswald didn't kill him.

b. If Oswald didn't kill Kennedy, then someone else did.

c. If Kennedy is alive then someone other than Oswald killed him.

(2.8) a. If this match was struck, it would light.

b. If this match had been soaked in water and was struck, it would light.

If the conditional is material implication, (2.7)c ought to be inferred from (2.7)a and b based on *transitivity*. Given "if p, q" and "if q, r," we expect to conclude "if p, r." (2.8)b ought to follow from *strengthening the antecedent* in (2.8)a. Given "if p, q," "if p and r, q" should also hold. The possible worlds treatment also incorrectly predicts both of these patterns. If all p-worlds are q-worlds, then p-worlds are a subset of q-worlds; thus, if all q-worlds are r-worlds, we can conclude that all p-worlds are r-worlds as well. Similarly, the worlds with both p and r must be a subset of p-worlds: given that all p-worlds are q-worlds, all p-and-r-worlds must also be q-worlds.

(2.7) and (2.8), however, provide evidence contradicting both inference patterns. Stalnaker and Lewis (1973) independently solve this problem by restricting the set of worlds under consideration. Their account holds that q is only considered in those p-worlds most "similar" to the world of evaluation; the choice is determined by a similarity ranking over possible worlds. Formally, if $\leq_W$ is the similarity ordering relative to a world of evaluation W, this account has "if p, q" true just in case q holds in all of the p-worlds which are minimal with respect to $\leq_W$ (where V is $\leq_W$-minimal if there is no world $U \neq W$ such that $U \leq_W V$).[2]

This revision introduces non-monotonicity into conditional semantics. Consider transitivity: if the most similar p-worlds are all q-worlds, and the most similar q-worlds are all r-worlds, this does not guarantee that the most similar p-worlds are a subset of the most similar q-worlds. For (2.7), *any* world in which Kennedy is alive is one in which Oswald did not kill him, but the most similar worlds in which Oswald didn't kill him are ones in which someone else did. These do not include any in which Kennedy is still alive, invalidating

[2]Stalnaker and Lewis do not describe identical orderings, but their accounts share the same basic assumptions, including that $\leq_W$ is a weak ordering, and that W is necessarily $\leq_W$-minimal.

the conclusion from transitivity. In (2.8), the most similar match-striking worlds are also match-lighting worlds. Crucially, however, the most similar worlds in which the match was soaked and then struck do not necessarily form a subset of the most similar worlds in which the match was only struck, and so the inference from strengthening the antecedent fails.[3]

The Stalnaker-Lewis account is not without issue. While it solves the problem of (2.7) and (2.8), it seems to do this better as a *post hoc* rationalization of inference failure than as a motivating explanation. Practically, how is similarity to be determined? Can we claim that a world W is more similar to V than U based on the number of discrete changes? Is a world where Kennedy is still alive different in one degree from the real world? Or do the consequences of a failed assassination attempt (e.g. Kennedy's continued presidency) add up? If so, how are we to determine what such a hypothetical world looks like, in order to compare it for similarity? The issue is, in large part, one of psychological plausibility: a worthy consideration, given the role of conditionality in natural language reasoning.

2.3 Conditional types

This discussion has so far glossed over the fact that conditionals can be of different types. The distinctions between them have been described in a number of ways: I follow von Fintel (2011) in using the most prevalent classification.

The Stalnaker-Lewis account was motivated by the failure of strict conditionality to capture the difference between *indicative* and *subjunctive* (or counterfactual) conditionals, and much of the literature on conditionals has been concerned with this distinction.

(2.9) a. If the Pied Piper called, the children of Hamlin followed.

b. If the Pied Piper had called, the children of Hamlin would have followed.

For the indicative conditional (2.9)a, the truth of p is an open issue; (2.9)b, however, suggests that p false.[4] It has been argued that subjunctive conditionals suggest their consequents are false as well (which indicative conditionals evidently do not).

Two additional types of conditional are usually distinguished:

(2.10) If you are hungry, there are biscuits in the cupboard.

[3]Braine (1979) argues that inference failure is not due to non-monotonicity, but rather to "unguarded speech." This is not incompatible with the Stalnaker-Lewis account: an unguarded speaker simply makes certain assumptions about the background for his remarks, which can be regarded formally as the basis for a similarity ranking.

[4]It is worth noting that the truth-based distinction between indicative and subjunctive conditionals may not be sustainable. Anderson (1951) gives the following example:

(2.i) If Jones had taken arsenic, he would have shown exactly those symptoms which he does in fact show.

Example (i) could be advanced as evidence that Jones *did* take arsenic — thereby cancelling the presupposition that the antecedent is counter to fact (see Karttunen 1971 for the argument that the falsity of p is presupposed).

(2.11) If she is in the lobby, the plane must have arrived early.

(2.10) is a *speech act* conditional;[5] the antecedent offers a rationale or felicity condition for the speech act performed by the consequent (in this case, an offer). (2.11) is a factual, or *epistemic*, conditional; the antecedent typically provides a premise from which the consequent is drawn as a reasoned conclusion.

These types differ first of all with respect to the relationship between p and q; causal in (2.9)a and b, metalinguistic in (2.10), and epistemic in (2.11). Secondly, they differ with respect to the perceived truth value of one of their constituents, and thus potentially in the manner of their evaluation.

Although Austin (1961), among others, speaks of "different kinds of *if*," multiple analyses are undesirable from the point of view of compositionality. Conditionals share the "if p, q" framework: ideally, then, they will share some aspect of their meaning as well.

2.4 The restrictor analysis

An important proposal for a unified "if" is Kratzer's (1986) claim that it should be regarded as a domain restrictor. Building on Lewis's (1973) theory of quantificational adverbs, Kratzer proposes that, in a sentence like (2.12), the role of "if" is to restrict the universe of discourse necessary for the interpretation of the modal quantifier "will."

(2.12) If my hen has laid eggs today, the Cologne Cathedral will collapse tomorrow.

For Kratzer, this can be given in pseudo-logical form as:

(2.13) [must: my hen has laid eggs] the Cologne Cathedral collapses tomorrow

Crucially, "if" on this account is not a two-place connective, but instead an adverbial modifier. According to Kratzer, "the history of the conditional is the story of a syntactic mistake" (p.11): there is no binary natural language counterpart to material implication.

This account has some points in its favour. Gibbard (1981) shows that any two-place connective R satisfying (2.14) must be material implication:

(2.14) a. $pR(qRr)$ and $(p \wedge q)Rr$ are logically equivalent

b. pRq entails $p \rightarrow q$

c. If q follows from p, then pRq is a logical truth.

This would force a material implication account of "if" as a binary operator. Kratzer's "if" simply sidesteps this issue.

The restrictor also addresses the similarity of the following:

(2.15) a. Every student will succeed if he works hard.

[5] Alternatively, a 'biscuit conditional' (see Austin 1961).

b. Every student who works hard will succeed.

The restrictive relative clause in (2.15)b apparently does the same work as the "if"-clause in (2.15)a, which supports Kratzer's treatment.

Von Fintel & Iatridou (2002), however, point out that "if"- and restrictive relative clauses cannot be maintained as interchangeable across the board.

(2.16) a. If Caesar woke up, he had coffee.

b. When Caesar woke up, he had coffee.

(2.16)a does not take a stance on whether or not Caesar did wake up, while b seems to take it as given that he did. This suggests that "if" brings some meaning ("iffiness," for von Fintel & Iatridou) beyond restriction to conditionals. The Stalnaker-Lewis account handles this difference, where Kratzer's cannot.

2.5 A "working definition"

Kratzer's account also leaves unexplained the question of how conditionals handle the relationship between p and q. That an account ought to demonstrate how the meaning of "if" establishes this relationship is not a new idea: Bree & Smit (1981) propose that "if" signals an "inference relationship" from p to q. In the same vein, Akatsuka (1986) argues that "if p, q" has the (abstract) meaning "correlation/correspondence between p and q" (p.335). Moreover, she foreshadows von Fintel & Iatridou's observations about "iffiness," noting that "if p" signals uncertainty on the speaker's part about the assertion of p.

What we expect an abstract conditional to convey, then, is that p and q are connected, q is somehow contingent upon p, and the speaker is uncertain (or wishes to entertain narrative uncertainty, in the case of subjunctives) about p. The Stalnaker-Lewis account (psychological concerns aside for the moment) addresses the latter two, but it is not immediately clear how it addresses the first.

By treating the similarity ranking as simply one instantiation of an accessibility relation on possible worlds, we can see how to extend the account to handle all conditional types with respect to the differences in the connection they assert. Roughly, the antecedent restricts consideration to the "most accessible" p-worlds, where q is then evaluated. The choice of accessibility relation is determined by conditional type and the relationship between p and q: similarity for indicative and subjunctive conditionals,[6] epistemic for epistemic conditionals, and bouletic (or similar) for speech act conditionals.

[6]There may be some debate on this point, which will depend on the details of the similarity relationship established. I take it that the most similar worlds to a world of evaluation in which p is possible will necessarily be those worlds that are compatible with the common ground, augmented by p. It may be necessary to modify this in certain cases: indicative conditionals, significantly, also include conditional promises and threats (of which more later), which may necessitate relativization to some sort of preference structure (see Condoravdi & Lauer 2011). Alternatively, similarity may not be the right accessibility relation for indicative conditionals, but rather something more causal and/or probabilistic — see Kaufmann (2005).

This approach requires a certain amount of context-sensitivity in conditional semantics. I believe this can be handled by a dynamic approach in which the content of the antecedent clause is (conditionally, or "iffily," as it were) added to the common ground prior to evaluation of the conditional as a whole. Von Fintel (2001a) addresses this approach for counterfactual conditionals: he proposes that the falsity of p (with respect to the discourse background) triggers update to a new context in which p *can* be entertained. This can easily be construed as a shift to the most similar p-worlds. It may be that the content of the q proposition needs to be entertained as well prior to context update, but I do not propose to work out this aspect of a dynamic treatment here. Von Fintel's account provides an example; I assume this can be worked out satisfactorily for other conditional types.

Modulo these details, then, (2.17) gives the account of conditional meaning that I will work with:

(2.17) "If p, q" is true in a context C just in case
$\forall C' \in W(C)$ such that $[\![p]\!]^{C'} = 1$, we have $[\![q]\!]^{C'} = 1$

where $W(C)$ is the set of worlds most accessible in C, and accessibility is fixed as outlined above. For brevity, I will also express this definition as follows:

(2.18) **If** P, $Q := \forall[W \cap P]\ Q$

This notation intentionally recalls Kratzer's notation in (2.13); this account is not incompatible with a view of "if" as a domain restrictor. It is possible that the quantifier (as well as the accessibility relation) may need to be sensitive to the content of q: in particular, that it may need to be adjusted relative to a modal operator in q. I will not examine this proposal here, but it is easy to see that (2.18) can be modified appropriately.

2.6 Mental spaces

Lastly, I wish to draw attention to some interesting features of an alternative approach to conditionals. Within the Construction Grammar framework (Fillmore 1988), Dancygier (1998) treats conditionals as a conventional pattern of linguistic structure, paired with "features of interpretation." This admits context-sensitivity of the kind required, but treats it as regulated by the parameters within which the "if" construction can be used.

Dancygier postulates the central generalization as asserting a relationship between p and q, and argues that the interpretation of a particular conditional is further specified in terms of the "cognitive domain" in which this relationship exists (Sweetser 1990, Dancygier & Sweetser 2005). This domain can be seen as a parallel to the accessibility relation in section 2.5: it may be the content domain (for "real world" events), the epistemic domain, or the metalinguistic domain (which deals with preferences, politeness, conversational norms, etc).

Dancygier makes an interesting observation about the morphological patterns of "content" conditionals (indicatives and subjunctives), which she terms "predictive" insofar as p is stated in order to make a prediction about q. Specifically, predictive conditionals are marked by verbal "backshift:"

(2.19) a. If he decides to file the suit, the company's lawyers will question him.

b. If he had decided to file the suit, the company's lawyers would have questioned him.

(2.19)a uses the present tense form of the verb, but has future reference; b is in past perfect, but refers to a more recent event. Backshift is a "linguistic metaphor" (Fleischman 1989) for the speaker's distance from asserting p as fact; crucially, it provides an anchor for determining the appropriate cognitive domain or updating the accessibility ranking in a dynamic account. Epistemic and speech act conditionals are less circumscribed with respect to morphology, but offer similar cues in other ways.

Finally, Dancygier's (and Dancygier & Sweetser's) treatment of conditionals is set within the "mental spaces" framework (Fauconnier 1985). This treats linguistic expressions as building up spaces and/or situations locally and partially, up to the level required to serve communicative goals. This provides a more psychologically plausible way of thinking about possible-world semantics: for instance, rather than needing to evaluate an entire world for similarity in considering a counterfactual conditional, we might build up a picture of the particular changes specified, fleshed out with respect to the common ground, and evaluate on this basis.

This is, of course, a very rough sketch: the mental spaces approach lacks a certain desirable degree of formality. However, it provides a way of understanding how conditional use across "domains" reflects the reality of natural reasoning. In particular, the ability to shift domain highlights how the sufficiency-reasoning at the heart of conditionality may be articulated in context-specific ways, with different consequences. As Dancygier & Sweetser observe, "conditional constructions exemplify the extent to which human cognitive access differs from cognition involved in standard logical [...] models" (p.272). The observations here show how a formal treatment of conditionals in dynamic semantics can take account of the flexibility involved in natural reasoning — this is particularly significant when it comes to examining perfection as a "tendency in the human mind."

Chapter 3

A taxonomy of perfectible conditionals

We have already seen that CP is not universally applicable. Lilje (1972) provides the following example of a non-perfectible conditional:

(3.1) If this cactus grows native to Idaho, then it's not an *Astrophytum.*

Perfection would give the inference that all cacti outside Idaho are *Astrophytum.* This is absurd; (3.1) claims only that *Astrophytum* are non-native to Idaho. Perfection does not arise, presumably due to the general knowledge that tells us it is extremely unlikely for all but one kind of cactus to be found exclusively in Idaho. That is, perfection fails because it goes against common sense.

A statement like "conditional perfection only arises when it is sensible" is not much good as a linguistic generalization. Nevertheless, the existence of "counterexamples" like (3.1) does not mean that we should regard CP as extra- or non-linguistic. What it does indicate is that the statement reproduced here from (2.2) is too general.

(3.2) **Conditional Perfection (revised):** A sentence of the form "If X, Y" invites an inference of the form "If not X, not Y."

(3.1) shows that CP cannot simply be regarded as a byproduct of the "if" construction: there must be other triggering factors.

What does this mean? CP is, after all, *conditional* perfection, and ought to be related to conditionality as discussed in Chaper 2. A statement like (3.2) ought to include some description of which features of a given conditional play a role in inviting the inference: it ought, in particular, to provide some criteria that isolate just those instances where perfection applies.

In this chapter, I provide a taxonomy of conditionals which are subject to perfection. This relies on conditional meaning as previously discussed, as well as on illocutionary force and the use to which a conditional is put. From this taxonomy, I isolate and describe characteristics that predict perfectibility — determining the commonality between perfectible conditionals will help in determining how the inference is invited.

3.1 Perfectible conditionals

G&Z themselves observe that perfection is restricted. In particular, they claim that it is "operative" for predictions, promises, threats, lawlike statements, commands, and counterfactuals (pp.562-563). It seems reasonable to begin with these.

3.1.1 Predictions

G&Z provide (3.3) as an example of a prediction:

(3.3) If John leans out of that window any farther, he'll fall.

The discussion of this example is somewhat confusing: they observe that a "novice logician" is likely to treat (3.3) as a biconditional, but say that this is "surely wrong," as there are other reasons (e.g. a strong gust of wind) that John might fall (p.562). Thus, they seem both to say that (3.3) is naturally perfected and also that it is wrong to perfect it. I take the following from this: (3.3) will frequently be interpreted as indicating that John can stop himself from falling — in the absence of unexpected or untoward circumstances — by not leaning farther out. In this sense, (3.3) is not just a prediction, but also provides an injunction about what John ought to do if he wishes to avoid a fall. On this basis, it seems reasonable to class predictions amongst perfectible conditionals. G&Z's suggestion that biconditionality is "wrong" points to the fact that there are contexts in which (3.3) is not perfected.

Boer & Lycan (1973) offer (3.4) as a counterexample to the claim that predictions invite perfection:

(3.4) If John quits, he will be replaced.

They argue that this does *not* invite the inference that John will not be replaced if he does not quit, since "in most occupations, tenure must be earned" (p.488). The presence of perfection, according to them, is due to the presence or absence of "collateral information," rather than to linguistic form — so (3.3) is only perfectible because it is difficult to imagine a wind strong enough to knock someone from a window.

This argument is problematic: the chief difference between (3.3) and (3.4) does not lie in the fact that reasons for a fall are hard to find while reasons for replacement are not. Rather, (3.3) has a quality of warning about it, while (3.4) is observationally predictive. If there is a difference in the operation of perfection with respect to these examples, it is likely to be attributable to this.

However, Boer & Lycan are incorrect to claim that (3.4) does not invite perfection; I argue that it does. Of course, (3.4) does not deny the possibility of John's ever being fired and replaced, but it does suggest that this is not currently likely. In particular, if John *were* likely to be replaced for some reason other than quitting, and the speaker of (3.4) were aware of this, it would be peculiar not to have mentioned it. Thus, (3.4) suggests that there are no

other *immediately relevant* reasons why John might be replaced, and invites the inference that if he does not quit, he will not be replaced.

Perfection in (3.3) and (3.4) is due to essentially the same process — it goes through in the absence of known (and/or unusual) conditions blocking it. In particular, these cases point to an observation that forms the basis of a number of explications of CP: often, it would be conversationally uncooperative to have mentioned p (and p alone) as a sufficient condition for q if it were not also necessary (i.e. if there were other sufficient conditions). I will examine this reasoning later. For now, it suffices to observe that predictions, on the whole, are perfectible, due to expectations about conversational behavior.

As G&Z interpret them, predictions are precisely indicative predictive conditionals. The asserted relationship between p and q is causal; due to the generality of these examples, it is impossible to say anything more specific.

3.1.2 Promises

(1.1)a, reproduced here, is the prototypical example of a promise:

(3.5) If you mow the lawn, I'll give you five dollars.

This example has met with much discussion in the literature: I take it as given that it invites perfection (see Fillenbaum 1975, 1976, 1978, 1986, Akatsuka 1997, van Canegem-Ardijns & van Belle 2008, among others). (3.6) shows that, as in (3.3)-(3.4), perfection *can* be defeated by further information, but this does not affect the analysis.

(3.6) If you mow the lawn, I'll give you five dollars — but also if you paint the fence.

(3.5), and promises in general, are a subcategory of predictive indicative conditionals (along with threats, often referred to as "commissives"). The relationship between p and q is causal: the hearer's mowing of the lawn will directly be the cause of payment. However, promise causality differs from (3.3)-(3.4): (3.7) further illustrates this point.

(3.7) If you get me some coffee, I'll give you a cookie. [van Canegem-Ardijns & van Belle 2008]

Causality in (3.5) and (3.7) is created by the speaker, and is the source of the commitment. The causal relationship is asserted "strategically in order to influence the hearer's behavior" (van Rooij & Franke 2010; p.3). In particular, the speaker offers q as a consequence of p in order to get the hearer to do p. Fillenbaum (1976) paraphrases the assertion in a conditional promise as "p on your part will be the cause of q on mine" (p.232), and thus characterizes the assertion as "purposive-causal." A conditional promise has the following structure: p is desirable for the speaker, and the hearer has control over it; q is desirable for the hearer, and the speaker controls it; she offers q because she wishes the hearer to do p (cf. van Canegem-Ardijns & van Belle 2008; p.353).

For a promise to be effective, these "desirable" outcomes must be mutually recognized by speaker and hearer. Significantly, q will not be a successful incentive for p if the hearer believes it can be achieved by other means. In particular, then, perfection is essential to the success of a conditional promise. In a promise, even more than a generic prediction, it is reasonable to expect that, because she has established the p-q relationship, the speaker would have mentioned other existing sufficient conditions. Perfection here is evidently related to (albeit perhaps stronger than) perfection in (3.3)-(3.4).

Fillenbaum (1976, 1986) adds bribes to G&Z's list of perfectible conditionals, classed with promises as "inducements."

(3.8) If you throw out the case, I'll pay you 5000 dollars.

(3.8) is clearly perfectible, and shares the structural analysis given for promises; I regard them as the same type.

Another related class of conditionals is suggested by van Canegem-Ardijns & van Belle (CA&B, henceforth). Examples like (3.9) and (3.10) are called "preconditionals."

(3.9) If the weather is fine tomorrow, we'll go swimming.

(3.10) If you sell your car, I'll sell mine.

These establish p as a "precondition" for the action described in q. Preconditionals are similar to promises in that they conditionally commit the speaker to a certain course of action, and establish a similar purposive-causal relationship between p and q; perfection is brought about by similar considerations. As in regular promises, the speaker controls the consequent; the remaining control and desirability factors are optional. For instance, q is potentially desirable for the hearer in (3.9), while the hearer evidently controls p in (3.10).

All three types of conditionals mentioned in this section (promises, bribes, and preconditionals) are perfectible; perfection seems to strengthen with more control and desirability features. I will refer to all three types as promises.

3.1.3 Threats

As commissives, threats share much with promises, and are as widely accepted to be perfectible. G&Z provide (3.11):

(3.11) If you disturb me tonight, I won't let you go to the movies tomorrow.

which they claim suggests that "good behavior will be rewarded" (p.563). Like promises, threats are asserted to influence the hearer's behavior. Some additional examples:

(3.12) If you don't give me your money, I'll kill you. [Fillenbaum 1986]

(3.13) If you tell the teacher I cheated, I'll tell her you did, too.

Threats, too, can be classified as predictives, and the relationship between p and q as purposive-causal.

The control structure on threats is the same as that of promises: speaker control on the consequent and hearer control on the antecedent. Desire valency, however, is reversed: p is undesirable for the speaker and q undesirable for the hearer. The speaker provides q, therefore, to get the hearer to avoid p. Again, desirability (or lack thereof) must be mutually recognized.

CP is invited by threats in much the same way as by promises. The consequent q will not be successful as a deterrent to p if the hearer believes that there is any way to avoid q other than abstaining from p. That is, he must believe that p is necessary as well as sufficient for q.

3.1.4 Commands

On the basis of (3.14), "commands" might also be called "instructions."

(3.14) If you see a white panther, shout "Wasserstoff" three times.

For G&Z, this suggests "silence in the absence of white panthers" (p.563). Boer & Lycan rightly point out that (3.14) ought actually to invite (3.15):

(3.15) If you see no white panthers, do not shout "Wasserstoff" three times.

They observe that this "hinges" on what we know about *why* people issue commands: they want to know definitively whether or not p has occurred (p.491). For Boer & Lycan, this is grounds for dismissing perfection as linguistically uninteresting. In fact, however, it illustrates the connection between perfection in commands and conversational expectations.

Commands have something in common with commissives. (3.14), in particular, can be structured as follows: the speaker wants information about p and the hearer can help with this goal by performing q; the speaker issues the command q in order to find out about p.

This is too specific, as (3.16) shows:

(3.16) If the burglar alarm goes off, call the police.

In this case, the speaker does not necessarily want to know whether or not p, and the structure of a command can be revised. The speaker wants a particular result based on p, and the hearer can effect this; the speaker issues the command q in order to achieve this goal.

This resembles a commissive in that the command loses its point if the hearer performs q in a not-p situation. For example, if in (3.14) the hearer deems it reasonable to shout "Wasserstoff" in the absence of white panthers, the speaker will not be able to extract the desired information. Similarly, if the police are called without the alarm going off in (3.16), the desired result will not be achieved. A speaker would not issue a command as a *conditional* command if p were not the only condition under which q should be obeyed — perfection is thus a result of considerations about the speaker's behavior, and aligns with the previous examples as a result of interacting with control and speaker-determined causality.

3.1.5 Counterfactuals

The term "counterfactual" is usually used for subjunctive conditionals, which are characterized by a causal p-q relationship and the suggestion that p is false. G&Z, however, use the term to describe (3.17):

(3.17) If Chicago is in Indiana, I'm the Queen of Rumania.

I will call this a *rhetorical counterfactual*, to avoid confusion. (3.17) and other rhetorical counterfactuals are usually asserted in (sarcastic) response to the assertion of their antecedents; as a result, p's falsity may not necessarily be in the common ground. The speaker in (3.17) proposes q as linked to p by its absurdity. Dancygier & Sweetser characterize this relationship as "metametaphorical" (p.132); at any rate, it is not causal.

I concur with Boer & Lycan that examples like (3.17) are "just a rhetorical way" of stating that their antecedent propositions are false; contra G&Z, they do not invite perfection. Since it is (presumably) obvious to all discourse participants that the speaker is not the Queen of Rumania, (3.17) employs *modus tollens* ($\neg q \rightarrow \neg p$), and is used to imply that Chicago is not in Indiana. The potential inference (3.18) plays no role.

(3.18) If Chicago is not in Indiana, I am not the Queen of Rumania.

Subjunctive conditionals, on the other hand, may invite perfection. Karttunen (1971) argues that they do: on his view, this explains the suggestion that their consequents are false.

(3.19) a. If Harry had known that Sheila survived, he would have gone home. [Karttunen 1971]

b. If Harry did not know that Sheila survived, he did not go home.

For Karttunen, (3.19)a invites (3.19)b. Since (3.19)a presupposes that Harry did not know Sheila survived, *modus ponens* on the invited inference gives the conclusion that Harry did not go home. This explanation also accounts for the fact that the speaker is not taken to have *asserted* that q is false: she can without contradiction deny this.

(3.20) If Harry had known that Sheila survived, he would have gone home, which he did anyway.

Although the details of Karttunen's argument may bear further scrutiny, his account seems broadly correct. Subjunctive conditionals do invite perfection. The inference, however, is not as straightforward as in the preceding examples: this is reflected in the form of (3.19)b. CP as in (3.2) would give the inference in (3.21), but this is itself subjunctive and does not seem quite right.

(3.21) If Harry had not known that Sheila survived, he would not have gone home.

(3.19)b is intuitively closer to the real inference: we seem to need to "remove" counterfactuality before applying CP.

In short, however, subjunctives do invite some form of perfection, and this roughly patterns with predictions. As predictives, the p-q relationship is causal. Again, perfection refers to the notion that it would be peculiar for the speaker to only mention p as a condition for q if there were other sufficient conditions.

3.1.6 Warnings

I have so far examined only those conditionals called perfectible by G&Z. There is, of course, no reason to suppose that this is an exhaustive list. Fillenbaum (1976, 1986) and CA&B add conditional warnings like (3.22):

(3.22) If you touch that wire, you'll get a shock.

Warnings are predictive and causal, but not (usually) purposive. They resemble threats in that the consequent is undesirable for the hearer. As a result, the hearer is more likely to wish to avoid q than to induce it, and the conditional would be infelicitous if it did not provide information relevant to this desire. (3.22) is therefore perfected: it suggests that not touching the wire will eliminate the shock. Again, this goes through in the absence of extenuating circumstances, such as the conversation taking place in a room full of electrical wiring. It results from expectations about speaker behavior.

3.1.7 Recommendations

CA&B present conditional recommendations as perfectible, and provide the following examples:

(3.23) If you want to save energy, turn off the PC when you're not using it.

(3.24) If you love your cat, give him Petboost.

These resemble commands in that they involve a causal relationship created by the speaker on the hearer's behalf. In particular, while neither p nor q necessarily represents a personal preference on either participant's part, both examples suggest that the speaker regards q as a general good. She provides something that she thinks the hearer will (or ought to) regard as a general good in order to convince him to do q, and thus conveys the belief that p will cause the hearer to do q. The imperative suggests, moreover, that the speaker has or is assuming the authority to convince the hearer of this; as a result, recommendations suggest that not doing q would be a consequence of wrongly failing to care about p, and thus are perfectible.

3.1.8 Non-perfectible conditionals

The conditionals so far identified as perfectible all seem to belong to the predictive class, while the only type dismissed (rhetorical counterfactuals) evidently belongs to the metalinguistic/speech act category. It is tempting to conclude, therefore, that predictive conditionals are perfected and others are not, but this claim must be examined carefully.

To begin with, I have not yet considered G&Z's "lawlike statements."

(3.25) If you heat iron in a fire, it turns red.

They claim that (3.25) suggests that "cold iron is not red" (p.563). This is somewhat misleading, as (3.26) gives the expected inference from CP:

(3.26) If you do not heat iron in a fire, it does not turn red.

Where G&Z's paraphrase seems arbitrarily general, (3.26) is too specific. It implies that heating iron in some other way will not result in its turning read. The "correct" inference, of course, is that not heating iron will result in its not turning red — and (3.25) does appear to suggest this. Heating iron is the only way to turn it red, under typical circumstances.

We have something of a borderline case here, then: the expected inference from perfection is too strong, but (3.25) does come with some degree of implied necessity for p. Additional examples will be useful here.

(3.27) If you heat mercury to 357 degrees, it boils. [adapted from Dancygier & Sweetser]

(3.28) If I drink too much milk, I get a rash. [Dancygier]

(3.27) is much like (3.25). The expected inference that not heating mercury to 357 degrees will result in its not boiling is only partially right: if we heat it to a higher temperature, it will still boil.

(3.28) sheds some light on this: it also represents a generalization, but does not invite perfection. The suggestion that there is no other way in which the speaker might get a rash does not arise. This is because we know that there are many ways to get a rash (heat, poison ivy, etc), and this is precisely the point about lawlike statements. As universals, they encourage us to employ general knowledge. (3.25) and (3.27) receive a perfection-like inference because we know of heating that there is more than one way to do it, and that heating something past its boiling point will still boil it. (3.28) is not perfected because that is not consistent with general knowledge about rashes.[1]

Lawlike statements, then, do not invite linguistically interesting perfection. The presence or absence of the inference here is not due to conditional form, but instead to Boer & Lycan's "collateral information." As lawlike statements are predictive, and assert a causal relationship between p and q, this shows that predictive conditionals cannot be universally perfectible.

What about other conditional types? Rhetorical counterfactuals escape perfection: the following examples further support the claim that this is typical of speech act conditionals.

[1] All three examples do suggest that their consequents are conditioned events — that is, that something must cause them to happen — but this is distinct from perfection. See Chapter 4, section 4.3.1, for a discussion of this phenomenon.

(3.29) If you are hungry, there are biscuits in the cupboard.

(3.30) If you need any help, my name is Ann. [Dancygier & Sweetser 2005]

Biscuits in the cupboard will be there whether or not you are hungry; similarly, the speaker in (3.30) is named Ann whether or not you need help. Even at the speech act level, we do not usually get perfection: p in (3.29) is typically interpreted as a rationale for the offer, not a condition upon it. Similarly, p provides a rationale for the introduction in (3.30); q is not "undone" if you need no help. In general, then, it appears that speech act conditionals are not perfected.

Just as it is not universal that predictives are perfected, however, this last claim is not without exception. I get a perfected (or similar) reading in the following exchange:

(3.31) A: Do you have any biscuits?
B: If you're hungry, there are biscuits in the cupboard.

Here, B is not only offering biscuits to a hungry A, but seems also to be saying that A should not take a biscuit if he is not hungry. This shows that it is possible for speech act conditionals to be perfected — albeit at the speech act, not the literal, level. Perfection is the exception rather than the rule in these cases.

Epistemic conditionals also typically escape perfection. Recall (3.1), reproduced here:

(3.32) If this cactus grows native to Idaho, it's not an *Astrophytum*.

As discussed, p provides the premise in the reasoning process leading to q. It makes sense, then, that conditionality behaves formally: we can draw the conclusion if the premise holds, but we do not know whether or not the cactus is an *Astrophytum* if it is not native to Idaho. (3.33) is similar:

(3.33) If she is in the lobby, the plane must have arrived early.

If she is not in the lobby, we will have to look elsewhere to determine whether the plane has arrived early. The epistemic relationship invites the hearer to think formally: it mimics material implication and does *not* invite perfection.

Again, I can construct an exception to this:

(3.34) A: Isn't this cactus an *Astrophytum*?
B: If this cactus grows native to Idaho, it's not an *Astrophytum*.

If A is read as indicating a presumption that the cactus is an *Astrophytum*, it is possible to hear B's response as perfected. However, (3.34) is evidently an exceptional case; epistemic conditionals are generally not perfected.

Broadly, then, albeit imperfectly, the divide between perfectible and non-perfectible conditionals seems to coincide with the divide between predictive and non-predictive conditionals. I will examine this more closely later; however, Dancygier & Sweetser suggest that the

asserted causal relationship in predictives may be at the center of this. On the mental spaces model, causal relationships invite the hearer to construct the predicted (p) situation as well as a contrasting alternative which has neither p nor q. In particular, causal relationships invite a comparison between p and not-p situations, where the former have q and the latter do not. This also explains why lawlike statements are not usually perfected; instead of setting up contrasting spaces, they generalize over a class of mental spaces. Extending this explanation to possible worlds may take some work, and I do not do this here. However, these observations may provide some insight useful in considering the range of CP.

3.2 Characteristics of perfection

The preceding discussion shows that perfection (or a perfection-like inference) can emerge in two ways. One is through general knowledge about the events involved in a conditional statement — the lawlike statements exemplify this. It is purely through "collateral information" that we get or reject the inference, and its resemblance to perfection, then, is a matter of happenstance. Crucially, it has little or nothing to do with speaker intent. Although it may interact with form-based perfection, it is not of particular interest from a linguistic perspective, and I will not examine it further.

The interesting type of perfection, which affects predictions, promises, threats, commands, subjunctives, warnings, recommendations, and even some non-predictive conditionals, is, by contrast, related directly to considerations about the speaker's intent. A central notion is that p in "if p, q" is often read as necessary because the speaker ought to have mentioned other sufficient conditions: this is a judgement about the speaker's conversational responsibility. These considerations may vary slightly between the different conditionals (for instance, between a promise and a warning), but the underlying principle remains the same in each perfected case.

In this section, I attempt to distill from the taxonomy any common features either leading to or resulting from conversational expectations laid upon the speaker. These will provide something like desiderata for an explanatory account of CP.

3.2.1 Desirability and control

CA&B give a breakdown of perfectibility that differs significantly from the one provided here. Despite this, their observations provide a good starting point for considering what conditional features tend to invite perfection.

For CA&B, perfection comprises three separate inferences; two specific ones in addition to the general "if not p, not q" inference. In particular, they argue that certain conditionals invite an inference to either "only if p, q" or "only if not p, not q."[2]

Promises and preconditionals are associated with "only if not p, q." CA&B relate this to speaker control on the consequent, and the fact that q is desired by one or more of the

[2]According to them, the first should be taken to mean "q in no event other than p," and the second "not q in no event other than not p."

discourse participants. As such, these conditionals are easily read as providing information about the circumstances under which q will be achieved. Speaker control sets up a situation where the hearer does not have access to this or any information about the p-q relationship, which influences the reading.

For similar reasons, CA&B claim that threats and recommendations invite "only if not p, not q."[3] Some warnings may do the same: consider (3.35), said by a doctor to his patient.

(3.35) If you do not have the operation, you will die.

These conditionals are unified by the fact that the hearer is not necessarily interested in achieving q (at least for its own sake — consider recommendations), which raises the salience of "not q" as a consequence.

These specific cases are not additional invited inferences. Each of the conditional types I have examined in this chapter is subject to a biconditional interpretation: given the sketch of conditional meaning from Chapter 2, this leaves only what is given in principle (3.2) for the inference. However, CA&B's discussion of the specific classes highlights certain situational characteristics that provide the ground work for CP as so far discussed. In particular, they show that speaker control and hearer desirability lead to increased salience for aspects of a conditional that come from a perfected reading. Thus, the breakdown provided by CA&B argues for a role for control and desirability in inviting perfection.

This view is supported by experimental evidence from a couple of sources. Fillenbaum (1986) reports that conditional inducements (promises and bribes) and deterrents (threats and warnings) are more likely to be interpreted biconditionally when the extent to which the hearer desires or does not desire the consequent is greater, and, where relevant, is matched by the speaker's "desirability weight" on the antecedent.[4] Evans & Twyman-Musgrove (1998) provide data supporting the influence of speaker control. They presented subjects with instances of promises, threats, and warnings which were varied according to perceived speaker control over the outcome, and found that high control also corresponded to an increased tendency towards biconditional interpretation.

All of this shows the importance of control and desirability in inviting perfection. Although these factors are by no means universally required (predictions are often perfected in their absence), they lend themselves to establishing a context in which the speaker would be expected to provide all sufficient conditions for the consequent. Speaker control sets up her authority, which gives rise to an assumed uncertainty on the part of the hearer, as well as the expectation of full communication. Hearer desirability works with this to affect which aspects of conditionality are most significant. A good account of perfection, then, will allow for these factors as special cases of the broader parameters deriving CP.

[3]Recommendations, as described, can be seen to suggest that only someone who does *not* want p would avoid doing q: consider examples (3.23)-(3.24).

[4]For instance, the following seems somewhat ineffective:

(3.i) If you don't give me a dollar, I'll shoot you.

A speaker who can be dissuaded from killing you by a single dollar seems likely to be easily deterred by some other (low cost) means, or, alternatively, to be likely to kill you in any case.

3.2.2 Relevance and defeasibility

CA&B also discuss an "if not p, not q" inference, as a more general case, and their observations pertain to a description of principle (3.2). In particular, they characterize CP as invited under the following conditions: (i) that the speaker can be assumed to have the information leading to the inference content, (ii) that the speaker intends to communicate this, and (iii) that the inference is relevant.

The preceding section argues that CA&B's inference form distinction is actually a result of overemphasizing the frequently-occurring features of certain conditional types that set up a situation in which perfection is appropriate. Put another way, a situation where one of the "only if" statements would be relevant is a situation where perfection is invited — the need for the "only if" information actually invites the inference, but does not, as CA&B argue, necessarily affect inference content. The three characteristics provided above for the general inference further support this view: speaker control provides both the presumption of speaker information as well as intent, and hearer uncertainty and/or desire for or against the antecedent affect relevance.

The following examples illustrate the signficance of (i)-(iii) in a broader capacity:

(3.36) If you touch that wire, you'll get a shock.

(3.37) If Mary is in the lobby, then the plane arrived early.

Assuming that (3.36) is not uttered in a lightning storm, (i), (ii), and (iii) are applicable — in particular, how to avoid a shock is likely to be a relevant consideration. On the other hand, the speaker in (3.37) seems to be making a conjecture based on the propositional information in p: thus neither (i) nor (ii) applies, and a case where Mary is not in the lobby is irrelevant to the utterance purpose.

We have already observed that there are circumstances under which perfectible conditionals are not perfected. In addition to providing situational requirements for perfection, (i)-(iii) secondarily offer a characterization of the ways to defeat perfection. For instance, perfection is negatively affected by the perception that the speaker does not have full information — and is readily cancelled by overt denial.

(3.38) If John quits, he'll be replaced, but I don't know what will happen otherwise.

Similarly, the speaker can cancel perfection without contradiction by indicating that she does not intend to communicate it. (3.20), reproduced here, illustrates this:

(3.39) If Harry had known that Sheila survived, he would have gone home, which he did anyway.

Finally, the situation in (3.40) demonstrates that irrelevance can contextually cancel a normally perfected conditional.

(3.40) A: What will you give me for mowing the lawn?
B: If you mow the lawn, I'll give you five dollars.

A's focus on the consequences of mowing the lawn precludes the relevance of a biconditional interpretation. Neither the speaker nor the hearer is particularly interested in what happens if A does not mow the lawn: the circumstances leading to a possible payment of five dollars are not under discussion here.

It is evident, then, that defeasibility is a characteristic of perfection, and that perfection, as per CA&B, is influenced by considerations about relevance and speaker intent. Defeasibility is a direct result of the means by which perfection is effected, and therefore ought to be represented in any account of the inference.

3.3 Desiderata and conclusions

In this chapter, I have provided a taxonomy of those conditionals that typically invite a perfecting inference, and used this as a basis from which to determine the general parameters of CP. Following on from this discussion, I have argued that perfection as a linguistic (rather than collateral) inference, is conditioned by situational and contextual factors which are directly connected to speaker intent and the speaker-hearer relationship *vis a vis* the propositional content of and relationship between p and q. Situationally-derived interest in the content of a biconditional interpretation draws the addition to conditional meaning as given by principle (3.2). This interest may be established by a generalized perception of speaker knowledge, communicative intent, and relevance, or more directly by these factors as brought about by control and desirability factors.

A satisfactory account of perfection will derive it from the general structure that can be realized in these factors. It will also, as discussed, account for defeasibility without contradiction in both the explicit and contextual cases. Put together, these desiderata form a heavy presumption in favour of a pragmatic account of CP, which I will examine in the next chapter.

Chapter 4

Towards an explanatory account of perfection

4.1 Conditional perfection as pragmatic inference

One of the conclusions of Chapter 3 was that CP is best treated as pragmatic. Most (if not all) of the literature on perfection shares this view; however, there is disagreement as to what type of inference is indicated. I examine the possibilities in detail here.

4.1.1 Presupposition

Presupposition has a complicated theoretical history; I follow Levinson's (2008) arguments that a speaker-based account is the correct approach. I assume familiarity with the overview of presupposition presented there, and extract from this certain (more or less uncontroversial) properties as diagnostics.[1]

An utterance A is regarded as presupposing s if s is a condition that must hold in order for A to receive interpretation. To give an (overtired) example, (4.1)a presupposes (4.1)b: if France has no king, a physical description is meaningless.

(4.1) a. The King of France is bald.

b. There is a King of France.

Perfecting (4.2)a, on the other hand, gives the inference in (4.2)b, and these do not have the same relationship.

(4.2) a. If John quits, he will be replaced.

b. If John does not quit, he will not be replaced.

[1] I cannot find any evidence that presupposition has been put forward as a classification for perfection. I include this discussion insofar as it sheds light on important properties of the inference.

If (4.2)b is known to be false — if, for instance, the company is considering hiring Mary to replace John — (4.2)a remains meaningful. In fact, it seems to accommodate knowledge of (4.2)b's falsity: since John may be replaced anyway, he will certainly be replaced if he quits. Inference failure in CP therefore does not pattern with presupposition failure.

This is to be distinguished from defeasibility, which is displayed by both perfection and presupposition. (4.3) provides an example of a defeasible presupposition.

(4.3) a. John doesn't regret doing a PhD.

b. John doesn't regret doing a PhD, because he never did one!

Factive verbs (e.g., "regret") trigger the presupposition that their complements are true; (4.3)a presupposes that John did a PhD. Denial in (4.3)b cancels this presupposition. This differs from presupposition failure in that the cancellation is explicit; false presuppositions derail their utterances if their falsity is backgrounded. For instance, if we already know that John did not do a PhD, (4.3)a is infelicitous. I have already argued that perfection is defeasible, and reproduce a key example without discussion here.

(4.4) a. If Harry had known that Sheila survived, he would have gone home.

b. If Harry had known that Sheila survived, he would have gone home, which he did anyway.

Presuppositions are also typically backgroundable: if A presupposes s, stating s prior to A does not cause redundancy.

(4.5) John did a PhD. He doesn't regret doing it.

This is not a particularly conclusive diagnostic for perfection, as shown by the following:

(4.6) John won't fall if he doesn't lean any farther out that window. If he does lean farther, he will fall.

(4.7) John won't be replaced if he doesn't quit. If he does quit, he will be replaced.

Backgrounding seems acceptable in both cases, but it is worth observing that the "converse" relationship between a conditional and its perfecting inference means that we could just as easily treat the first sentences in (4.6) and (4.7) as inviting the second sentences. Redundancy may be avoided because the second sentence spells out the inference invited by the first, and backgrounding thus does not provide a definitive test.

Constancy under negation is likewise unhelpful. It is well known that if A presupposes s, the negation of A will also presuppose s: (4.8)a and b both presuppose that France has a king.

(4.8) a. The King of France is bald.

b. The King of France is not bald.

It is difficult to find a natural way of negating conditionals at the sentential level. So-called "metalinguistic" negation, as in (4.9)b, is ambiguous:

(4.9) a. If John quits, he will be replaced.

b. It is not the case that if John quits, he will be replaced.

(4.9)b *could* be read as indicating that John won't be replaced even if he does quit. Significantly, however, it is perfectly well continued with "He will be replaced anyway." As far as this goes, it seems to show us that CP need not be constant under negation, and this is sufficient to distinguish it from presupposition.

Many presuppositions are tied to aspects of surface structure, or "triggers." Factive "regret" in (4.3)a is an instance of this. CP is, of course, related to the "if" construction, but this is not the same. In particular, it is easy to provide conditions for a statement like (4.2)a which preclude perfection. If it were tied to the "if" construction in the same way as a presupposition, one would expect similar failure effects. (4.10) exemplifies this problem for triggered presuppositions.

(4.10) John didn't do a PhD. #John regrets doing a PhD.

The second sentence triggers a presupposition that contradicts the first. By contrast, the presence of the first sentence in (4.11) blocks the invited inference without causing contradiction.

(4.11) John's company is thinking of hiring Mary for John's job. If he quits, he will be replaced.

The presupposition "projection problem" is related to this (Karttunen 1973, 1974). Presuppositions project from embedding under sentential negation (see (4.8)b), and also from under modals and factive verbs ((4.12)a and b, respectively).

(4.12) a. John can't regret doing a PhD.

b. Mary knows that the King of France is bald.

Embedding a conditional under a modal verb is as awkward as negating one. Considering the effect of a factive verb is sufficient to show that perfection, again, does not behave like presupposition.

(4.13) Mary knows that if John leans any further out of that window, he'll fall.

Where (4.12)b clearly presupposes that there is a King of France, here it is not clear that there is no other way for John to fall. Perfection, then, does not project through known presupposition "holes."

CP is also not blocked by presupposition "plugs" (e.g. verbs of propositional attitude):

(4.14) Mary believes that the King of France is bald.

(4.15) Mary believes that if John quits, he will be replaced.

In both examples, the inference does not project. In (4.14), the presupposition is attributed to Mary — it seems to be the case that she believes there is a King of France. On the other hand, no such attribution occurs for the inference in (4.15): it is not clear whether or not Mary believes that quitting is the only way that John will be replaced.

From this evidence, I conclude that perfection is not presupposition. However, we have garnered some important information about its behavior. It is both contextually and explicitly cancelable, is largely immune to backgrounding and/or redundancy effects, and does not project out from presupposition holes — specifically negation and factive verbs. In addition, perfection fails to project from verbs of propositional attitude, and these verbs also block its attribution to the subject.

4.1.2 Conventional implicature

Conventional implicature (CI) was first proposed by Grice (1975). His discussion is only intended to distinguish CIs from conversational implicatures, and thus their elaboration as a rigorous concept has fallen to others (Karttunen & Peters 1979, Potts 2005). I regard Potts's (2005) account as definitive, and use the properties he attributes to CIs as a set of reliable diagnostics.[2]

Some of the relevant data have already been considered. Potts observes that CIs have an "antibackgrounding" requirement (backgrounding them causes redundancy effects), and project out of attitude predicates:

(4.16) #Lance is a cyclist. Lance, the cyclist, battled cancer.

(4.17) Mary believes that Lance, the cyclist, battled cancer — #but Lance isn't a cyclist.

In (4.16), backgrounding the CI (that Lance is a cyclist) makes it redundant in the second sentence. In (4.17), the CI projects out of the attitude predicate without being attributed to Mary, and thus its cancelation is contradictory. Perfection exhibits neither of these properties, as shown by (4.6) and (4.15), respectively. In addition, (4.18) shows that CIs are not usually reinforceable, while (4.6) and (4.7) can as easily be taken to demonstrate perfection's reinforceability as its backgroundability.

(4.18) Lance, the cyclist, battled cancer. #Lance is a cyclist.

[2]It is important to note that, while Potts does not regard CI as "pragmatic" in the traditional sense, he distinguishes between CI and entailment on the basis of "at-issue" content: in particular, entailment content is readily available for question, contradiction, etc, in a discourse, while CI content is not. This distinction seems to be close enough to what I have called "pragmatic" to permit the consideration of CI as a classification for perfection.

Potts also argues that CI failure does not interfere with at-issue content. The following example shows this:

(4.19) Lance Armstrong, the astronaut, battled cancer.

The CI is false, as Lance Armstrong is actually a well-known cyclist. However, while (4.19) is likely to be met with a response to this effect, the information that he battled cancer is neither derailed nor affected. As this discussion of (4.2) shows, perfection patterns with CI on this count.

Finally, to distinguish CI from conversational implicature, Potts observes that CIs are typically neither calculable nor malleable. Where conversational implicature can usually be "computed" on the basis of notions about conversational behavior, CIs are immediate. Consider (4.19) again: no assumptions about the speaker's intent are needed to understand that she has communicated that Lance is an astronaut — CIs are not "calculable." In this they differ sharply from perfection, which I have argued is subject to considerations about the speaker's intent, and is therefore calculable in the sense of Grice.

Malleability, for conversational implicature, refers to the property by which a sentence uttered in different discourse contexts may carry different implicatures. This is clearly not true of CIs. It is a bit difficult to isolate the behavior of perfection in this regard, but consider the following:

(4.20) If John quits, he will be replaced.

In the absence of any general knowledge to the contrary, (4.20) invites the inference that John will not be replaced if he does not quit. On the other hand, if it is known that the company is considering hiring Mary, (4.20) remains a felicitous utterance. Crucially, however, it now indicates that if John quits, his replacement is certain (presumably by Mary), but that if John does not quit, his replacement is only a possibility. In addition, it seems to suggest that if John does not quit, and Mary is not hired, John is unlikely to be replaced. Perfection has been weakened: it no longer says that John will not be replaced if he does not quit, but it does not permit the conclusion that John will be replaced regardless of his actions. In particular, it has turned into the inference that John will not be replaced *ad hoc*. Thus, perfection appears to be somewhat malleable.

CP is evidently not CI. This discussion shows that it shares some significant properties with conversational implicature, which I discuss in the following section.

4.1.3 Conversational implicature

Conversational implicature, as proposed by Grice (1975), comes in two varieties: particularized (PCI) and generalized (GCI). These have a number of properties in common. This is unsurprising, since Grice argues that a GCI starts out as a PCI, and becomes generalized through frequent use, which causes it to attach to utterance form (while PCIs usually arise from contextual considerations).

Both types of conversational implicature arise through speaker intent. A speaker conversationally implicates s by saying A if (i) she can be assumed to be following the conversational maxims and the cooperative principle (Grice 1975; pp.26-28), (ii) supposing s accommodates (i), and (iii), the speaker can be assumed to intend for her audience to recognize (ii).[3] It is evident that these share something with the criteria provided by van Canegem-Ardijns & van Belle (2008) for perfection. Relevance is one of the Gricean maxims, and the speaker's intent to communicate inferential content is a significant factor in both cases.

Grice identifies defeasibility, calculability, nondetachability, and nonconventionality as properties of both types of conversational implicature. We have already seen that perfection is both defeasible and calculable. Nondetachability refers to the fact that any other utterance carrying the same explicit content will also carry the same implicature, and nonconventionality is another side of this: the inferences are "noncoded" and depend on the explicitly expressed content.

As there is no other equally typical method of expressing conditional relationships, nondetachability presents a problem for conditionals. Certain conditionals can be expressed via other logical connectives (see Dancygier 1998), but this is dependent on illocutionary force.

(4.21) [**Promise**] Mow the lawn, and I'll give you five dollars.

(4.22) [**Warning**] Don't touch that wire or you'll get a shock.

This cannot be extended to conditionals that are not speech acts.

(4.23) ?John leans further out of that window, and he'll fall.

As a result, it is hard to determine whether or not perfection is detachable: vacuously, it appears not to be.

Nonconventionality also presents complications. If perfection goes from "if p, q," to "if not p, not q," it does seem to be conventional. On the other hand, this is tied to the coded utterance information, and in particular to the "if" construction. In addition, the possibility of weakening (malleability) described in the previous section suggests that perfection is not coded with any particular strictness.

Within an acceptable range of flexibility, then, an analysis of perfection as some type of conversational implicature shows a good deal of promise.[4] It remains to decide whether it is particularized or generalized.

Levinson (2000) distinguishes PCIs and GCIs on the following basis (p.16):

(4.24) a. An implicature i from utterance U is *particularized* iff U implicates i only by virtue of specific contextual assumptions that would not invariably or even normally obtain.

b. An implicature i is *generalized* iff U implicates i unless there are unusual specific contextual assumptions that defeat it.

[3]This characterization is adapted from Levinson (2000), p.15.

[4]This goes against G&Z's original intuition (p.565).

The consequences of this are dual. First, GCIs are more "typically" associated with an utterance and form than PCIs. Second, the cancellation of a GCI is associated with unusual circumstances, while these may be what gives rise to a PCI. Based on these distinctions, perfection seems to be a GCI.

This classification is further supported by the example Levinson provides to illustrate the PCI-GCI divide.

(4.25) A: "What time is it?"
B: "Some of the guests are already leaving."

(4.26) A: "Where's John?"
B: "Some of the guests are already leaving."

In (4.25), B's response implicates that it is late, whereas in the second it indicates that John may have left — these are particularized, brought on by the precise conversational context of the utterance. In both conversations, on the other hand, B also implicates that *not all* of the guests are leaving — this is associated with the choice of "some," and is generalized. Perfection is more like the generalized implicature than the particularized ones — it is typically associated with "if," would arise independently of conversational context (unless this context contains information specifically denying it), and is essentially the same in all cases where it arises. This does not preclude the interaction of perfection with more specific contextual cues — for example, malleability is caused by this interaction. Nevertheless, it is not as context-specific as a PCI is expected to be, and exhibits the GCI tendency towards universality (Levinson; p.15).

4.1.4 Generalized conversational implicature

GCIs are as "default" inferences, which "capture our intuitions about preferred or normal interpretations" for an utterance or linguistic form (Levinson; p.11). They rely on certain heuristics that apply to communicative behavior at large: that we communicate as much information as needed in a given situation (Q-heuristic), do not communicate extraneous or unnecessary information (I-heuristic), and that we communicate information in a manner commensurate with its content (M-heuristic).[5] Section 1.4 of Levinson (2000) provides a detailed explication of the heuristics. Due to the generality of these principles, Levinson's GCIs lie midway between "grammar" and speaker meaning. The heuristics allow us to communicate more complex information than is strictly encoded in an utterance, and thereby solve the communicational "bottleneck" imposed by the slow rate of human speech transmission (Levinson; p.28).

On Levinson's view, CP is indeed a GCI, and specifically is due to the I-heuristic. It represents an instance of the speaker limiting her utterance to the minimum needed to

[5]These correspond to Grice's two quantity principles and the perspicacity principle under "manner," extrapolated to communicative behavior at large.

achieve a certain effect, knowing that the recipient will furnish the utterance with additional information as consistent with the common ground and the discourse context. Levinson argues that the recipient of a "minimal" transmission knows to assume that stereotypical relationships hold between referents (or propositions, for perfection). This can be seen to apply both to the imposition of causality on conditionals, as well as to the previously-discussed fact that the speaker is expected to provide additional sufficient conditions for q if they exist. CP, then, is an I-implicature in the sense that it allows the speaker to maximize informational load of a conditional utterance on the assumption that the hearer will move to the more specific biconditional unless circumstances dictate otherwise. I-implicatures are inferences from "the lack of further specification to the lack of need for it" (Levinson; p.116), and since a hearer will tend to perfect a conditional, the speaker does not need to make biconditionality explicit.

On the evidence provided here, I conclude that perfection is a GCI: it satisfies the general diagnostics for implicature, falls on the generalized side of the GCI-PCI split, and, most significantly, fits well with Levinson's characterization of GCIs as "default" inferences lying between grammar and speaker meaning. Given the regularity with which conditionals are intepreted biconditionally, it seems to be the case that the speaker simply assumes that conditionals will point the hearer to biconditionality in all relevant situations. The generality of the inference explains the appearance that biconditionality is simply one of the range of meanings of the conditional form: the speaker implicates, as it were, at a subconscious level.

However, Levinson's claim that perfection is an I-implicature has not gone unchallenged. I next consider how this compares with some important treatments of CP.

4.2 Q and I implicatures

4.2.1 Perfection as scalar implicature

CP has often been treated as a scalar implicature (Cornulier 1983, van der Auwera 1997). These are motivated by Grice's Quantity-1 maxim (Levinson's Q-heuristic) — that a speaker should make her contribution as informative as required — and so these accounts contradict Levinson's I classification.

An overview of scalar implicature

Scalar implicature involves two or more utterances, which are ranked with respect to the strength of the information communicated. On the assumption that the speaker is adhering to Quantity-1, the use of a weaker element indicates the negation of the stronger. A typical instance of scalar implicature is the inference from (4.27)a to (4.27)b:

(4.27) a. Some of John's children are bald.

b. Not all of John's children are bald.

The relevant ranking is between the expressions "all" and "some:" {ALL > SOME}. The speaker's use of the lower item implicates that she either knew the higher (more informative) item was not the case, or had insufficient information to permit its assertion. As a result, the inference drawn is that the stronger item does not hold.

The rankings that give rise to scalar implicatures are known as Horn scales, after Horn (1972). Other possible Horn scales include the following:

(4.28) a. {ALWAYS > SOMETIMES}
b. {HOT > WARM }
c. {NECESSARILY > POSSIBLY}.

It is clear that there must be constraints on the relationships between elements in a scale. Exactly what constitutes these constraints has been much discussed in the literature, and for the most part two types of restrictions have been observed. Matsumoto (1995) refers to these as the "informativeness requirement" and the "functional alternative requirement" (p.22).

Informativeness has already been discussed: this refers to the fact that stronger elements on a scale must, in some precise way, provide more information than weaker elements. Horn (1972) proposes to formalize this via logical entailment (e.g. "all" entails "some"), but Hirschberg (1985) argues that scalar implicature can also be induced by orderings (e.g. numerical and temporal) that do not enter into entailment relationships, and this is widely agreed to be correct.

The functional alternative requirement has proved harder to pin down. Items in a scale must be "about" the same kind of thing, in order to represent actual alternatives in a given utterance context. This has been formulated in a number of different (and not altogether satisfactory) ways: for instance, Gazdar (1977) proposes that items must share selectional restrictions and induce the same presuppositions, while Atlas & Levinson (1981) argue that they must belong to the same "semantic field," and be lexicalized to the same degree. The lexicalization requirement has had a significant impact. A compelling explication of functional alternativity is Matsumoto's (1995) "conversational condition," which subsumes lexicalization, along with other proposed constraints. The conversational condition can be stated as in (4.29): I take this as the best formulation of the functional alternative requirement on Horn scales.

(4.29) **Conversational Condition**: The choice of a weaker element instead of a stronger element [on a Horn scale] must not be attributed to the observance of any information-selecting (Gricean) maxim of conversation other than the quality maxims and the first quantity maxim. [Adapted from Matsumoto; p.25].

This handles, for instance, the fact that {KNOW > BELIEVE} is not a Horn scale, despite the fact that knowing is stronger than believing: observance of Quantity-2 (not to provide more information than required) can account for the use of the weaker item and therefore this choice need not implicate the negation of the stronger item. Matsumoto provides a more detailed explication as to how (4.29) interacts with the Gricean maxims and the requirements proposed by others for Horn scales.

Conditional scales

A natural scale for conditionals would, naively, be {IFF > IF}. As the perfecting inference ("if not p, not q") is itself not informationally stronger than the conditional, the scale must necessarily rank the latter against the biconditional. Further consideration, however, shows that this scale cannot possibly derive perfection: the use of the weaker item in "if p then q" would implicate the negation of the stronger biconditional, which is precisely the opposite of the observed effect.

Van der Auwera (1997b) argues that this problem arises because {IFF > IF} is the wrong scale. He proposes the following alternative:

(4.30) { ... > IF P, Q & IF R, Q & IF S, Q > IF P, Q & IF R, Q > IF P, Q}

On this scale, using "if p, q" implicates the negation of all higher items, and therefore negates the possibility of all other alternative conditions for q. This derives perfection by implicating that p is the only sufficient (and therefore necessary) condition for q.

This is unsatisfactory for a number of reasons (see also Horn 2000, von Fintel 2001). Psychologically speaking, an infinitely long scale seems implausible: the inference to perfection does not seem to negate *all* possible alternative conditions, but rather all those that might be considered relevant in context. This might be rectified (in keeping with the conversational condition) by stipulating that the list of alternatives is constructed in a discourse context along with the accessibility ranking on worlds, and is finite and salient as per this context. This does not solve the problem, however. In particular, van der Auwera's scale requires the negation of *specified* alternative conditions. CP, on the other hand, makes no reference to specific alternatives: it leads directly to "if not p, not q," without going through any list of other conditions.

In lieu of {IFF > IF} and (4.30), which he also dismisses, Horn (2000) provides another alternative:

(4.31) {Q > IF P, Q}

This improves on (4.30) insofar as it requires no reference to specific alternatives. However, as Farr (2011) points out, the negation of q (or "whatever the case, q," as Horn alternatively suggests) at the top of the scale does not automatically implicate that p is the only sufficient condition for q. Rather, the implication is that q is not unconditional — there must be conditions, but there may be conditions other than p. (4.31), then, is also insufficient to derive "if not p, not q," and cannot account for perfection.

Blocking a scalar implicature

Having found alternative scales wanting, the problem presented by {IFF > IF} persists. Even setting aside perfection itself, we need to account for the fact that the contradictory implicature predicted by {IFF > IF} does not arise.

Atlas & Levinson (1981) take the position that {IFF > IF} does not form a valid Horn scale: they explain this with reference to the aforementioned lexicalization condition (lacking

a natural language counterpart, "iff" is not lexicalized to the same degree as "if"). The Conversational Condition, however, argues against the lexicalization restriction — Matsumoto points out that statements of varying lexical complexity can, under the right circumstances, be included on the same scale. He provides the example {KILL > CAUSE TO DIE} as evidence of this.

If lexicalization is not an issue, the "reverse" implicature generated by {IFF > IF} no longer appears as an isolated case. Consider, for instance, the hypothetical scale {SOME BUT NOT ALL > SOME}. This is no longer blocked by lexical complexity, and the stronger element is certainly more informative than the weaker. Like {IFF > IF}, this scale predicts the opposite of the expected inference. A similar problem arises with {EXACTLY THREE > THREE} (see Matsumoto for further examples).

What these scales have in common is that their stronger elements are more informative by virtue of containing the literal meaning of the weaker element plus a negative proposition ("not all," "if not p, not q," "not more than three"). That is, they are stronger due to the addition of a negative restriction. This violates an aspect of the informativeness requirement as defined by Horn (1989): items on a Horn scale must be all either positively scalar ({ALL > SOME}) or negatively scalar ({NONE > A FEW}).[6] "Some but not all" and "iff" are non-scalar because they combine a positive element with a negative one, and are therefore prohibited from entering into a scale.

As noted, the "scalarity condition" comes from informativeness, rather than from (4.29). It prohibits the existence of the scale {IFF > IF} and thereby blocks the scalar implicature to the negation of the biconditional. Coupled with the rejection of van der Auwera and Horn's scales, this also handles the apparent conflict between perfection as I-implicature or Q-implicature on Levinson's account of GCIs. If CP is neither a Q-implicature nor in direct conflict with one, it is free to be drawn on the basis of the I-principle.

[6]For Horn and Matsumoto, positive and negative scalarity are analogous to increasing and decreasing monotonicity in quantifiers/determiners. A monotone increasing quantifier allows its predicate to be weakened *salva veritate* (but not strengthened). Similarly, "if" as a positive scalar item allows its consequent to be weakened but not strengthened: (4.i)(b) entails (4.i)(a), but is not entailed by it.

(4.i) a. If you mow the lawn, I will give you five dollars.

b. If you mow the lawn, I will give you five dollars by noon.

"Iff," on the other hand, permits neither weakening nor strengthening of its consequent, and is therefore nonscalar:

(4.ii) a. If and only if you mow the lawn, I will give you five dollars.

b. If and only if you mow the lawn, I will give you five dollars by noon.

It is clear that (4.ii)a does not entail (4.ii)b. For the reverse, suppose that the speaker gives the hearer five dollars after noon for painting the fence; this would satisfy (4.ii)b but not (4.ii)a, and so (4.ii)b does not entail (4.ii)a.

4.2.2 Perfection from informativeness

Levinson (2000) does not go into detail about his classification of perfection as I-implicature. An earlier version of this treatment comes from Atlas & Levinson (1981). I sketch their account here and compare it to Levinson's later remarks to elaborate the I-based view.

Atlas & Levinson distinguish two types of implicata that relate "what is said" to "what is communicated." The first is characterized as more definite than what is said; this is achieved by negatively restricting the range of possibilities associated with what is said. Scalar implicature is an example of this. The second type of implicature enriches what is said by "reshaping" the range of associated possibilities to a narrower, albeit compatible, selection. These implicatures are thus more precise than what is said (Atlas & Levinson; pp.35-36).

The class of implicatures picked out by precision, which includes perfection, is rather heterogeneous (Atlas & Levinson; p.37). Atlas & Levinson argue that there is nevertheless an overarching pragmatic principle licensing these implicatures. This is the Principle of Informativeness. It is related to Quantity-2, as well as Relevance and Brevity.

(4.32) **Principle of Informativeness:** Suppose a speaker S uses utterance U to a hearer H in context K. If, in K, H has competing interpretations $U_1, U_2 \ldots, U_n$ for U, compatible with the common ground, H should select the U_i which is most informative. [Modified from Atlas & Levinson, pp.40-41]

For Atlas & Levinson, "more informative" is determined relative to a number of considerations. For instance, A is more informative than B if:

> "(a) the set of logical consequences of B is contained in the set of logical consequences of A; (b) the set of sentences incompatible with B (its potential falsifiers) is contained in the set of sentences incompatible with A; (c) what B is "about" is contained in (is a part of) what A is "about""(p.40).[7]

However, they also observe that these notions can be contextually affected (and even superseded) based on what is mutually known. In particular, Atlas & Levinson highlight the fact that speakers rarely communicate "noncontroversial" or "stereotypical" information, although augmenting an utterance with this sort of content technically increases its informativeness.

"Conjunction buttressing" illustrates Informativeness:

(4.33) John and Mary got married and had a baby.

(4.33) could either communicate the coordinated propositions on an equal footing, or with a temporal ordering. Unless the ordering contradicts shared knowledge, the latter interpretation is noncontroversial, and also satisfies the relevant semantic relationships.

Perfection works similarly:

[7] Atlas & Levinson provide a small amount of explication as to how "aboutness" is to be interpreted; I find this vague, but do not address it here.

(4.34) If John leans any further out of that window, he'll fall.

If both conditional and biconditional interpretations for (4.34) are available (there are no gale-force winds about), the latter is noncontroversially more informative. This is known by speaker and hearer: in particular, the hearer not only selects biconditionality, but the speaker *knows* this will happen and can therefore be said to have intended to communicate it.

Intentionality on the speaker's part relates Informativeness to Levinson's I-heuristic. The I-heuristic describes the effect of informativeness on speaker and hearer behavior; (4.32) is a version of the hearer's principle, while the speaker's principle indicates his knowledge of the informativeness bias (Levinson; pp.114-115).

An issue arises in relating (4.32) to Levinson's claim that I-implicatures are "defaults." In particular, (4.32) suggests that a hearer chooses the best interpretation from amongst a number of available options. This implies a process of elimination. Levinson, on the other hand, states that GCIs are reached without too much calculation. This is, after all, the point of the heuristics, and seems to better reflect reality. For (4.34), we either get the biconditional reading or not. The idea of weighing up options for informativeness prior to selection is not especially plausible when considered against the instantaneous nature of judgements about examples like (4.33)-(4.34).

(4.32) is perhaps best regarded as a principle underlying the I-heuristic: a calculation like the one described may occur in unfamiliar cases, but the heuristic takes over with frequency, and completely controls the derivation of implicatures in "common" cases, including conjunction buttressing and perfection. This permits (4.32) to inform PCIs, as well as to play a role in the transition process from PCI to GCI.

A more serious problem with the Atlas & Levinson account is that Informativeness refers to "competing interpretations" as existing objects, but fails to explain *how* these interpretations come about. It does not explicitly postulate multiple senses — presumably Atlas & Levinson wish to avoid this — but nevertheless conflicts with a principle like Modified Occam's Razor (Grice 1975). Alternatives cannot exist in a vacuum, but must to a certain extent be produced *in situ*; we need an account of how context, content, and/or common ground gives rise to them. A plausible explanation of the temporal interpretation of (4.33), for instance, might be that the order of utterance suggests an order of occurrence. On the not-unreasonable assumption that causes precede their effects, this type of explanation would at most handle the perceived causal *p*-*q* relationship in (4.34), however. It would not explain the origin of biconditionality.

The issues identified here point to a broader problem with GCI theory. The Q-heuristic and the I-heuristic do not seem to operate at the same level with respect to pragmatic and communicative reasoning.[8] The Q-heuristic, at least for scalar implicature, rationalizes the development of implicated meaning; the I-heuristic only addresses how to adjudicate between such meanings when they are already available. Levinson's method of dealing with the clash between Q and I — by prioritizing Q-implicatures (Levinson; pp.39-42) — could perhaps

[8] I have not and will not consider the M-heuristic here, but it seems likely that similar concerns apply.

be augmented to get at this issue orthogonally (perhaps I applies "after" Q in a *post hoc* sense), but this is unlikely to be a promising approach. There is a real distinction between the type of implicatures classed under the Q-heuristic and those under the I-heuristic, marked by definiteness versus precision in Atlas & Levinson's terms, and the different levels at which the governing principles apply points to the nontrivial conclusion that grouping them together as GCIs may be theoretically inadequate.

In terms of the matter at hand: informativeness gives us a way of choosing between conditional and biconditional interpretations of "if" constructions, but it does not answer the most pressing question. Where does the biconditional interpretation come from? Relatedly, informativeness also (implicitly) claims that (4.34) is directly received as biconditional, rather than inviting an inference of the form suggested by the CP principle (3.2). This alone does not preclude informativeness, but is nevertheless noteworthy.

4.3 Strengthening and exhaustivity

4.3.1 Conditional strengthening

We are back at the drawing board. Having found both scalar analyses and Informativeness to be explanatorily unsatisfactory, we are in need of a workable (GCI) account.

As a starting point, I return to Horn's scale (4.31). "If p, q" is treated as weaker than the *unconditional* q (cf. Zaefferer 1991), which can be expressed as "whatever the case, q." I rejected (4.31) on the grounds that it was insufficient to generate perfection, instead giving rise to a weaker inference that there *are* conditions on q.

I want to examine this not-unconditional inference more carefully. Consider:

(4.35) If John leans out of that window any farther, he'll fall.

(4.36) If John quits, he'll be replaced.

Perfection holds in (4.35)-(4.36) in the absence of obvious mitigating circumstances — and on the assumption that the speaker would have mentioned any other relevant conditions. The not-unconditional move is represented in this process: "if p, q" in these cases, at least, suggests that there *are* conditions on q, leading to consideration of the speaker's responsibility in mentioning them. There is *something* right, then, about Horn's scale.

Von Fintel (2001b) makes the same observation, providing a number of examples which are not necessarily perfected. These include (4.36), and the point is good: the discussion in 3.1.1 observes that there are conceivable circumstances under which perfection fails. What does seem to be the case, however, is that even in non-perfecting situations (e.g., if we know the company is considering hiring Mary to replace John), it is nevertheless not *settled* that John will be replaced. Even unperfected conditionals are subject to the inference that q is not "free for the taking." What von Fintel calls "conditional strengthening" is precisely the inference expected from Horn's scale.

Von Fintel concurs with the scalar analysis, offering "q no matter what" as the unconditional. The main difference between his account and Horn's is that, while Horn supposes perfection to be derivable from this scale, von Fintel argues that it derives only strengthening, and *cannot* derive perfection.

For von Fintel, "q no matter what" represents universal quantification over possible antecedents r:

(4.37) q no matter what is true in a situation s iff
$\forall r : \forall s' \in C(s) \wedge r$ is true in $s' \Longrightarrow q$ is true in s'

where $C(s)$ is the set of situations accessible[9] from s. Negating (4.37) gives:

(4.38) $\exists r : \exists s' : s' \in C(s) \wedge r$ is true in $s' \wedge \neg(q$ is true in $s')$

which can be paraphrased as: "there are accessible situations in which q does not hold." It is clear that this captures strengthening — and equally clear that it does not capture perfection.

4.3.2 Exhaustive interpretation

Despite limiting the scope of scalar implicature, von Fintel does not deny the existence of perfection. Like Horn, he refers to the idea that perfection arises in circumstances where a speaker would have been expected to mention all of the sufficient conditions for q. He regards this as a follow-on to strengthening: perfection is the inference that the speaker has provided all of the conditions that we know must exist for q.

To explain perfection, then, we need to explain when the speaker would have been expected to mention all of the sufficient conditions for q. (4.39) is such a case:

(4.39) If you know Chapter 4, you will do well on the test. [said by someone who has taken the test]

We expect the speaker to mention all conditions for two reasons. First, having taken the exam, she can be assumed to have full knowledge of the situation. Second, the point of (4.39) seems to be to provide the listener with a complete understanding of what success requires.

Consider this second point. Just as situations in which perfection arises are those in which the speaker "ought" to provide a complete list of conditions, perfection is precisely the inference that p fully constitutes this list. That is, perfection is the inference that p exhausts the set of conditions for q.

As von Fintel observes, this characterization opens the way to treating perfection as an instance of exhaustive intepretation *à la* Groenendijk & Stokhof (1984) (G&S, henceforth). G&S argue that, relative to the information being sought (or the purpose of the questioner), answers to questions are typically interpreted as being exhaustive.

[9] See Chapter 2, section 2.5, for a discussion of accessibility rankings.

(4.40) A: Who is in the garden?
B: Mary.

(4.41) A: Is there anyone in the garden?
B: Mary.

B's response in (4.40) will usually indicate that only Mary is in the garden. Crucially, B does not need to make "only" explicit. Quite the reverse: if Mary is not the only one in the garden, we will consider B remiss for not having mentioned it. Exhaustive interpretation is the default in (4.40), while a non-exhaustive answer would need to be explicitly indicated.

(4.41) clarifies the reason for this. Here, "Mary" is not intended as a list of people in the garden. A's question shows that she does not care about *who* is in the garden, but simply wants a yes-or-no response. "Mary" provides this pragmatically. As G&S point out, relative to the yes-no framework this is also exhaustively interpreted, albeit vacuously, due to the mutual exclusivity of the alternatives. In (4.40), the questioner expects a list of people in the garden, and exhaustivity gives the "only" reading.

G&S model exhaustivity as a function taking a question-predicate (the information being sought) and a (subsentential) term-answer, and returning the correct (exhaustive) interpretation of the answer relative to the question.

(4.42) For a question-predicate R and a term-answer F,
$\text{exh} = \lambda F.\lambda R[F(R) \wedge \neg\exists R' : [F(R') \wedge R \neq R' \wedge \forall x[R'(x) \rightarrow R(x)]]]$

To show how this works in (4.40), I treat the question-predicate "in the garden" as monolithic: $R = \lambda y.g(y)$. F is the answer "Mary," which can be represented as $\lambda P.P(m)$. Applying (4.42), we get the following interpretation for "Mary" as an answer to "Who is in the garden?"

(4.43) exh(**Mary**)(**in-the-garden**)
$= \lambda F.\lambda R[F(R) \wedge \neg\exists R' : [F(R') \wedge R \neq R' \wedge \forall x[R'(x) \rightarrow R(x)]]](\lambda P.P(m))(\lambda y.g(y))$
$= \lambda R[\lambda P.P(m)(R) \wedge \neg\exists R' : [\lambda P.P(m)(R') \wedge R \neq R' \wedge \forall x[R'(x) \rightarrow R(x)]]](\lambda y.g(y))$
$= \lambda R[R(m) \wedge \neg\exists R' : [R'(m) \wedge R \neq R' \wedge \forall x[R'(x) \rightarrow R(x)]]](\lambda y.g(y))$
$= \lambda y.g(y)(m) \wedge \neg\exists R' : [R'(m) \wedge \lambda y.g(y) \neq R' \wedge \forall x[R'(x) \rightarrow \lambda y.g(y)(x)]]$
$= g(m) \wedge \neg\exists R' : [R'(m) \wedge \lambda y.g(y) \neq R' \wedge \forall x[R'(x) \rightarrow g(x)]]$

Thinking of "in the garden" as denoting a set of entities with the property of being in the garden, this communicates that Mary is in the set of those who are in the garden, and there is no way of specifying a nonidentical set containing Mary, such that membership in this set implies membership in the garden set. That is, there is no proper subset of this set that also contains Mary — Mary, therefore, is the only member of the set.

This process resembles perfection in some important ways. First, it has the same "default" character. Second, it shares the same (pseudo)scalar structure: just as the possibility of additional antecedents is negated in a perfected conditional, "Mary" in (4.40) negates the possibility of additional list members. Finally, both inferences are simultaneously anti-scalar

from an informativeness perspective: "if and only if p, q" is more precise (*à la* Atlas & Levinson) than "if p, q," and "only Mary" is more precise than "Mary."

Exhaustivity provides a promising route for perfection. G&S's question-and-answer framework provides a way of describing the necessary conditions for perfection: we simply need to determine what type of question elicits a perfected response. In fact, G&S themselves observe that conditional answers are sometimes interpreted biconditionally (pp.320-328), and show that exhaustivity captures this interpretation:

(4.44) A: Does John walk?
B: If Mary walks.

G&S translate "If Mary walks" as a sentential adverb $\lambda S[\text{walk}(m) \rightarrow S]$, where S is a proposition. This is the term-answer F. "Does John walk?" needs a yes-or-no response, and thus the question-predicate R here is the sentential expression walk(j). (4.42) gives the following:

(4.45) $\text{exh}(\lambda S(\text{walk}(m) \rightarrow S))(\text{walk}(j))$
$= [\text{walk}(m) \rightarrow \text{walk}(j)] \wedge \neg\exists S'[[\text{walk}(m) \rightarrow S'] \wedge S' \neq \text{walk}(j) \wedge [S' \rightarrow \text{walk}(j)]]$

Suppose we are in a situation where Mary walks. Then the first conjunct requires that John also walks — that is, that $\text{walk}(j) = 1$. Any other sentential expression S' satisfying $\text{walk}(m) \rightarrow S'$ in must also have value 1, and so the second conjunct is also satisfied. Now suppose we are in a situation where Mary does not walk. The first conjunct can be satisfied by either $\text{walk}(j) = 1$ or $\text{walk}(j) = 0$. However, if $\text{walk}(j) = 1$, any expression S' with $S' = 0$ will satisfy $[[\text{walk}(m) \rightarrow S'] \wedge S' \neq \text{walk}(j) \wedge [S' \rightarrow \text{walk}(j)]]$. This is disallowed by (4.45), and so exhaustivity demands that $\text{walk}(j) = 0$. Thus, when Mary walks, John walks, and when Mary does not walk, John also must not walk. These are precisely the truth conditions of the biconditional.

Something very peculiar has happened here. We turned to exhaustivity as a means of determining when perfection is "expected." By analogy to (4.40), it seemed reasonable to think that "perfection will be triggered when the conditional is asserted as an answer to a question eliciting an exhaustive list of sufficient conditions" (von Fintel; p.17). Indeed, von Fintel suggests that such a question will look like "Under which conditions will q take place?" In the same way as "Who is in the garden?" expects an exhaustive list of people in the garden, it seems as though this question should expect an exhaustive list of conditions for q.

How does this compare with the exchange in (4.44)? As von Fintel points out, it does not compare at all. Something entirely different has happened in (4.44). A evidently wants a yes-or-no response, but has been given a conditional. The biconditional reading in (4.45) comes about as a result of seeking an exhaustive answer within the yes-no framework. Von Fintel points out that this works because G&S treat "if"-clauses as material implication, which we have already seen is insufficient. Nevertheless, it will not do to treat (4.45) as simply a fluke of translation, because it captures a real effect. The following exchanges exhibit the same question and answer pattern. Each response, crucially, receives a perfected reading.

(4.46) A: Will John fall out of that window?
B: If he leans any farther out.

(4.47) A: Will John be replaced?
B: If he quits.

(4.48) A: Will you go for a swim tomorrow?
B: If the weather is fine.

These are not the type of questions we would expect to get a perfected response. Von Fintel explains this away by arguing that these exchanges are conversational shorthand for longer ones, along the lines of (4.49):

(4.49) A: Will you go for a swim tomorrow?
B: That depends.
A: On what?
B: If the weather is nice.

A's second question does appear to ask for a list of conditions. Von Fintel argues that the intermediate steps in (4.49) are implicit in (4.44) and (4.46)-(4.48); thus, a conditional response to a yes-no question can be read as responding to an underlying question about conditions.

I do not find this explanation satisfactory, but it might pass were it not for one thing: the "right kind" of question does not elicit perfection. Von Fintel apparently overlooks this issue with the example he provides:

(4.50) A: Under what conditions will Robin come to the party?
B: If there is vegetarian food, he'll come.

This does not invite the inference that Robin will certainly not come if there is no vegetarian food (although it does, via strengthening, indicate that he will not come unconditionally). The problem is, admittedly, exacerbated by the fact that A's question is somewhat unnatural. However, a less marked substitution produces the same result.

(4.51) A: What will get Robin to come to the party?
B: If there is vegetarian food, he'll come.

(4.51) receives only a mention-some reading: vegetarian food will be sufficient to entice Robin, but there may well be other ways to tempt him. G&S note the existence of readings which escape exhaustivity in certain situations:

(4.52) Where can I buy an Italian newspaper?

An exhaustive answer to this question would be intentionally obtuse — a single location will suffice as a complete response, since the normal purpose of a question like (4.52) is to enable the purchase of a newspaper. (4.51) and (4.52) similarly require only mention-some responses — offering "vegetarian food" as a sufficient but not necessary condition parallels the offering of the nearby newspaper stand. Von Fintel acknowledges the existence of mention-some questions, even offering (4.53) as an example, but he appears to miss the generalization.

(4.53) A: How can I earn 5 dollars?
B: If you mow the lawn, I'll give you 5 dollars.

Mention-some readings affect precisely the set of questions he postulates will elicit perfected responses, whereas conditional answers to yes-no questions are the ones reliably perfected.

4.3.3 Completeness

What is to be made of this? Through treating conditional antecedents as exhaustive lists of conditions, exhaustivity seemed to promise an explanatory account of CP. Yet questions which ostensibly[10] ask for such conditions instead elicit mention-some readings. This derails an appeal to exhaustivity along von Fintel's lines.

On the other hand, conditionals offered in response to polar questions on their consequents are reliably perfected. The problem, then, is that we get perfection via exhaustive interpretation where it is not expected (indeed, where a conditional is not expected), and not where it *is* expected. Both facts need explanation.

Some critical insight can be gained by referring to the discussion following (4.45). Despite G&S's use of material implication, there is something intuitively right about the process of calculation. Someone asking a polar question is seeking complete information, in as straightforward a way as possible. Unlike (4.40), the answer to which can be given a non-exhaustive reading if the context is appropriately developed, a yes-no question does not admit the possibility of a mention-some or partial answer. If the truth of the question-predicate is dependent on something, then a biconditional response provides the complete information required, *modulo* the truth status of the antecedent. Without perfection, however, a conditional response provides incomplete information — the questioner will be able to work out the answer to the question only if the antecedent of the answer is true, but not otherwise. This would represent failure, on the part of the responder, to provide the asked-for information. The only explanation for this non-cooperation would be that the responder himself does not know the complete answer. But then, just as someone who knows that Mary is not alone in the garden but does not know who she is with would be expected to indicate his

[10] A question which explicitly asks for a *full* list will receive a perfected response, but this is hardly remarkable:

(3.ii) A: What are all the conditions under which Robin will come to the party?
B: If there is vegetarian food, Robin will come to the party.

lack of knowledge on this point in (4.40), so would the responder in the previous scenario be required to own up to having insufficient information. Questions are asked on the implicit (if conventional rather than genuine) assumption that the questioned party has the information required to provide a complete answer. As responders, we are under obligation to either accept that assumption or explicitly disclaim it: communication would fail if we knowingly gave partial or misleading information without flagging it for incompleteness. Thus, an unembellished conditional response to a polar question gets a biconditional reading from the impetus to interpret any unqualified response as providing all of the information necessary for ascertaining the truth-value of the question-predicate.

I refer to this phenomenon as "completeness." Although it is, as per G&S, a side-effect of exhaustivity with respect to polar questions, it is not exhaustivity in the sense that von Fintel and others suggest, and a terminological distinction will help to separate the two.

Two observations help support an account from completeness. First, consider (4.39) again:

(4.54) If you know Chapter 4, you will do well on the test. [said by someone who has taken the test]

As observed, the speaker's status gives rise to the assumption of full knowledge. Explicit polar questions automatically induce this assumption, but the need for it in unelicited perfected conditionals confirms that it is a necessary factor in deriving perfection. The speaker in both situations is responsible for indicating any existing knowledge gap — failure to do so is (tacit) assertion that any information provided is complete.

Second, consider (4.55) in a situation where A and B both know that John intends to quit his job:

(4.55) A: Will John be replaced?
B: If he quits, he'll be replaced.

Since John is quitting, this provides complete information without biconditionality. Thus, completeness successfully predicts the lack of perfection in (4.55). In this situation, it simply does not matter what happens if John stays on. Recall CA&B's idea that perfection is sometimes "irrelevant." Completeness provides an explanation of this: perfection is irrelevant when biconditionality is not needed to complete the conditional as an answer.

Although completeness can handle perfection in the polar case, we need an explanation of the mention-some readings in (4.50) and (4.51). (4.52) is a good place to start. G&S attribute the mention-some reading here to the "linguistic context" (p.278): if someone asks you where she can buy an Italian newspaper, you will normally understand that she wants to get hold of one, and will (if you can) provide her with a response that enables this. The point of her question, then, is not to get complete information about where Italian newspapers are and are not sold (which an exhaustive list would provide), but rather simply to find a place to buy one.

Similarly, under normal circumstances, you will assume that someone asking how to get Robin to come to the party is trying to get Robin to come. Thus, any one way of doing so

is a sufficient response. The questioner does not need multiple enticements — one is enough to achieve the goal.

The problem with von Fintel's analysis — that conditionals will be perfected when they answer a question about the circumstances under which their consequents will occur — is, essentially, that this is often a metalinguistic, or at least abnormally formal, question. When we ask questions about the conditions on something, it is usually because we want to know enough to either make a prediction (whether or not John will be replaced), or to bring something about (earn 5 dollars, or get Robin to come to the party). The latter precludes the need for an exhaustive list of the conditions on q. It is, admittedly, possible to ask for conditions on q without this goal, but this occurs only in a limited range of situations, e.g.:

(4.56) A: Under what conditions does x times y equal 0?
B: If $x = 0$, x times y equals 0.

Although B's answer is true, it will generally be regarded as the wrong (or an incomplete) answer if given in a mathematics lesson. This is due to the expectation of an exhaustive list of conditions for q, here. The point of the question is not to simply find a way to make the product of x and y be 0; rather, it is to fully describe the possible causes. The question, here, has more to do with the exchange of knowledge than with the realization of a goal, and exhaustivity *à la* von Fintel applies.

So far, this is all quite informal. Before attempting a formalization, it is important to clearly establish the difference between a conditional asserted as a response to a polar question and one used as a list of conditions for q. This difference is the key to uncovering the source of perfection. A polar question seeks certainty about a given outcome; unless the speaker disclaims full knowledge, a conditional response is narrowed to provide this. A "conditional" question (e.g. (4.50) or (4.51)), on the other hand, is goal-oriented: one way of achieving the goal is sufficient. Restated, polar questions are about achieving complete knowledge or control over a situation, whereas conditional questions are only about seeking sufficient information for the questioner's purposes. As a corollary of this, polar questions represent uncertainty on the hearer's part regarding the possibility of the consequent, while questions eliciting conditions on q usually presume that q is attainable, *modulo* certain events or actions.

4.3.4 Beyond questions

Considering the type of question that elicits a perfected response provides the beginning of an answer to the question of when perfection arises. CP is not, however, limited to conditionals offered as answers, and so a full account will need to generalize beyond the question-and-answer framework. We expect conditionals to be perfected when they can be understood as being asserted in response to a polar question on the consequent. The communicative context for such a polar question, then, is the context for perfection; a description of this ought to capture the circumstances under which perfection takes place.

The relevant contextual features have already been mentioned. First, polar questions indicate a need for complete information on the consequent. This is supplemented by the

assumption of full information on the part of the speaker, and uncertainty on the part of the hearer as to whether or not the consequent will occur (both of which are implied by an explicit polar question). If completeness is the correct explanation of perfection, these features ought to pick out those conditionals categorized in Chapter 3 as perfectible, and to exclude the others.

A first test for any conditional type is whether or not it is felicitous and perfected in response to a polar question. Predictions, promises, threats, preconditionals, and recommendations all pass this test:

(4.57) A: Will John be replaced?
B: If he quits, he'll be replaced.

(4.58) A: Can I have 5 dollars?
B: If you mow the lawn, I'll give you 5 dollars.

(4.59) A: Are you going to kill me?
B: If you don't give me your wallet, I'll kill you.

(4.60) A: Will you take me swimming?
B: If the weather is nice tomorrow, I'll take you swimming.

(4.61) A: Should I give my cat Petboost?
B: If you love your cat, give him Petboost.

This is not the only test, however. Perfected conditionals also occur in situations where we do not expect the hearer to ask about their consequents. Warnings exemplify this:

(4.62) A: Will I get a shock?
B: If you touch that wire, you'll get a shock.

Nevertheless, the situation does have the features needed for completeness. By issuing a warning, the speaker takes on a position of authority. Moreover, she is responding to uncertainty and a need for complete information on the hearer's part. This is sufficient to produce perfection — it is easy to regard (4.62) as the speaker's answer to the situational question "Will the hearer get a shock?"[11]

This recalls the control and desirability structure described in Chapter 3 (section 3.2.1). I argued that these two features were nonessential to perfection, but appeared to lend themselves to establishing the appropriate context. (4.62) is evidence of this — the fact that the hearer is unlikely to want the consequent lends itself to an interpretation on which the speaker is providing complete information, rather than a means to an end.

Control plays a similarly helpful role with promises, threats, and preconditionals. The speaker sets up the *p*-*q* relationship, and has control over *q*, which directly gives full information. This, additionally, puts the hearer in a position of uncertainty . Consequently,

[11]This is related to the notion of the "question under discussion," cf. Roberts (1996).

these conditionals are hard to read as responses to requests for ways of achieving q. As with warnings, such an interpretation is infelicitous with threats, due to the hearer's aversion to the antecedent. It is only when the hearer is in a position of uncertainty and therefore "in need" of complete information that the biconditional reading (and the implicit polar question) arises. Speaker control, again, derives the question.

If preconditionals involve a hearer-desired consequent, they behave like promises. Perfection arises in (4.60), but not in (4.63):

(4.63) A: What will get you to take me swimming tomorrow?
B: If the weather is fine, I'll take you swimming tomorrow.

When q is not hearer-desired, a question about how to achieve it is often peculiar. Preconditionals like (4.64) are more easily perceived as responses to polar questions.

(4.64) If the weather is nice tomorrow, I will go swimming.

Like warnings, commands and recommendations set up a situation in which the speaker takes on a position of authority, delivering full information. Although the speaker does not control the consequent, her authority nevertheless suggests hearer uncertainty. Recommendations like (4.61) are more easily rendered as responses to explicit questions than commands, but the discussion of warnings applies here as well: the speaker is responding to the hearer's perceived "need" for information, in these cases about whether or not to perform the action in the consequent. Moreover, it is unlikely that the hearer is searching for a means of achieving q; his interest is (usually) in whether or not to perform the relevant action. (4.65) is, evidently, a peculiar exchange.

(4.65) A: ?When should I give my cat Petboost?
B: If you love your cat, give him Petboost.

A secondary consideration, with respect to commands like (4.66), is that they are often issued with the intention of providing someone with binary data on the antecedent — and achieve this through binary information on the consequent.

(4.66) If you see a white panther, shout "Wasserstoff!" three times.

Completeness, then, captures perfection in these cases.

The last two types of perfectible conditionals are predictions and counterfactuals. As they lack control and desirability structure, completeness predicts that these will be perfected just in case the situational features match those induced by polar questions. (4.57) shows that predictions are perfected as answers to polar questions. Beyond this, we have seen that perfection emerges when there are grounds for accepting the speaker's authority, as in (4.54), and when they are about providing information about the uncertain truth-value of q. In particular, (4.67) will not receive a perfected reading in a situation where the hearer is looking for a way to meet Robin (and is determined to get him to come to the party); it will be perfected, by contrast, if the hearer simply wants a head count on guests.

(4.67) If there is vegetarian food, Robin will come to the party.

Again, completeness captures this difference.

Counterfactuals are more complicated:

(4.68) A: What would have made Harry go home?
B: If Harry had known that Sheila survived, he would have gone home.

(4.68) shows that they are not perfected as responses to "conditional" questions. The use of the subjunctive makes it difficult, however, to offer a polar question eliciting a counterfactual:

(4.69) A: ?Would Harry have gone home?
B: If Harry had known that Sheila survived, he would have gone home.

On the other hand, (4.70) is a reasonable exchange, and the conditional is perfected.

(4.70) A: Did Harry go home?
B: If Harry had known that Sheila survived, he would have gone home.

B's response is not counterfactual in the strong sense (i.e. neither the speaker nor the hearer need be certain that Harry did not know), but it is hypothetical. It appears that the speaker is insufficiently informed to answer the question, and so moves to a speculative domain in which she is informed. This moves gives her authority and, if anything, increases the hearer's uncertainty. Outside of the question framework, counterfactuals normally provide a prediction about the truth value of a hypothetical consequent. The presumed falsity of the antecedent largely precludes the possibility that it is offered to enable the consequent, and the speaker's creation of the speculative domain creates a presumption in favour of complete information.

Completeness also rules out unperfectible conditionals. Question-answer exhaustivity provides a litmus test for such cases. For instance, if the question under discussion deals with possible consequences of the antecedent, perfection does not arise. This eliminates many epistemic conditionals, which are often about reasoning from the antecedent (as a premise) to its consequences.[12]

(4.71) A: Mary just called. She's in the lobby.
B: If she is in the lobby, the plane must have arrived early.

Lawlike statements, similarly, usually focus on what follows from the antecedent rather than on the consequent, and this explains their failure to be perfected without "collateral information" (see 2.2.5).

(4.72) A: Would you like a glass of milk?
B: If I drink too much milk, I get a rash.

[12]The exception in (3.34), crucially, is given as a response to a polar question.

Speech act conditionals are also about the consequences of their antecedents, albeit not in a logical sense:

(4.73) A: I haven't eaten since lunchtime.
B: If you're hungry, there are biscuits in the cupboard.

They tend to be offered in situations where the question under discussion relates to the antecedent. Crucially, if they are offered in a situation where binary information about the consequent has been requested, the situation is different. Recall (3.31), reproduced here:

(4.74) A: Do you have any biscuits?
B: If you're hungry, there are biscuits in the cupboard.

As discussed in Chapter 3, the response is perfected relative to the speech act.

This discussion shows that completeness (as a special case of exhaustive interpretation) picks out just those conditionals which receive a perfected interpretation. Moreover, (4.74) shows that when typically unperfectible conditionals are framed as responses to polar questions, perfection applies. This further supports the account from completeness. Similarly, when "perfectible" conditionals are offered as responses to the wrong kind of question, they do not receive a perfected reading.

This also provides a starting point for extending a completeness-based account beyond the framework of explicit questions. A rigorous treatment of when, precisely the requisite discursive requirements for completeness (i.e. when the implicit question under discussion is the right sort of question for producing perfection) will, as von Fintel (2001b) argues, require a theory of discourse.

4.4 Default inferences

This chapter began with an examination of the pragmatic properties of CP, and concluded that perfection represents a default implicature (in Levinson's GCI sense). Subsequently, I examined several accounts and found that completeness (from G&S's exhaustive interpretation) provides an intuitively correct mechanism for deriving perfection as well as a predictive and explanatory account.

How do these two conclusions match up? The first potential problem is that G&S regard formula (4.42) as a semantic operation. This is not due to a convinction that exhaustivity is fundamentally apragmatic, but rather to a sense that the Cooperative Principle is insufficiently precise to permit its rigorous implementation. G&S are unsure where exhaustivity might be located relative to the Gricean maxims (p.369); given the aforementioned conflict between Q- and I-implicatures, this seems a legitimate concern.

Treating exhaustivity as pragmatic, however, would represent a step towards increased precision in implicature theory. As formulated, Quantity-1 and -2 induce a potential conflict between scalar analyses, which block the biconditional interpretation, and Informativeness, which selects for biconditionality. Exhaustivity, on the other hand, gives an exact mechanism

for deriving perfection, *modulo* certain conditions. As such, it is not about providing either as much or as little information as required, but rather about interpreting conversational contributions as meeting precise, contextually-developed discursive needs. Exhaustivity cuts across both Q- and I-heuristics and captures both scalar implicatures (which discard unnecessarily strong meanings) as well as perfection (which is regarded as a strengthening of meaning). Exhaustivity is thus "forged in the crucible of the conflict," between the Q and I principles (Horn 1984; p.11). It represents a method of determining equilibria between the need to maximize communicated content and to minimize communicative effort.[13] I propose, then, that exhaustive interpretation be regarded as a formal pragmatic process. Although current theories of discourse perhaps lack the rigour of semantic theory, it seems clear from all of this that exhaustivity figures prominently into a theory of how conversational offerings respond to "implicit" questions — that is, how they are used to solve perceived informational gaps in discourse.

One issue remains with regarding exhaustivity as a mechanism for deriving "default" implicatures. Levinson argues that default inferences are automatic, and require explicit contextual input for cancellation; this suggests that drawing GCIs incurs no particular processing cost, while canceling them is more effortful. However, recent experimental work by Noveck, et al (2011) shows that the inference to CP in fact incurs the higher cost. This disconnect highlights an issue that has indirectly been raised in this chapter: although there is ample evidence for the existence of default, yet context-based implicatures, the notion of "default" is insufficiently well-defined to pick out a coherent class of inferences. In this regard, GCI theory is a bit of a pragmatic wastebasket.

Exhaustivity, however, provides one possible interpretation of what it means to be a default inference, and thus offers a way of implementing some necessary class boundaries. The calculation induced by exhaustivity goes through in all applicable situations, but is nevertheless a calculation that must be made. This accounts for processing costs, without denying the fact that perfection requires explicit contextual input (e.g. the declaration of incomplete speaker knowledge) to prevent its application. More broadly, exhaustivity suggests that Levinson's heuristic-based taxonomy of GCIs is not an adequate solution to the coherence problem. Searching for mechanisms which can (formally) derive various inferences, as exhaustivity does for scalar implicatures and perfection, is a much more promising approach to take in this regard.

Finally, exhaustivity also helps to answer one of the questions I began with: whether or not invited inference (as represented by CP) constitute a "new class" of inferential phenomena. The short answer is that they do not, in that they share a formal mechanism with well-known scalar implicature. The long answer, however, is that perfection via exhaustivity does give us something new: a set of pragmatic inferences that are not only formally derived, but also are tied to formal ideas in discourse theory and information structure, and which come from an analysis of "conversational needs" based on those ideas. Invited inferences, then, belong to a class which is coded at the pragmatic but nevertheless formal level of dis-

[13]This is reminiscent of Sperber & Wilson's (1986) Principle of Relevance. Exhaustivity possibly has a role to play in establishing a more formal and precise articulation of Relevance Theory.

course structure. This represents a new way of considering the role played by certain types of pragmatic inference.

Information structure and discourse structure are, in a real sense, about how we reason our way through conversational situations, and decide what is sensible, relevant, or necessary at a particular stage of interaction. It seems reasonable, therefore, that (pseudo)logical inference would be located at this level. Via exhaustivity, perfection can be seen to link directly to how we reason in natural situations, and about natural language.

Chapter 5

A few formalities

The account from completeness leaves a few loose ends. First and foremost, while I have argued that G&S's exhaustivity operator (4.42) provides an intuitively correct derivation of perfection, this is relative to an inadequate material-implication account for conditionals. Although the motivation for completeness as an explanatory account of CP remains strong even without a working formal mechanism, the account is improved by such a mechanism. Secondly, we have observed that conditionals offered as answers to questions of the form "under what conditions q?" often (if not always) receive a mention-some reading; a goal-oriented rationalization of this is relatively satisfactory, but it is worth considering whether this reading can be derived on a par with completeness/exhaustivity. Finally, section 4.3.1 discussed conditional strengthening as a scalar phenomenon (*à la* von Fintel 2001b); it is worth considering in more detail the relationship of strengthening to conditionality ("iffiness," from von Fintel & Iatridou 2002) and to CP. This chapter provides a brief look at each of these issues, particularly with respect to the working definition of conditional semantics in (2.17)-(2.18) and the formal exhaustivity operator (4.42).

5.1 Exhaustivity in dynamic semantics

Schulz & van Rooij (2006) (S&R, henceforth) observe (after van Benthem 1989) that the notion of exhaustive interpretation can be regarded as a special case of McCarthy's (1980) predicate circumscription. McCarthy's interest was in formalizing the "normality" assumptions that accompany common-sense reasoning; that is, the assumption that if an unusual property or situation is not mentioned, it is not the case. G&S's goal in defining exhaustivity is essentially the same: to minimize the question-predicate of the answer by assuming that unmentioned states/properties/conditions do not hold.

McCarthy develops predicate circumscription from a model-theoretic perspective, where it corresponds to interpretation of properties in minimal models. This requires an ordering on the set of models (possible worlds) such that a world v is more minimal than a world w with respect to a predicate P just in case the set denoted by P in v is a proper subset of the set denoted by P in w; v and w match in all other respects. Consider again example (4.40):

(5.1) A: Who is in the garden?
B: Mary.

Here, $v <_P w$, where $P = g$ (in-the-garden) just in case $\{x|g(x) \text{ in } v\} \subset \{x|g(x) \text{ in } w\}$. Thus, the minimal models in which Mary is in the garden are those in which *only* Mary is in the garden. I will not give the details of predicate circumscription here, but instead provide directly an expression of exhaustivity with respect to the model-theoretic approach (adapted from S&R).

(5.2) For a question-predicate R and a term-answer F, in context W:[1]
$\text{exh}^W(F, R) := \{w \in [F(R)]^W | \neg\exists v \in [F(R)]^W : v <_R w\}$

S&R develop this to deal with insufficient context-sensitivity in G&S's original exhaustivity operator, and, relatedly, to deal with exchanges such as the following:

(5.3) A: Who passed the exam?
B: John and Mary.

Exhaustive interpretation as in (4.42) returns the result that only the plural object $j \oplus m$ belongs to the set of individuals who passed the examination. Interpretation with respect to minimal models, on the other hand, allows restrictions on the context set W that permit the objects j and m to be members of the passing set. See S&R for details. The important point here is that the model-theoretic interpretation permits a narrowing from W as the set of all models to W as an accessible context set — thus, S&R's reinterpretation of exhaustivity also gives us a mechanism better equipped to handle the working definition of conditional meaning I gave in (2.17)-(2.18):

(5.4) **If** P, $Q := \forall[W \cap P]\ Q$

A polar question on Q will have sentential question-predicate $R = Q$, while $F(R) =$ **If** P, Q. In this case, then, $v <_Q w$ just in case v matches w in all respects except that w has Q and v does not. **if** P, Q picks out the set of worlds where P is always accompanied by Q. Let w be in this set, and assume w has P. Then, by definition, there can be no world v where **if** P, Q holds and $v <_Q w$, since v can only differ from w on Q: v must have P, and therefore must also have Q. Now suppose w does not have P. Then if w has Q, there may be a more minimal v such that v has neither P nor Q; this violates the requirement. Minimal models therefore either have both P and Q or neither, and, with this approach, we can interpret a conditional answer to a polar question on Q as narrowing from the context of utterance to one in which the accessible worlds give this biconditional interpretation.

So far, so good: the intuitions behind exhaustive interpretation appear to hold. This is fairly unsurprising, given that the bulk of the change between (4.42) and (5.2) comprises framing exhaustivity so as to explicitly take account of classes of models. S&R, however,

[1] Given a proposition $\phi, [\phi]^W$ is the set of models accessible from context W such that ϕ is true.

provide a further extension of exhaustivity to dynamic semantics, and it is worth examining this as well.

Instead of considering a context W, let us call W an information state, and regard a sentence ϕ as mapping to a new information state $W[\phi]$. So far, this is all terminological, but, as S&R observe, dynamic semantics accommodates the introduction and reassignment of referents; thus, minimality here will need to specify that possible worlds are only comparable when their agreement functions are identical (we note this by using $<_{R*}$ instead of $<_R$). Dynamic exhaustive interpretation is then given by (5.5):

(5.5) $\text{exh}^W(F, R) := \{i \in W[F(R)] | \neg\exists i' \in W[F(R)] : i' <_{R*} i\}$

S&R develop dynamic exhaustivity from the model-theoretic version to handle additional context-sensitivity in certain scalar implicatures, including predicting the difference between the two answers in (5.6):

(5.6) A: Who passed the exam?
B: Three students.
C: At least three students.

B's response picks out only states in which exactly three students passed, while C's picks out all states in which three or more students passed. Neither G&S's original operator or static model-theoretic exhaustivity derives this difference, but dynamic exhaustivity does. Again, details of this and other problems that dynamic exhaustivity solves can be found in S&R, but are not relevant here: we are concerned primarily with the potential advantages dynamic exhaustivity brings to dealing with conditional statements.

It turns out that dynamic exhaustivity solves an issue that the calculation after (5.3) glossed over: how to accommodate the variable accessibility relations demanded by conditional semantics. Instead of regarding $[\textbf{if } P, Q]^W$ as restricting to a subset of worlds in W, $W[F(R)]$ can move to a different set as per the indicated accessibility relation. This allows us to accommodate not only predictive causal conditionals, but also the exceptional examples (3.31) and (3.34), reproduced here, where speech act and epistemic conditionals receive a perfected reading.

(5.7) A: Do you have any biscuits?
B: If you're hungry, there are biscuits in the cupboard.

(5.8) A: Isn't this cactus an *Astrophytum*?
B: If it grows native to Idaho, it's not an *Astrophytum.*

This is, therefore, an important extension of G&S's exhaustivity: in addition to handling the contextually exhaustive examples that S&R are primarily concerned with, dynamic exhaustivity provides a mechanism that captures the spectrum of perfection on conditionals as defined in Chapter 2, while maintaining the original intuition of G&S's exhaustivity operator.

5.2 Relevance and mention-some readings

A related question is whether or not mention-some readings can be accommodated by a context-sensitive account of exhaustivity. It seems appropriate that some should be: in particular, those mention-some readings that are induced by considering the domain of mutual relevance to all discourse participants.

(5.9) A: Who went to the party?
B: John.

If A and B are discussing their circle of friends, which includes John, Mary, and Robin, B's response in (5.9) will not indicate that the party was a failure, but rather that, of their friends, only John attended. When the relevant domain of individuals is taken into account, we can see that B's response is not truly a mention-some reading, but is in fact exhaustive.

(5.10) is not precisely the same.

(5.10) A: Where can I buy an Italian newspaper?
B: At the drugstore on 51st street.

B's response does not indicate that A and B share a shop-domain in which no other shops sell Italian papers, but rather that one shop is sufficient for discursive goals. At the same time, understanding this response as complete involves a notion of relevance, again: a full listing of paper-selling shops is not relevant to A in (5.10), just as party guests other than John, Mary, and Robin are irrelevant in (5.9). The question to be asked, then, is whether this (variable) concept of a "relevant" answer can be incorporated into exhaustivity.

S&R address this question as well. One way of describing the information needed by someone asking a question is by a set of propositions representing possible answers. Incorporating relevance becomes a question of restricting this set so that it contains only possible answers that meet the questioner's notion of relevance. Assuming that relevance is addressed only in the answer, and is not to be determined by reinterpreting the question,[2] it can be handled in one of two ways: either by relativizing the accessibility ranking to some notion of relevance, or by incorporating relevance at the level of the minimality ordering. The second is more promising here, because it means that we do not need to consider relevant restrictions of all domain types, but rather just those addressed by the predicate P which defines the minimality ordering. S&R propose that we may regard a world v as more minimal than a world w if, *ceteris paribus*, the statement that the set denoted by P in v is a subset of the set of objects with property P is more relevant than the equivalent statement for P in w:

(5.11) $v <_{P,\text{rel}} w$ iff $\lambda u.[P](v) \subseteq [P](u) >_{\text{rel}} \lambda u.[P](w) \subseteq [P](u)$

[2]This is a preferable approach insofar as I wish to address exhaustive interpretation in the absence of explicit questions.

Incorporating this into (5.5) simply involves replacing $<_R$ with the relation $<_{R,\text{rel}}$, and gives us a way of deriving mention-some readings as exhaustive relative to the question under discussion. This allows us to think of exhaustivity as a means for formalizing the interpretation of conversational contributions as satisfying continuously-updated discursive needs.

Of course, a method for incorporating relevance needs to be accompanied with a proposal for how to determine the relevance ordering $<_{\text{rel}}$. I do not propose to resolve this question here, but rather give only a sketch of the potential offered by a dynamic version of exhaustive interpretation.[3]

5.3 Conditionality and strengthening

As far as CP goes, the role of strengthening is a tangential topic. I address it insofar as one of the major accounts of CP instead derives strengthening (section 4.3.1), and insofar as von Fintel (2001b) treats it as an inference midway between unperfected conditional meaning and perfection. In particular, given that perfection does not seem to represent the extreme of strengthening in the way von Fintel envisions, it is worth considering whether or not strengthening ought to be regarded as a pragmatic inference at all.

This discussion is motivated in part by the fact that the scale {NO MATTER WHAT, Q > IF P, Q} seems somewhat inexplicable. Where other Horn scales involve lexical items or expressions, this involves skeletal propositions. Moreover, the conditionality that prompts strengthening seems entirely in opposition to unconditionality in an abstract sense, and does not really need to involve the propositions p and q. In particular, then, strengthening seems wholly wedded to "if;" is there really a need for an independent generating scale? Indeed, von Fintel's examples include (5.11), which suggests that strengthening cuts across conditional types, and thus supports a case for strengthening as semantic.

(5.12) If this cactus grows native to Idaho, it's not an *Astrophytum*.

This indicates that there is a possibility that the cactus in question is an *Astrophytum*: it is not settled that it is not. Similarly, the speech act conditional in (5.12) also seems to incorporate some notion of strengthening:

(5.13) If you're hungry, there are biscuits in the cupboard.

This does not indicate that there may not be biscuits in the cupboard, but it does suggest that you are not being *offered* a biscuit unconditionally — you are not intended to take one if you are not hungry. Strengthening, here, is interpreted relative to the speech act in the consequent, but nevertheless appears to come with conditionality.

The notion that strengthening may be included in conditional semantics is not altogether without precedent. I take some further motivation for this move from von Fintel's (1993)

[3]See S&R for a decision-theory account of relevance; van Rooij (2003) also addresses relevance and related issues in greater detail.

account of free exceptive operators, which incorporates the following semantics for "except for" in a sentence such as "Except for John, all of the students attended the meeting." In (5.13), C represents the excepted set ("John"), D the determiner/quantifier ("all"), A the domain of quantification ("students"), and P the property asserted of A ("attended the meeting").

(5.14) **except for** C, $D\ A\ P := D[A - C][P] \wedge \neg(D[A][P])$

The first conjunct is the obvious aspect of "except for" — that all students who are not John attended the meeting. The second is what makes it reasonable to regard John as exceptional: it stipulates that not all of the students attended the meeting (and, indirectly, that John is a student). This guarantees exceptionality, and is conceptually parallel to the idea contained in strengthening.

Including strengthening in conditional semantics will go some way towards addressing the "iffiness" observed by von Fintel & Iatridou (2002), and discussed in section 2.4. Coupled with the stipulation that all p-worlds in the context must have q, the stipulation that q is not unconditional requires that there are non-p worlds accessible, which gives p as "iffy" in the sense needed.

A formal definition of "if p, q" along the lines of (5.14) will necessarily be somewhat more complex, as we have seen that conditionality refers to an accessibility ranking absent from (5.14); strengthening also refers to accessible worlds. I reproduce (4.38), von Fintel's formulation of the strengthening proposition, here:

(5.15) $\exists r : \exists s' : s' \in C(s) \wedge r$ is true in $s' \wedge \neg(q$ is true in $s')$

Simplifying this to the notion that there are relevant situations in which q does not holds, I provide (5.16) as a first pass at including strengthening in conditional semantics:

(5.16) **If** P, $Q := \forall[W \cap P]\ Q \wedge \neg(\forall[W]\ Q)$

I believe there is a good deal of motivation for conditional semantics of this sort, but (5.16) remains at this point an extremely rough proposal, and must be considered against a much wider variety of examples. It remains to be seen, for instance, whether this can accommodate modality (*à la* Kratzer 1986); or, indeed, whether the relativization of strengthening to the speech act in speech act conditionals can be handled by this or a related formula. It is clear, however, that this extension will not interfere with the derivation of perfection as provided in section 5.1 — exhaustive intepretation simply removes any non-p q-worlds from consideration, which is compatible with what is required by strengthening.

5.4 Summary

This chapter has presented three related ideas: a dynamic extension of exhaustive interpretation (due to S&R) that handles the formal problem with conditionals for G&S's exhaustivity,

a sketch of a possible extension of exhaustivity that will handle mention-some readings of conditionals, and a potentially new semantics for conditionals that incorporates strengthening as a possible way of addressing the "iffiness" that divides conditionals from restrictive relative clauses. Each of these proposals will bear further examination and elaboration; however, they provide promising avenues for further exploration of the topics addressed in this thesis, and support Chapter 4's promise of a formal treatment of pragmatic default inference via exhaustivity.

Chapter 6

Conclusions

In the preceding five chapters, I have examined and treated a number of issues. First, I have spelled out the problem of conditional perfection, and located it relative to a dynamic treatment of conditional meaning. Subsequently, I have provided an overview of the features and conditions which prompt a biconditional interpretation of conditional statements, via a taxonomy of the conditional uses and types that invite perfection. I have, in addition, examined the pragmatic properties of perfection and classified it as a default inference (GCI). Finally, I have provided an explanatory account via exhaustive interpretation, and have given an outline of the formal machinery needed to support this. It remains to be considered how this addresses the questions with which this thesis began, and what the account provided promises with respect to future research.

6.1 Invited inferences and natural reasoning

I motivated an investigation of CP in part with the goal of using it as a case study for invited inferences more broadly. In some respects, this was a well-defined goal; in others, it has proved not to be. As outlined by G&Z, the concept of an "invited inference" seems to suggest a unified class of inferential phenomena in which the inferences have some relationship to the logical form of the asserted semantic content. In this regard, invited inferences promised a new set of pseudological pragmatic inferences, distinct from presuppositions, CIs, and conversational implicatures (of either type). At least, invited inferences promised to comprise a unique subclass of one of these areas.

This is not borne out. The other inferences (inclusive "or" and inferred causation) proposed by G&Z are unlikely to be explicable by the same mechanism as CP.[1] Moreover, exhaustivity is not an explanation of CP alone: among other inferences, it additionally handles scalar implicature, thus resolving the inherent Q and I conflict in Levinson's GCI typology, and so can hardly be argued to pick out a unique class of "invited inferences." In this respect, then, an investigation of invited inferences via CP has proved fruitless: "invited inference" does not seem to mark an identifiable and well-defined class of inferential

[1] A dynamic extension of exhaustivity may derive an *exclusive* interpretation of "or" in limited cases.

phenomena.

From another perspective, however, my investigation of invited inferences and CP in particular has proved quite productive. The examination was prompted by the intuition that there are inferences, notably CP, that relate to natural patterns of human reasoning. This has, very directly, turned out to be the case. As noted in section 5.1, exhaustive interpretation represents a special case of McCarthy's predicate circumscription, which was developed as a means of representing "common sense" reasoning in logic. Thus perfection — and scalar implicature — can be said to directly represent the application of natural reasoning processes to linguistic interpretation and behavior. In this sense, CP provides significant insight into the role that natural reasoning plays in language.

6.2 Outlook

This has significance beyond the boundaries of CP, as Levinson (2000) argues that default inferences in general represent a failure of the monotonicity of formal reasoning. He suggests that they may be best handled in a nonmonotonic logic (Levinson; pp.42-54). Predicate circumscription is a means of doing just this for a certain subset of GCIs. Capitalizing on the success of exhaustive interpretation, other nonmonotonic reasoning patterns may represent a method of treating other GCIs that have yet to be formally captured —- the relationship between conjunction buttressing and *post hoc ergo propter hoc* may be a place to start here. As noted in Chapter 4, formal reasoning-based treatments of GCI phenomena seem to be a much more promising avenue for categorizing default inferences than Levinson's heuristic-based typology, which is minimally explanatory at best.

More specifically, predicate circumscription is "a form of nonmonotonic reasoning augmenting first order logic" (McCarthy 1980; 37), but is not itself a full logic. There are two important points here. First, as noted, it is possible for natural reasoning to account for linguistic phenomena where formal logic does not. Second, full-blown nonmonotonic logic does not appear at this point to be needed: it is possibly sufficient to augment formal reasoning with "common sense" inferential patterns. This provides a link between natural reasoning and formal logic, which indicates that they need not be regarded as completely separate systems, and is thus in the spirit of the Gricean program in pragmatics.

In addition to the future work outlined in Chapter 5, then, this thesis points the way to a fruitful new project in the investigation of GCIs. The longstanding notion that GCIs sit midway between CI and PCI is upheld here; however, the success of exhaustivity in treating perfection suggests that GCIs are properly regarded as midway in the sense that they represent inference based on established reasoning patterns about communicative strategy and discourse structure, rather than based on Cooperative Principle-type heuristics. Attempting to refine default inferences in this light promises to be illuminating with respect to several areas in linguistic theory: information structure and the theory of discourse (which will provide a way of determining the question under discussion), as well as to linguistic reasoning and formal pragmatics. The convergence of these areas suggests that a good approach will incorporate tools such as decision theory and/or a game-theoretic approach to pragmatics

(Resnik 1987, Merin 1999, van Rooij 2003, Clark 2011).

It seems to me that GCIs represent an area of pragmatics that can be made fully formal if the correct level of inspection is selected; exhaustivity locates this level in discourse theory, and with respect to considerations about how communicative contributions are made and interpreted relative to a continuously-developing notion of the question under discussion, and what is needed to resolve the perceived "information gap" at any point in a conversation. At this stage, it seems likely that other default inferences will prove to be related to similar considerations (albeit through different reasoning patterns). Consideration of psychological theories of reasoning systems and patterns, including Johnson-Laird's (1983) "mental models" and/or Cheng & Holyoak's (1989) "pragmatic inference schemas" may be of use here.

In a broad sense, this project represents a much-needed step towards making rigourous the Gricean principles, and towards formalizing the "calculations" of implicatures outlined by Grice (1975). If default inferences can be regarded as induced by relevant patterns of reasoning, more contextualized PCIs may be accounted for by the interaction of these patterns with unusual and specific situational considerations. On this view, conversational implicature represents a level of formal strategy in language use, which operates as a parallel to mathematical (compositional) formality in semantic meaning.

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